EVALUATION OF HIGHWAY CRASHES WITHIN UGBOWO AXIS ALONG BENIN-LAGOS EXPRESS WAY, BENIN CITY. EDO STATES

BY

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MAT NO: ENG1905179

A PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT

FOR THE AWARD OF BACHELOR OF CIVIL ENGINEERING (B.ENG) DEGREE

IN

THE DEPARTMENT OF CIVIL ENGINEERING, FACULTY OF ENGINEERING,

UNIVERSITY OF BENIN, NIGERIA.

JANUARY, 2024

PLAGIARISM

This work, ANALYZING THE OCCURRENCE, CAUSES AND POSSIBLE SOLUTIONS OF HIGHWAY ACCIDENTS IN BENIN – LAGOS, EDO STATE, NIGERIA, USING DATA FROM THE FEDERAL ROAD SAFETY CORPS (FRSC) by IBUDE, Oghosa Destiny with Matriculation number, ENG1905179 of the Department of Civil Engineering, Course of Study (Civil Engineering), Faculty of Engineering, University of Benin, Benin City, Edo State, Nigeria, has passed the PLAGIARISM TEST.

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CERTIFICATION

This is to certify that this work was carried out by IBUDE, Oghosa Destiny with a Matriculation Number of ENG1905179 of the Department of Civil Engineering (Course of study: Civil Engineering). Faculty of Engineering, University of Benin, Benin-City, Edo State, Nigeria.

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HEAD OF DEPARTMENT Date

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DEDICATION

I dedicate this project to God Almighty for the wonder works he has done in my life and for seeing me through all the hurdles and also to my beloved parents, Mr and Mrs IBUDE for their support to consider my education as priority.

ACKNOWLEDGEMENT

I express my profound gratitude to God almighty, the one who has kept me through these years, providing me with relentless support and strength which has sustained me throughout this my undergraduate program, all I can say is thank you father.

However, I want to thank the Department of Civil Engineering, University of Benin, my supervisors Engr. Prof. H.A.P. Audu for his inspirational guidance and instructions throughout the course of this project. His listening ears and well directed counsel have fostered in me a deep sense of appreciation and affinity for civil field of study. Also, special thanks to our Head of Department Engr. Prof. Mrs. Ngozi Ihimekpen.

I want to appreciate all civil and structural lecturers; to mention a few - Engr. Prof. O.C. Izinyon, Engr. Prof. O.U. Orie, Engr. Prof. S.O. Osuji, Engr. Prof. H.A.P. Audu, Engr. Prof. S.D. lyeke, Engr. Prof. J.O. Okovido, Engr. Dr. R.I. Umasabor, Engr. Dr. R.O. Ogirigbo, Engr. Dr. A. Rawlings, Engr. Dr. A.I. Agbonaye, Dr. L.O. Bobor, Engr. Dr. R. Ilaboya, Engr. Dr. S. Okonofua, Engr. U. Ukeme, Engr. J.O. Ekhodiaehi(late), Engr. E. Oria-Usifo, Engr. S. A. Adegbemileke, Engr. P. N Ogbeifun, Engr. Nosakhare Engr. O. Oriakhi, Engr. O. Osasu, Engr. B. Omosefe, Engr. C. Okolie, Engr. N. K. Oghoyafedo, Engr. Mrs. E. Ambrose-Agabi, Engr. Mrs. G.E. Evbaru-Okhuahesuyi, Engr. U. K. Ogbonna for their positive support and assistance in the in the process of my undergraduate degree in this great department.

I also want to appreciate the entire staff of the Civil Engineering Lab & Workshop who shared their technical experience and showed a light where practical knowledge was lacking. My special thanks also go to my colleagues during this period of my service in Civil and Structural Department, I say big thanks to you all.

ABSTRACT

Highway accidents are a significant concern worldwide, leading to substantial loss of life, property, and economic productivity. This study aims to conduct a comprehensive analysis of highway accidents by investigating their frequency, underlying causes, and exploring effective preventive measures. Through an extensive review of historical accident data, this research will assess key factors contributing to highway accidents, including human behavior, vehicle conditions, environmental influences, and road infrastructure. Special attention will be given to identifying accident-prone areas (blackspots) and determining the most common types of accidents, as well as the timeframes in which they frequently occur.

To better understand the root causes of these accidents, the study will employ statistical analysis and machine learning techniques on data sourced from government databases and highway safety reports. The study will focus on critical factors such as driver error, vehicle malfunctions, poor road design, adverse weather conditions, and inadequate traffic management systems. It will also analyze the effectiveness of existing safety measures like traffic signals, road signage, and speed limits, while proposing new, data-driven interventions for improving highway safety.

The expected results of this research include a clearer identification of high-risk areas and times for highway accidents, as well as the discovery of key accident causative factors. Based on these findings, the study will propose targeted solutions, such as enhancing road infrastructure, increasing public awareness campaigns on safe driving, implementing stricter vehicle inspection protocols, and adopting advanced traffic monitoring systems. Ultimately, the results are expected to provide actionable insights for policymakers and highway authorities to reduce accident rates and improve overall road safety.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The advancement of computer and communication technologies has led to significant progress in the development of intelligent vehicles. These vehicles fundamentally transform the traditional 'human-vehicle-road' closed-loop control system by removing the variability of human drivers, thus enhancing road efficiency and improving traffic safety. As a key direction in the future of automotive technology, intelligent vehicles present promising applications and offer substantial economic benefits. Currently, vehicles with varying technical capabilities and automation levels coexist, contributing to a more complex road traffic system and a wider range of traffic accidents. Additionally, the legal frameworks surrounding intelligent vehicles remain underdeveloped in many countries, giving rise to various social challenges (Yuan et al., 2021).

According to the World Health Organization (WHO), over 1.25 million people worldwide lose their lives each year due to road traffic accidents, while an additional 20 to 50 million individuals sustain non-fatal injuries, many of which result in long-term disabilities. Road traffic accidents cost most countries around 3% of their gross domestic product (WHO, 2015). The rate of traffic accidents in Gulf Cooperation Council (GCC) countries is notably higher compared to other nations with similar income levels (Abbas, 2011). In the United Arab Emirates (UAE), the Ministry of Interior reported 381 traffic-related fatalities and 2,620 injuries in 2021, compared to 256 fatalities and 2,437 injuries in 2020 across all seven emirates (Alkaabi, 2023).

Highway safety is a critical component of transportation engineering, as traffic accidents are inevitable in daily life. Developing countries, such as Pakistan, face new safety challenges with the introduction of motorways, requiring more careful attention due to the high-speed nature of these roads. This study outlines a method for identifying accident-prone areas, also known as blackspots, along highways. The research focuses on the M-2 Motorway, which connects Lahore and Islamabad. Factors contributing to accidents include a lack of driving skills, inadequate education, economic conditions, insufficient signage, geometric design flaws, and poorly designed pedestrian crossings. Other contributing factors include road conditions, vehicle issues, road user behavior, and environmental influences. The analysis revealed that the primary causes of accidents are reckless driving (25%), falling asleep at the wheel (23%), tire blowouts (18%), brake failures (9%), and pedestrian crossings (6%). To address these issues, the study recommends implementing an effective traffic control system to guide road users for safer travel. Additionally, several lowcost measures have been suggested, such as constructing pedestrian underpasses near Lahore, installing dozing alert systems to prevent drowsiness, tire inspection stations to reduce blowouts, driver training to avoid brake failures, and raising public awareness through media campaigns to improve road safety and reduce accidents (Chand et al., 2021).

Mobility is central to our sense of freedom, serving as the foundation of modern, rapid development. Without progress in mobility, societies would stagnate. However, while mobility facilitates interaction and advancement, it also poses significant risks. We pay a high price for mobility in the form of injuries and property damage caused by accidents. Though it may seem pessimistic to say that accidents related to mobility are inevitable, it remains a reality. As long as people control vehicles, Murphy's Law "anything that can go wrong, will go wrong" applies. Only complete automation could eliminate accidents, but such systems are still under

development. The evolution of transportation has empowered humans, contributing to the rise of advanced civilizations. However, this growth has also introduced safety challenges, where improving efficiency and comfort has come at the cost of lives. Various fields are actively seeking solutions to these problems. Traffic engineers, in particular, are dedicated to analyzing accidents and predicting potential risks within transportation systems (Shah and Khattak, 2013).

1.2 Statement of the Problem

Highways are designed to facilitate smooth and efficient transportation, yet they are often the sites of frequent and severe accidents. These accidents result in significant loss of lives, property damage, and disruptions to economic activities. The primary causes range from driver error, speeding, and poor road conditions to inadequate traffic management systems and vehicle malfunctions.

Despite numerous safety measures implemented by authorities, the rate of highway accidents remains alarmingly high in many regions. This situation raises concerns about the effectiveness of existing road safety policies, infrastructure quality, and public awareness programs. Additionally, the socio-economic impacts of these accidents, including the costs associated with medical care, legal processes, and loss of workforce productivity, are often underappreciated.

This study seeks to investigate the factors contributing to highway accidents, assess the effectiveness of current prevention strategies, and recommend solutions that could reduce the frequency and severity of these incidents. Addressing this problem is crucial for improving road safety, saving lives, and ensuring that highways serve their purpose without becoming hazards for motorists.

1.3 Aim and Objectives of the Study

The aim of this study is to analyze the occurrence and causes of highway accidents in Edo State, using data from the Federal Road Safety Corps (FRSC). The study seeks to identify key factors contributing to these accidents and provide recommendations for reducing their frequency and severity to improve road safety in the state.

The objectives of the study are to;

i. analyze accident occurrence trends on highways in Benin - Lagos Road, Benin City Edo State using data from the Federal Road Safety Corps (FRSC).
ii. identify the primary causes of highway accidents, including factors such as driver behavior, road conditions, vehicle issues, and traffic management.
iii. assess the effectiveness of existing road safety measures and policies implemented by the FRSC in reducing highway accidents.
iv. evaluate the socio-economic impact of highway accidents in Benin - Lagos Road, Benin City Edo State, including the costs associated with medical care, property damage, and loss of productivity.

1.4 Scope of the Study

This study focused on analyzing highway accidents within Benin - Lagos Road, Benin City Edo State, Nigeria, using occurrence data provided by the Federal Road Safety Corps (FRSC). The time frame for the data will cover recent years to capture current trends and patterns in accident occurrences.

The scope includes investigating the frequency, causes, and severity of highway accidents across highways in Benin - Lagos Road, Benin City Edo State. Factors such as driver behavior, road

conditions, vehicle maintenance, and traffic enforcement will be considered. The study also examine the role of existing safety measures and policies implemented by the FRSC to determine their effectiveness in reducing accidents.

Furthermore, the study limit its geographical focus to highways under the jurisdiction of the FRSC in Benin - Lagos Road, Benin City Edo State, providing specific insights into accident patterns in this region. Recommendations for improving road safety will be tailored to the unique conditions of these highways.

1.5 Justification of the Study

Highway accidents represent a major public safety concern in Nigeria, causing significant loss of life, injuries, and economic damage each year. Benin - Lagos Road, Benin City Edo State, being a transit hub for many vehicles traveling across various regions, experiences a high volume of traffic on its highways, which increases the likelihood of accidents. Despite efforts by the Federal Road Safety Corps (FRSC) to reduce these occurrences, the rate of highway accidents remains a critical issue that warrants in-depth investigation.

This study is justified by the need to better understand the underlying factors contributing to highway accidents in Benin - Lagos Road, Benin City Edo State. By using occurrence data from the FRSC, the study will provide a data-driven analysis of the current situation, identifying patterns and risk factors that can be addressed. The research will also assess the effectiveness of existing road safety measures, helping to identify areas where improvements are needed.

The findings from this study will be valuable for policymakers, traffic authorities, and road users alike, offering evidence-based recommendations aimed at reducing accident rates and enhancing the safety of highways. Additionally, the study will contribute to broader national efforts to improve road safety and reduce the socio-economic burden caused by highway accidents.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction to Highway Accidents

Highway accidents are a global concern, contributing significantly to mortality and morbidity rates worldwide. The World Health Organization (WHO) estimates that approximately 1.3 million people die annually due to road traffic accidents, with many more suffering from non-fatal injuries, often leading to long-term disabilities. Highways, due to their high speeds and heavy traffic, are particularly prone to more severe accidents compared to urban or rural roads. These accidents not only result in loss of life but also cause significant economic losses through damage to infrastructure, vehicles, and medical expenses.

In Nigeria, highway accidents are a critical public safety issue, with thousands of lives lost each year. The country's highways serve as major transit routes, connecting different regions and facilitating economic activities. However, the high frequency of accidents on these highways has been attributed to a variety of factors, including reckless driving, poor road conditions, and inadequate traffic law enforcement. According to the Federal Road Safety Corps (FRSC), road traffic accidents in Nigeria account for a large proportion of accidental deaths, particularly on major highways such as the Benin-Lagos Expressway, the Abuja-Kaduna Highway, and others.

In Edo State, where this study is focused, highways play a crucial role in connecting the state to other parts of the country. However, these roads are not exempt from the high accident rates seen across Nigeria. The occurrence of highway accidents in Edo State has been a major concern for both residents and authorities. Various studies have highlighted the need for improved road safety

measures, better enforcement of traffic laws, and the enhancement of road infrastructure to mitigate these accidents.

Despite efforts by the Federal Road Safety Corps and other stakeholders to curb these accidents, they continue to occur at alarming rates, necessitating a detailed investigation into their causes and possible solutions. This study will contribute to the body of knowledge by examining the specific factors contributing to highway accidents in Edo State, using occurrence data from the FRSC. The findings will provide insights that can inform policy and safety interventions aimed at reducing accident rates and saving lives on the state's highways.

2.2 Theories and Models of Traffic Accidents

Understanding the causes and dynamics of traffic accidents requires a theoretical framework that explains the interaction of various factors involved in road safety. Several theories and models have been developed over the years to explore the complexities of traffic accidents, focusing on the roles of human behavior, road conditions, environmental factors, and vehicle design. These models aim to help researchers and policymakers design interventions to reduce accidents and enhance road safety.

2.2.1 The Domino Theory of Accident Causation

One of the earliest theories of accident causation is Heinrich’s Domino Theory, which was developed in the early 20th century. The theory suggests that accidents occur due to a chain of events, much like falling dominoes. Each event triggers the next, eventually leading to an accident. Heinrich proposed that accidents result from unsafe human actions or mechanical failures, which are themselves the result of underlying causes, such as poor supervision or lack of safety training.

In the context of highway accidents, the Domino Theory emphasizes the role of human error, such as speeding, distraction, or fatigue, as well as mechanical factors, such as vehicle malfunctions. However, the theory has been criticized for oversimplifying accident causation and for not accounting adequately for the interaction between different factors.

2.2.2 The Human Factors Theory

The Human Factors Theory places a greater emphasis on the role of human error in accident causation. According to this theory, most accidents are the result of mistakes made by drivers due to three main factors: overload, inappropriate responses, and inappropriate activities.

i. Overload occurs when the demands placed on a driver exceed their ability to cope. This can result from excessive speed, distractions (e.g., mobile phones), or stress.
ii. Inappropriate responses are actions taken by drivers that either fail to address a dangerous situation or exacerbate it, such as swerving in the wrong direction to avoid a collision.
iii. Inappropriate activities include actions such as driving while under the influence of alcohol or drugs, or engaging in risky behaviors like aggressive driving.

This theory is particularly relevant to highway accidents, where high speeds and long distances place significant cognitive and physical demands on drivers. Overload can occur when drivers are fatigued, distracted, or driving in adverse weather conditions. The Human Factors Theory is widely used in accident prevention strategies, particularly in designing driver training programs and public awareness campaigns.

2.2.3 The Systems Theory of Accidents

The Systems Theory of accident causation views traffic accidents as the result of interactions between three main components: the driver, the vehicle, and the environment. This theory is based on the premise that accidents occur when these three elements fail to interact properly, leading to a breakdown in safety.

i. Driver-related factors include the driver's experience, training, health, and behavior on the road. Fatigue, distraction, and reckless driving are common driver-related issues in highway accidents.

ii. Vehicle-related factors involve the mechanical condition of the vehicle, such as the functionality of brakes, tires, and lighting systems. Poor vehicle maintenance can significantly increase the risk of accidents.

iii. Environmental factors include the road conditions, weather, and traffic volume. Inadequate road signage, poor lighting, and dangerous weather conditions such as heavy rain or fog are environmental factors that can lead to accidents.

This theory is highly relevant for the study of highway accidents, as highways are complex systems where drivers, vehicles, and the road environment interact at high speeds. The Systems Theory helps in understanding how breakdowns in any one of these areas can lead to accidents and offers a holistic approach to accident prevention by focusing on improving each element of the system.

2.2.4 The Haddon Matrix

Developed by William Haddon, the Haddon Matrix is a widely-used model for understanding the various factors involved in traffic accidents. The matrix categorizes factors into three phases:

i. **Pre-crash (before the accident):** Factors that can prevent an accident, such as road design, driver training, and vehicle safety features.

ii. **Crash (during the accident):** Factors that influence the severity of the crash, such as vehicle speed, the use of seat belts, and airbag deployment.

iii. **Post-crash (after the accident):** Factors that affect the outcome of the crash, such as the availability of emergency medical services and the time it takes for help to arrive.

The Haddon Matrix also categorizes factors into three categories: human, vehicle, and environmental. This model allows for a comprehensive analysis of traffic accidents by considering not only what causes the accident but also what can mitigate the impact and improve post-accident outcomes. For highway accidents, the pre-crash phase is particularly important, as most interventions aim to prevent accidents from occurring in the first place.

2.2.5 The Risk Homeostasis Theory

The Risk Homeostasis Theory, developed by Gerald Wilde, suggests that individuals have a certain level of risk tolerance, and they adjust their behavior to maintain this level of risk. For example, if a driver feels that the highway is very safe due to the presence of guardrails or improved road conditions, they may drive faster or more recklessly, offsetting the safety benefits. This theory has been used to explain why certain safety measures, such as the introduction of seat belts or speed limits, do not always lead to a reduction in accident rates.

In the context of highway accidents, the Risk Homeostasis Theory highlights the importance of not only improving road and vehicle safety but also addressing driver behavior. It suggests that drivers may compensate for increased safety by taking more risks, and therefore, behavioral

interventions, such as driver education and stricter law enforcement, are necessary to complement engineering solutions.

2.2.6 The Social Learning Theory

The Social Learning Theory posits that individuals learn behaviors through observation and imitation of others, particularly role models or authority figures. In the context of driving, this theory suggests that drivers may adopt risky behaviors, such as speeding or aggressive driving, by observing others engaging in such behaviors without apparent negative consequences. Social norms also play a role in shaping driving behavior; for example, if speeding is socially accepted or seen as a norm on certain highways, more drivers may engage in it.

This theory emphasizes the need for public awareness campaigns and community involvement in shaping safer driving behaviors. Social learning can be leveraged to promote positive driving habits by highlighting the consequences of reckless driving and showcasing safer alternatives.

2.3 Factors Contributing to Highway Accidents

Highway accidents result from a complex interplay of multiple factors that include human behavior, environmental conditions, vehicle performance, and infrastructural shortcomings. Identifying these factors is crucial for developing effective strategies to reduce accident rates and improve road safety. This section examines the key contributing factors to highway accidents, focusing on the Nigerian context, with particular emphasis on Edo State highways.

2.3.1 Driver Behavior and Human Error

Human error is one of the leading causes of highway accidents globally, and Nigeria is no exception. Poor driving habits and risky behavior on the part of drivers are significant

contributors to road crashes. Some of the common forms of driver behavior that lead to accidents include:

i. **Speeding:** Excessive speeding is one of the most prevalent causes of highway accidents. On highways where speed limits are often disregarded, drivers are more prone to lose control of their vehicles, especially when navigating bends or encountering sudden obstacles. Speeding reduces a driver's reaction time and increases the severity of crashes.

ii. **Distracted Driving:** With the increasing use of mobile phones and other electronic devices, distracted driving has become a major concern on highways. Whether texting, making phone calls, or using social media, drivers are often not fully focused on the road, leading to accidents. Studies show that even a momentary distraction can have severe consequences, particularly at high speeds.

iii. **Fatigue:** Long-distance driving, which is common on highways, often results in driver fatigue. Tired drivers are more likely to make poor judgments, fall asleep behind the wheel, or lose concentration. Fatigue-related accidents tend to be more severe due to the delayed reaction time of drivers and the likelihood of higher speeds on highways.

iv. **Drunk Driving and Drug Influence:** Driving under the influence of alcohol or drugs impairs a driver's judgment, reaction time, and coordination. Despite legal penalties, drunk driving remains a serious issue in Nigeria. Alcohol-related accidents are particularly common during weekends and holidays when road traffic is higher, and alcohol consumption is more frequent.

v. **Aggressive Driving:** Road rage, tailgating, unsafe overtaking, and other forms of aggressive driving are frequent causes of accidents. Highways, with their long stretches of open road, often encourage risky maneuvers such as overtaking without adequate space or driving aggressively to maintain high speeds.

2.3.2 Road and Environmental Conditions

The condition of highways and the surrounding environment also plays a crucial role in determining the likelihood of accidents. In Nigeria, where road infrastructure is often inadequate, the following factors are common contributors:

i. **Poor Road Maintenance:** Many Nigerian highways suffer from poor maintenance, leading to potholes, cracks, and uneven surfaces. These hazards pose serious risks to drivers, especially at high speeds, as they can cause vehicles to swerve or lose control. The lack of proper signage, lane markings, and guardrails also increases the risk of accidents.

ii. **Weather Conditions:** Adverse weather, such as heavy rainfall, fog, and high winds, can significantly increase the risk of highway accidents. Rainwater often collects in potholes and poorly drained areas, creating slick surfaces that reduce tire traction and increase the likelihood of hydroplaning. In Nigeria's tropical climate, rainy seasons see a sharp rise in accident rates.

iii. **Inadequate Lighting:** Poor visibility due to inadequate lighting on highways is another major factor contributing to accidents, especially at night. In many parts of Edo State and other regions in Nigeria, streetlights are either non-existent or poorly

maintained, leaving drivers vulnerable to obstacles, pedestrians, and other vehicles they may not see in time to avoid.

iv. **Wildlife and Pedestrian Crossings:** In rural and semi-urban areas, pedestrians often cross highways without designated crossing points, increasing the risk of accidents. In addition, livestock or wildlife can unexpectedly cross highways, leading to collisions, especially in areas with poor visibility or no warning signs.

2.3.3 Vehicle-Related Issues

Vehicle performance is a critical factor in road safety. Poor vehicle maintenance and mechanical failures are common causes of accidents on highways. In Nigeria, where vehicle inspection and maintenance standards are often lax, the following issues are frequent contributors to highway accidents:

i. **Brake Failures:** Defective or worn-out brakes are a significant cause of accidents, particularly in older vehicles. On highways, where sudden braking is sometimes necessary, brake failure can lead to high-speed collisions or vehicles veering off the road.

ii. **Tire Blowouts:** Worn-out or improperly inflated tires can blow out at high speeds, causing drivers to lose control of their vehicles. Tire blowouts are particularly dangerous on highways where vehicles are traveling at high speeds, and the time to react is limited.

iii. **Faulty Headlights and Taillights:** Poorly functioning headlights and taillights reduce visibility for drivers, making it harder to see obstacles or signal intentions to other

drivers. Nighttime driving without properly functioning lights is a significant risk factor for accidents.

iv. **Overloading**: In Nigeria, vehicles, particularly commercial ones, are often overloaded, increasing the likelihood of mechanical failures and accidents. Overloaded vehicles

place excessive strain on tires, brakes, and suspension systems, leading to a higher risk of tire blowouts, brake failure, and vehicle rollover.

2.3.4 Traffic and Infrastructure Issues

The design and management of highways significantly impact the safety of road users. In many parts of Nigeria, including Edo State, inadequate infrastructure and traffic management contribute to the frequency of accidents. Some of the key issues include:

i. **Poor Road Design:** Many highways in Nigeria have inadequate road designs, such as sharp bends, insufficient lane width, and lack of merging lanes. These design flaws make it difficult for drivers to navigate safely, particularly in high-speed zones.

ii. **Traffic Congestion:** Highways, especially those connecting major cities, often experience traffic congestion, leading to an increased risk of rear-end collisions and other types of accidents. The lack of proper traffic management systems, such as lane discipline and traffic signals, exacerbates the problem.

iii. **Lack of Emergency Response Systems:** In many regions, including Edo State, the lack of an efficient emergency response system increases the severity of accidents. Delayed medical response can result in preventable fatalities and worsened injuries

for those involved in highway crashes. Additionally, the absence of emergency lanes and proper signage makes it harder for rescue teams to access accident sites quickly.

iv. **Road Construction and Maintenance Work Zones:** Temporary construction zones on highways, often poorly marked, present hazards for drivers. Sudden changes in road conditions, narrow lanes, and lack of proper diversion signs can confuse drivers, leading to accidents.

2.3.5 Traffic Law Enforcement and Public Awareness

Traffic law enforcement is essential for maintaining road safety, yet in many areas of Nigeria, enforcement is inadequate or inconsistent. The following issues are significant contributors to highway accidents:

i. **Inconsistent Law Enforcement:** While the Federal Road Safety Corps (FRSC) is tasked with enforcing traffic regulations, law enforcement on highways is often inconsistent. Speeding, overloading, and seatbelt violations frequently go unpunished, contributing to the high accident rates.

ii. **Lack of Public Awareness:** Many drivers lack adequate knowledge of road safety regulations or disregard them due to a lack of awareness. Public education campaigns targeting safe driving behavior, such as the dangers of drunk driving, speeding, and distracted driving, are crucial in reducing accident rates.

2.4 The Impact of Highway Accidents

Highway accidents have far-reaching consequences that extend beyond immediate physical injuries. They affect individuals, families, communities, and society as a whole, leading to economic losses, emotional trauma, and public health issues. This section explores the various

impacts of highway accidents, focusing on personal, social, and economic dimensions, particularly within the context of Nigeria and Edo State.

2.4.1 Human Cost: Injuries and Fatalities

The most immediate and severe impact of highway accidents is the loss of life and the suffering of those injured. According to the World Health Organization (WHO), road traffic injuries are a leading cause of death globally, with vulnerable populations such as pedestrians, cyclists, and motorcyclists disproportionately affected. In Nigeria, the Federal Road Safety Corps (FRSC) reports thousands of fatalities and injuries each year due to road accidents.

i. **Injuries:** Survivors of highway accidents often face severe injuries that can result in long-term disabilities, chronic pain, and psychological trauma. The physical rehabilitation process can be lengthy and costly, placing additional emotional and financial burdens on individuals and their families.

ii. **Fatalities:** The loss of life from highway accidents is devastating for families and communities. Each fatality creates a ripple effect, affecting not only the immediate family but also friends, colleagues, and the broader community. The emotional toll of losing a loved one in a preventable accident can lead to long-lasting grief and trauma.

2.4.2 Economic Impact

The economic consequences of highway accidents are significant, impacting individuals, businesses, and national economies. In Nigeria, where road traffic injuries and fatalities are prevalent, the economic burden can be substantial:

i. **Direct Costs:** These include medical expenses for treatment and rehabilitation, emergency response costs, and property damage. Individuals injured in accidents may

face high medical bills, often compounded by loss of income during recovery periods. Furthermore, vehicle repairs and the cost of damaged property can lead to financial strain.

ii. **Indirect Costs:** Highway accidents result in indirect costs such as lost productivity, which affects both victims and their families. Individuals who sustain injuries may be unable to return to work, leading to a loss of income and financial instability.

Additionally, the economy suffers from reduced productivity and increased burden on healthcare systems due to the treatment of accident-related injuries.

iii. **Impact on Businesses:** Businesses, particularly those relying on transportation and logistics, may face disruptions due to accidents. Delivery delays, increased insurance premiums, and potential liability claims can lead to financial losses. The reputational damage to businesses involved in accidents can also affect customer trust and loyalty.

2.4.3 Social and Psychological Effects

The social implications of highway accidents extend beyond immediate victims and families. Communities often experience a range of social and psychological effects, including:

i. **Emotional Trauma:** Survivors and witnesses of highway accidents frequently suffer from emotional trauma, including post-traumatic stress disorder (PTSD), anxiety, and depression. The psychological effects can impact daily life, relationships, and overall well-being.

ii. **Stigmatization:** Victims of accidents may face stigmatization, particularly in cultures where road safety is not well understood. Families of accident victims may experience

social isolation or blame from their communities, compounding their grief and distress.

iii. **Community Impact:** High accident rates can foster a culture of fear and anxiety within communities. Residents may become increasingly wary of using highways, impacting their mobility and access to essential services. Communities may also experience decreased social cohesion as families deal with the repercussions of accidents differently.

2.4.4 Public Health Concerns

Highway accidents pose significant public health challenges, as they contribute to the burden of injury-related morbidity and mortality. The health system often becomes overwhelmed by the need for emergency services, medical treatment, and rehabilitation for accident victims.

i. **Increased Healthcare Demand:** High accident rates place additional pressure on healthcare facilities, which must respond to emergencies and provide ongoing care for injured individuals. This increased demand can strain resources, leading to longer wait times for treatment and decreased access to care for other patients.

ii. **Burden on Mental Health Services:** The psychological impact of highway accidents necessitates access to mental health services for victims, families, and communities. However, in many areas, mental health resources may be limited, leaving individuals without adequate support.

2.4.5 Legal and Policy Implications

Highway accidents often result in legal proceedings, raising important issues related to liability, compensation, and regulatory enforcement. The legal implications can affect not only the individuals involved but also the broader society:

i. **Liability and Compensation:** Victims of highway accidents may seek legal redress for injuries and losses incurred, leading to complex legal battles. This process can be time-consuming and stressful, and outcomes are often uncertain.

ii. **Regulatory and Policy Changes:** High accident rates can prompt calls for changes in traffic laws, safety regulations, and enforcement measures. Policymakers may implement stricter regulations regarding speeding, drunk driving, and vehicle safety standards in response to rising accident statistics.

iii. **Public Awareness Initiatives:** The impact of highway accidents often leads to increased public awareness campaigns aimed at promoting road safety. These initiatives seek to educate drivers about safe practices, the dangers of distracted driving, and the importance of adhering to traffic laws.

2.5 Strategies for Reducing Highway Accidents

Reducing highway accidents requires a comprehensive approach that encompasses various strategies targeting driver behavior, road infrastructure, vehicle safety, and law enforcement. Effective measures not only mitigate the frequency of accidents but also minimize their severity when they do occur. This section outlines key strategies for enhancing road safety, with a focus on the Nigerian context, particularly in Edo State.

2.5.1 Improving Driver Education and Training

Driver education and training programs are essential for fostering safe driving behaviors. These programs should focus on:

i. **Comprehensive Driver Training:** Implementing structured training courses that cover essential topics such as defensive driving techniques, the dangers of distracted and aggressive driving, and the importance of obeying speed limits can significantly improve driver safety.

ii. **Public Awareness Campaigns:** Regular public awareness campaigns can educate drivers about safe driving practices and the consequences of risky behaviors. Utilizing various media channels, including social media, radio, and community outreach, can enhance the reach and impact of these campaigns.

iii. **Promotion of Defensive Driving Courses:** Encouraging drivers to participate in defensive driving courses can equip them with skills to anticipate and respond to potential hazards on the road. This proactive approach to driving can significantly reduce the likelihood of accidents.

2.5.2 Enhancing Road Infrastructure

Investment in road infrastructure is critical for improving highway safety. Strategies to enhance road infrastructure include:

i. **Regular Road Maintenance:** Ensuring timely and regular maintenance of highways can address issues such as potholes, cracks, and poor drainage, which are common causes of accidents. A well-maintained road surface improves vehicle control and reduces the risk of collisions.

ii. **Design Improvements:** Implementing better road design features, such as adequate lane widths, improved signage, and clear lane markings, can enhance safety. Features like rumble strips, speed bumps, and dedicated pedestrian crossings also contribute to safer roadways.

iii. **Lighting and Visibility Enhancements:** Improving lighting on highways, particularly in poorly lit areas, can enhance visibility for drivers at night. Installing reflective signage and road markings can also help in guiding drivers, reducing the likelihood of accidents.

iv. **Traffic Calming Measures:** In areas with high pedestrian traffic or near schools, implementing traffic calming measures such as speed humps, roundabouts, and narrow roadways can encourage drivers to reduce speed and be more cautious.

2.5.3 Strengthening Law Enforcement and Regulatory Measures

Effective enforcement of traffic laws is crucial for promoting compliance and enhancing road safety. Strategies in this area include:

i. **Increased Law Enforcement Presence:** Increasing the visibility of law enforcement officers on highways can deter risky behaviors such as speeding, drunk driving, and seatbelt violations. Regular checkpoints and patrols can reinforce the importance of adhering to traffic regulations.

ii. **Implementation of Stricter Penalties:** Instituting stricter penalties for traffic violations, such as hefty fines for speeding or DUI offenses, can discourage risky driving behaviors. Publicizing the consequences of such violations can serve as a deterrent for potential offenders.

iii. **Use of Technology for Enforcement:** Leveraging technology, such as speed cameras and automated license plate recognition systems, can enhance enforcement efforts. These tools can provide consistent monitoring and reduce reliance on manual enforcement.

2.5.4 Promoting Vehicle Safety Standards

Ensuring that vehicles on the road meet safety standards is vital for reducing accident severity. Strategies for enhancing vehicle safety include:

i. **Mandatory Vehicle Inspections:** Implementing regular vehicle inspections to ensure that all vehicles meet safety standards can help identify and address mechanical issues before they lead to accidents. This includes checking brakes, tires, lights, and other critical components.

ii. **Encouraging Vehicle Safety Features:** Promoting the adoption of modern vehicles equipped with advanced safety features, such as anti-lock braking systems (ABS), electronic stability control (ESC), and airbags, can reduce the likelihood and severity of accidents.

iii. **Public Awareness on Vehicle Maintenance:** Educating vehicle owners about the importance of regular maintenance and timely repairs can prevent mechanical failures that contribute to accidents. Workshops and informational campaigns can help raise awareness.

2.5.5 Community Involvement and Collaboration

Engaging communities and fostering collaboration among various stakeholders can enhance road safety efforts. Strategies in this area include:

i. **Community-Based Road Safety Programs:** Establishing community-based programs that involve local residents, schools, and organizations can raise awareness of road safety issues and foster a culture of safe driving within communities.

ii. **Collaboration with NGOs and Civil Society:** Partnering with non-governmental organizations (NGOs) and civil society groups can enhance road safety initiatives. These organizations can provide resources, expertise, and grassroots support for awareness campaigns and educational programs.

iii. **Involvement of Local Governments:** Local governments can play a vital role in road safety by prioritizing infrastructure improvements, traffic management, and public awareness initiatives in their communities. Collaborating with the FRSC and other stakeholders can strengthen these efforts.

2.5.5 Emergency Response and Post-Accident Management

Enhancing emergency response and post-accident management systems is crucial for minimizing the consequences of highway accidents. Strategies to improve these systems include:

i. **Training Emergency Responders:** Providing training for emergency responders, including paramedics and firefighters, on efficient accident response techniques can ensure timely and effective assistance to accident victims.

ii. **Improving Emergency Communication Systems**: Establishing efficient communication systems for reporting accidents can expedite the response time of emergency services. Utilizing mobile applications and hotlines for reporting incidents can improve accessibility.

iii. **Post-Accident Support Services:** Developing support services for accident victims and their families, such as counseling and rehabilitation programs, can aid recovery and address the emotional and psychological impacts of accidents.

2.6 Future Directions in Highway Safety Research

As highway safety continues to be a pressing concern globally, ongoing research is essential to address emerging challenges and develop effective strategies for accident prevention. This section outlines key areas for future research in highway safety, emphasizing innovative approaches and technologies that can contribute to reducing accident rates and enhancing road safety, particularly in the context of Nigeria and Edo State.

2.6.1 Advanced Data Analytics and Machine Learning

The use of advanced data analytics and machine learning techniques can provide valuable insights into highway safety. Future research should focus on:

i. **Predictive Modeling:** Developing predictive models using historical accident data can help identify patterns and risk factors associated with highway accidents. By analyzing variables such as weather conditions, traffic volumes, and road characteristics, researchers can create models that predict high-risk situations, allowing for proactive measures to be implemented.

ii. **Real-Time Data Analysis:** Leveraging real-time data from traffic cameras, sensors, and GPS-enabled devices can enhance situational awareness and inform decisionmaking. Research into how to integrate and analyze this data effectively can lead to more responsive traffic management and accident prevention strategies.

iii. **Machine Learning Algorithms:** Employing machine learning algorithms can improve the accuracy of accident prediction models and help identify potential accident hotspots. Research should explore the application of these algorithms in different contexts and their effectiveness in various geographical areas.

2.6.2 Autonomous and Connected Vehicle Technologies

The advent of autonomous and connected vehicle technologies presents new opportunities for enhancing highway safety. Future research in this area could include:

i. **Impact of Autonomous Vehicles:** Investigating the effects of autonomous vehicles on highway safety, including how they may reduce human error, which is a significant factor in many accidents. Research should assess the integration of these vehicles into existing traffic systems and the implications for infrastructure and regulations.

ii. **Vehicle-to-Everything (V2X) Communication:** Exploring the potential of V2X communication technologies, which allow vehicles to communicate with each other and infrastructure, can lead to improved safety outcomes. Research can focus on developing protocols, standards, and safety measures for implementing V2X systems effectively.

iii. **Driver Assistance Systems:** Evaluating the effectiveness of advanced driver assistance systems (ADAS) in preventing accidents. Research should examine how features such as lane-keeping assistance, adaptive cruise control, and emergency braking systems influence driver behavior and accident rates.

2.6.3 Behavioral and Psychological Research

Understanding the psychological factors influencing driver behavior is crucial for developing effective interventions. Future research directions should include:

i. **Driver Behavior Studies:** Conducting studies to analyze the psychological and behavioral factors that contribute to risky driving behaviors, such as speeding, aggressive driving, and distracted driving. Research can explore the motivations behind these behaviors and identify effective strategies for changing them.

ii. **Public Perception and Attitudes:** Investigating public perception of road safety measures and the effectiveness of awareness campaigns. Understanding how individuals perceive risks and safety can inform the development of targeted educational programs and campaigns.

iii. **Impact of Stress and Fatigue:** Researching the effects of stress and fatigue on driver performance. Understanding how these factors contribute to accidents can help develop targeted interventions, such as education on the importance of rest and managing stress.

2.6.4 Policy and Regulatory Research

Effective policies and regulations are essential for promoting road safety. Future research should focus on:

i. **Evaluation of Existing Policies**: Analyzing the effectiveness of current traffic laws and regulations in reducing highway accidents. Research can assess compliance levels and identify areas where enforcement is lacking.

ii. **Best Practices in Policy Development:** Investigating successful road safety policies from other countries and their applicability in the Nigerian context. This research can provide insights into effective strategies for reducing accidents and improving road safety.

iii. **Public Health Approaches**: Exploring the integration of public health approaches in road safety initiatives. Research can examine how collaboration between traffic safety agencies and public health organizations can enhance the effectiveness of interventions aimed at reducing accidents.

2.6.5 Infrastructure and Technological Innovations

Innovative infrastructure solutions and technologies can enhance highway safety. Future research directions should include:

i. **Smart Infrastructure:** Investigating the implementation of smart infrastructure, such as intelligent traffic signals and dynamic message signs, to improve traffic flow and safety. Research can explore how these technologies can adapt to real-time traffic conditions to minimize accidents.

ii. **Road Design Innovations:** Studying innovative road design techniques that enhance safety, such as roundabouts, raised medians, and pedestrian-friendly intersections. Research can assess the effectiveness of these designs in reducing accidents and improving overall traffic safety.

iii. **Environmental Factors:** Examining the influence of environmental factors, such as weather conditions and road surface materials, on highway safety. Understanding how

these factors contribute to accidents can inform better design and maintenance practices.

2.6.6 Community Engagement and Public Involvement

Engaging communities and stakeholders is vital for promoting road safety. Future research should explore:

i. **Community-Based Interventions:** Investigating the effectiveness of community based interventions aimed at enhancing road safety. Research can assess how local initiatives, such as neighborhood watch programs and community awareness campaigns, impact accident rates.

ii. **Stakeholder Collaboration:** Studying the role of collaboration among various stakeholders, including government agencies, NGOs, and local communities, in promoting road safety. Research can identify best practices for fostering effective partnerships.

iii. **Public Engagement Strategies:** Exploring innovative public engagement strategies to raise awareness of road safety issues. Research can examine the use of social media, community events, and educational programs to promote safe driving behaviors.

2.7. Review of Related Works

Road traffic accidents are a significant global cause of injuries and fatalities, making them a critical area for research focused on accident analysis, prediction techniques, and identifying the main contributing factors. This paper presents an overview of available data sources, methods for analyzing traffic accidents, and various algorithms used to predict accidents, along with their relevance to the type of data analyzed and ease of interpretation. Additionally, it addresses

operational issues related to traffic, highlights risk factors, and evaluates the effectiveness of road safety measures based on statistical analysis of accident severity. The paper also explores potential future research directions by identifying gaps in the current understanding of road traffic accidents (Chand et al., 2021).

Highway safety is a critical component of transportation engineering, as traffic accidents are inevitable in daily life. Developing countries, such as Pakistan, face new safety challenges with the introduction of motorways, requiring more careful attention due to the high-speed nature of these roads. This study outlines a method for identifying accident-prone areas, also known as blackspots, along highways. The research focuses on the M-2 Motorway, which connects Lahore and Islamabad. Factors contributing to accidents include a lack of driving skills, inadequate education, economic conditions, insufficient signage, geometric design flaws, and poorly designed pedestrian crossings. Other contributing factors include road conditions, vehicle issues, road user behavior, and environmental influences. The analysis revealed that the primary causes of accidents are reckless driving (25%), falling asleep at the wheel (23%), tire blowouts (18%), brake failures (9%), and pedestrian crossings (6%). To address these issues, the study recommends implementing an effective traffic control system to guide road users for safer travel. Additionally, several lowcost measures have been suggested, such as constructing pedestrian underpasses near Lahore, installing dozing alert systems to prevent drowsiness, tire inspection stations to reduce blowouts, driver training to avoid brake failures, and raising public awareness through media campaigns to improve road safety and reduce accidents (Shah and Khattak, 2013).

Despite significant government efforts to reduce traffic accidents in the UAE, a deeper understanding of the root causes is still needed. This research investigates the various factors contributing to road accidents in Abu Dhabi, such as circumstantial influences, demographic

traits, traffic violations, fault attribution, and driver behavior. A Geographic Information System (GIS) statistical approach, specifically spatial autocorrelation analysis, was used to identify traffic accident hotspots within the city for the year 2014. In addition, a survey conducted in 2017 gathered responses from 1,072 drivers involved in accidents, covering six categories: accidentrelated, seatbelt-related, speed-related, policy-related, and general socio-related factors. The analysis, using logistical regression models, revealed that careless driving was the leading cause of road accidents in the city. It also showed that both age and driving experience significantly influenced accident likelihood, with middle-aged drivers being more prone to accidents, while increased driving experience reduced the risk.

The study concludes by offering recommendations to improve traffic safety in Abu Dhabi. Furthermore, it tested the hypothesis that most accidents occur near central business districts using 2014 crash data from Abu Dhabi. The results confirmed the utility of the Getis-Ord Gi* statistic method in accurately identifying and ranking high-density crash areas near the city's central business district (Alkaabi, 2023).

Highway work zones are a significant safety concern for government agencies, legislators, the highway industry, and the public. Despite efforts by these stakeholders, there has been little evidence of a nationwide reduction in work zone crashes. One of the primary reasons is the ineffectiveness of current safety countermeasures. This ineffectiveness may stem from a limited understanding of the specific characteristics of work zone crashes. The main goal of this research was to examine the features of fatal crashes and identify the risk factors associated with these incidents in work zones, with the aim of developing and implementing more effective safety measures. The research followed a four-step approach. First, a thorough literature review of previous studies on work zone crashes was conducted to establish a comprehensive

understanding of the issue. Next, the research team gathered crash data from the Kansas Department of Transportation (KDOT) accident database and reviewed original accident reports. A total of 157 fatal crashes occurring between 1992 and 2004 were analyzed. Using statistical methods, including descriptive and regression analyses, the researchers identified the unique characteristics and risk factors associated with fatal crashes in work zones. Finally, the study concluded by recommending strategies to improve safety in work zones (Bai and Li, 2006).

Intellectualization is considered the future development trend in the automobile industry. Although intelligent vehicles have made progress, their automation level remains relatively low. As a result, the road traffic system will continue to involve a mix of non-autonomous vehicles and those with varying levels of automation for the foreseeable future. This mixed environment is likely to increase the complexity of road traffic systems and contribute to a wider variety of accidents. This paper examined the characteristics and contributing factors of intelligent vehicle accidents. It addressed current challenges in investigating, analyzing, and determining liability for these incidents. The study proposed a preliminary framework and method for investigating such accidents, highlighting key aspects of accident analysis, including technical defects, information security, and passive safety features. Additionally, it outlined the legal liabilities of parties involved in intelligent vehicle accidents. The findings of this study aim to support the development of effective accident investigation processes for intelligent vehicles and provide valuable insights for enhancing vehicle safety and preventing accidents (Yuan et al., 2021).

As one might expect in one of India’s poorest and most densely populated states, Bihar’s capital, Patna, is marked by noise, overcrowding, pollution, and a general state of disorder. The city’s roads are heavily congested and often encroached upon by various activities. The deterioration of bus services, coupled with declining efficiency and quality, has driven many passengers to rely

on personalized transport and intermediate public transport (IPTs). This shift not only hampers traffic flow but also poses significant risks to road users' safety. The number of fatal accidents and related fatalities has been steadily rising in Patna over the years. The rate of fatalities per 100 accidents reached an alarming figure of 45 in 2000. Pedestrian deaths make up a significant portion of road fatalities, accounting for over 90% of total road-related deaths in recent years. Furthermore, more than 80% of casualties involved individuals within the working-age group of 18 to 60 years. The newly constructed bypass road on National Highway 38 (NH-38) has become the most accidentprone area in the city, accounting for approximately 15% of all accidents in 2000. It is recommended that a comprehensive road safety audit be conducted for this location by a multidisciplinary team of experts to propose effective safety measures (Singh and Misra, 2004).

This study utilized GIS-based statistical analysis techniques to explore how the Severity Index (SI) of accidents affects the temporal and spatial patterns of traffic accident hotspots, particularly in relation to specific times of day and seasonal variations. Road Traffic Accident (RTA) data from Hanoi, Vietnam, spanning three years (2015–2017), was employed to assess this approach.

Initially, the data was categorized by four seasons, reflecting Hanoi's climate, and further divided into specific time intervals such as daytime, nighttime, and peak hours. The Kernel Density Estimation (KDE) method was then applied to identify accident hotspots based on these time and seasonal factors. The findings were visualized using the comap technique. The study examined both analyses with and without incorporating the SI, which quantifies the severity of accidents by assigning higher weights to more serious incidents, though not excessively so. The results indicated that while both approaches identified similar hotspots, the inclusion of SI resulted in different hotspot rankings, offering more accurate and detailed results. By factoring in SI, traffic

authorities can gain a clearer understanding of accident causes and prioritize the most dangerous hotspots, especially when resources and budgets are limited (Le et al., 2020).

Understanding the causes and effects of road accidents is crucial for developing effective road safety strategies and action plans in any country. The causation hypothesis helps clarify how accidents happen and can be applied to accident analysis to better anticipate, prevent, and manage road safety initiatives. A significant factor in determining the causes of traffic accidents is driving behavior; inappropriate driving actions can create conditions leading to accidents. This study focuses on Al-Ahsa city in Saudi Arabia's Eastern Province, where a Bayesian Belief Network (BBN) model was established using an expectation-maximization algorithm. The model investigates the relationships among various indicator variables, particularly emphasizing driving behavior to assess the uncertainty linked to accident outcomes. The BBN was designed to analyze both intentional and unintentional driving behaviors that contribute to different types and severities of accidents. The findings revealed that when considering speeding as a factor, there is a 26% likelihood of a collision occurring, which represents a 63% increase from the initial estimate.

Furthermore, when brake failure is factored in alongside speeding, the likelihood of a collision rises from 26% to 33%, more than doubling the risk compared to the initial value. These results indicate that the BBN model effectively explores the complex relationships between driver behavior and the causes of accidents, providing valuable insights for improving road safety measures (Rahman et al., 2022).

Reducing the severity of injuries from motor-vehicle crashes has been a longstanding priority for highway agencies and vehicle manufacturers. While measuring progress through the reduction of

injury levels over time is straightforward, evaluating the effectiveness of injury-reduction technologies, policies, and regulations requires a more nuanced empirical assessment of the complex interactions among vehicle, roadway, and human factors affecting crash-injury severities.

Over the years, researchers have employed various methodological tools to analyze the impact of these factors on disaggregate-level injury-severity data. Recent advancements in methodology have led to the development of sophisticated models that can more accurately determine the influence of these factors on injury outcomes. This paper summarizes the evolution of research in this area, highlighting current approaches to the statistical analysis of motor-vehicle injury severities. Additionally, it discusses future methodological directions that could enhance understanding and assessment of injury-reduction strategies in the context of road safety (Savolainen et al., 2011).

Road accidents represent a significant adverse outcome of transportation systems, leading to injuries, fatalities, traffic congestion, and economic losses. As urban areas expand and the number of vehicles increases, traffic accidents (TAs) have emerged as a pressing issue. Research indicates that urban development significantly impacts transportation safety, often more than previously recognized. According to the Permanent International Association of Road Congress (PIARC) and the World Health Organization (WHO), low-income countries experience higher fatality rates compared to high-income countries. Thus, predicting and preventing accidents and congestion is critical worldwide, particularly in developing nations where fatality rates are alarming. This study aims to conduct a comparative analysis of existing literature on the global challenge of road accidents in both low-income and high-income countries. It explores various prediction techniques to enhance road safety and reduce traffic congestion. The research

evaluates multiple methodologies, including logistic regression, decision trees, random forests, deep neural networks, support vector machines, K-nearest neighbors, Naïve Bayes, empirical Bayes, geospatial analysis methods, and advanced algorithms such as UIMA, NSGA-II, and MOPS. The study identifies current challenges, prevention strategies, and future directions for addressing accidents and congestion within road networks. By integrating GIS-based spatial statistical methods with temporal data and leveraging advanced optimization algorithms and machine learning techniques, the research aims to develop accurate prediction models capable of identifying accident hotspots. This approach can significantly enhance traffic safety and mitigate congestion. Effective prevention of urban traffic congestion necessitates incorporating spatial data into precise accident prediction models. Through spatial analysis, road safety planning can be improved, high-risk areas can be identified, interventions can be evaluated, and resources can be allocated optimally. Such measures facilitate effective road safety initiatives and informed decision-making, especially in resource-constrained environments. Therefore, it is imperative to incorporate machine learning, spatial analysis techniques, and advanced optimization algorithms into road safety research and transport planning efforts (Berhanu et al., 2023).

In addition to implementing preventive strategies through risk assessment and management, thoroughly investigating rail and road hazardous material transportation accidents (RRHTA) is crucial to minimizing their occurrence. The initial step in this process involves identifying the root causes, which can only be achieved by applying appropriate techniques. This study introduces a comprehensive method for investigating RRHTA, built on a framework derived from literature reviews, fuzzy logic, and the Topsis method. Based on research aimed at identifying suitable criteria for evaluating incident analysis techniques, six key criteria were selected. Topsis results indicated that the COMIHTA method, with a proximity coefficient of

0.580, was the most effective in analyzing hazardous material transport accidents. The FAM and SCAT techniques ranked second and third, respectively. This research highlights the COMIHTA method, which integrates the strengths of four techniques while addressing their weaknesses, providing a systematic, graphical approach to identifying accident causes and minimizing subjective biases from analysts at all levels (Mohammadfam et al., 2021).

The global issue of traffic accidents results in significant loss of life and property, making it a critical concern. Research aimed at addressing this societal problem highlights the importance of urban planning, expanding and improving divided roads, optimizing traffic signal usage, enhancing the awareness of drivers, pedestrians, and passengers, and improving vehicle safety equipment. Recently, traffic accident blackspots have been identified through the spatial analysis of accident data using GIS, enabling the implementation of preventive measures at locations where accidents are most concentrated. This study focuses on identifying accident blackspots through a hot spot analysis of traffic accidents that occurred in 2019 in the districts of Eyyübiye, Haliliye, and Karaköprü, located in the city center of Şanlıurfa. The goal was to develop strategies for reducing accidents in these areas. Traffic accident reports from the General Directorate of Security for 2019 in the aforementioned districts were utilized for the study. The findings revealed that 1,626 traffic accidents occurred in the study area in 2019, with October being the month of the highest accident frequency, and Thursday as the day with the most occurrences. The time period between 16:00 and 17:59 showed the highest accident density. Key accident blackspots were identified at the Abide Junction, D-400 (east-west) and E-99 (north-south) highways, as well as the Bamyasuyu and Bahçelievler neighborhoods. The study concluded that accidents are concentrated in specific areas and during particular times. To mitigate accidents in Eyyübiye,

Haliliye, and Karaköprü, targeted measures should be implemented during these peak periods. Additionally, enhancing traffic signal systems, conducting road maintenance, and widening roads in high-risk areas are essential steps to reduce the number of accident blackspots (Güngör et al., 2021).

Highway-rail grade crossing (HRGC) accidents present a significant safety hazard for highway users, including pedestrians attempting to cross these intersections. The global rise in HRGC accidents highlights the need for expanded research, not only focusing on accident analysis but also exploring user perceptions, driver behavior, potential conflict points at crossings, the effectiveness of countermeasures, and how users perceive these safety measures. HRGC safety is a key priority in Florida, as the state witnessed 429 injuries and 146 fatalities at these crossings between 2010 and 2019, with a notable rise in incidents in recent years. This study seeks to perform a comprehensive analysis of HRGC accidents in Florida over the past decade. Data for 578 crossings that experienced at least one accident from 2010 to 2019 were gathered from the Federal Rail Administration (FRA) databases. Unlike previous studies, this research considers a broad spectrum of factors, including the physical and operational attributes of crossings, characteristics of vehicles and trains involved, as well as spatial, temporal, environmental factors, and driver behaviors. The findings from this research will provide deeper insights into the primary causes of HRGC accidents in Florida, enabling relevant stakeholders to implement effective safety improvement initiatives throughout the state (Singh et al., 2021).

It is well-established that road accidents are influenced by four interconnected factors: human behavior, vehicle performance, environmental conditions, and infrastructure characteristics. While the majority of accidents are primarily attributed to the first three, particularly improper user behavior, it is essential to minimize the risk linked to infrastructure. This research addresses

the evaluation of urban road safety on existing roads with the aim of identifying hazardous sections where resources should be concentrated for necessary functional improvements. The study analyzes the operational accident rate to tackle this issue.In particular, the research introduces a novel model that evaluates the inherent risk of urban road infrastructure by analyzing accidents, categorized by type, and calculating a risk index based on two key variables: the frequency of accidents and the severity of the resulting damages. Additionally, the study outlines three critical steps to enhance urban road safety. First, it pinpoints dangerous road sections (blackspots) by applying the new model alongside

CHAPTER THREE

METHODOLOGY

3.1 Description of Study Area

The study area for this research focuses on Edo State, located in the southern region of Nigeria. Edo State serves as a significant hub in Nigeria's road transportation network due to its strategic location, linking the northern, western, and eastern regions of the country. The highways in Edo State are among the busiest in the country, facilitating the movement of goods, services, and people across these regions. The high traffic volume on these highways makes the state a vital area for studying road accidents.

3.1.1 Geographic Overview of Edo State

Edo State is situated in the South-South geopolitical zone of Nigeria, bordered by Kogi State to the north, Delta State to the south, Ondo State to the west, and Anambra State to the east. The capital city, Benin City, is a major urban center with a dense population and significant commercial activities. The state is traversed by several key federal highways, such as the Benin-Lagos Expressway, Benin-Asaba Expressway, and Benin-Auchi Road, which serve as major routes for commuters and goods. These highways are of critical importance for Nigeria’s economic activities, as they are heavily used by transporters moving between different regions. However, the heavy traffic and poor road conditions often result in frequent accidents.

3.1.2 Characteristics of Highways in Edo State

The highways in Edo State present a combination of challenges that contribute to the prevalence of road accidents. These include:

i. **Road Conditions:** Many sections of highways in the state are poorly maintained, with potholes, narrow lanes, and inadequate signage. These conditions significantly increase the risk of accidents, especially for high-speed vehicles.

ii. **Traffic Volume:** Due to its strategic location, Edo State experiences heavy traffic on its highways, particularly from commercial vehicles such as buses, trucks, and tankers. This congestion leads to frequent traffic accidents, especially in high-speed areas where lane discipline is often lacking.

iii. **Environmental Factors:** Seasonal variations, particularly during the rainy season, also contribute to road hazards. Flooding and reduced visibility during heavy rains can lead to accidents, while dry seasons are often associated with dust storms that impair drivers' vision.

3.1.3 Accident Prone Zones

Certain areas within the highways of Edo State have been identified as accident-prone, due to factors such as poor road conditions, sharp bends, and lack of appropriate safety measures. Some of these zones include:

i. **Ovia River Bridge on Benin-Ore Road:** Known for frequent accidents, especially involving large trucks and trailers due to the narrowness of the bridge and poor road alignment.

ii. **Ehor on Benin-Auchi Road:** A busy section where reckless driving and road deterioration contribute to frequent crashes.

iii. **Benin Bypass:** Designed to ease traffic congestion in Benin City, the bypass has become a high-risk area due to overspeeding and inadequate enforcement of traffic regulations.

3.1.4 Population and Demographics

The state has a population of over 4 million people, with a significant portion concentrated in urban areas like Benin City, Ekpoma, and Auchi. The heavy movement of people within and across these regions leads to an increased number of vehicles on the roads, contributing to congestion and road safety issues. Additionally, the state's role as a commercial corridor increases the traffic burden, with both personal and commercial vehicles contributing to the high accident rate.

3.1.5 Data Source: Federal Road Safety Corps (FRSC), Edo State

The primary source of data for this study comes from the Federal Road Safety Corps (FRSC), Edo State Command. The FRSC is the leading agency in Nigeria responsible for road traffic management and accident prevention. It collects detailed records of road accidents, including:

i. Date and time of accidents
ii. Location (specific highway and exact accident spot)
iii. Type of vehicles involved
iv. Causes of the accidents (e.g., over speeding, drunk driving, road conditions)
v. Number of casualties (injuries and fatalities)

This dataset provides a comprehensive overview of road accidents in Edo State and forms the basis of the quantitative analysis in this study.

3.2 Data Collection Methods

The data collection methods employed in this study are designed to gather comprehensive and accurate information on highway accidents in Benin - Lagos Road, Benin City Edo State. This section outlines the primary and secondary data sources used, as well as the techniques applied to ensure the reliability and relevance of the data collected. Given the focus on highway accidents, data from the Federal Road Safety Corps (FRSC) forms the foundation of this research.

3.2.1 Primary Data Collection

Primary data collection involves gathering firsthand information through direct engagement with relevant stakeholders and fieldwork, if necessary. However, for this particular study on highway accidents, the primary data collection is limited to supplementary methods, as the bulk of the accident records are sourced from existing data maintained by the FRSC. Nevertheless, primary data may include:

i. **Interviews with Road Safety Officials:** Structured or semi-structured interviews with officers from the FRSC can provide insights into the interpretation of accident records, trends observed in the field, and the challenges faced in accident prevention.

ii. **Surveys (if applicable):** In some cases, surveys of drivers, commuters, or local communities along key highways might be used to gain qualitative data regarding perceptions of road safety, hazardous zones, and common causes of accidents. These surveys help in understanding public attitudes towards road safety and compliance with traffic laws.

3.2.2 Secondary Data Collection

The primary data source for this study is secondary data obtained from the Federal Road Safety Corps (FRSC) records. The FRSC is responsible for monitoring and enforcing road safety across Nigeria's highways, and it maintains detailed records of road traffic accidents. The secondary data used in this study includes:

i. **Accident Occurrence Data:** Detailed reports of accidents that have occurred on highways in Edo State, including the date and time, location (specific highway and accident site), type of vehicles involved, and causes of accidents (such as overspeeding, drunk driving, mechanical failure, etc.).

ii. **Casualty Data:** Information on the number of fatalities and injuries associated with each accident, broken down by type of road user (e.g., drivers, passengers, pedestrians).

iii. **Road Condition and Weather Data:** Information on road surface conditions (dry, wet, damaged) and weather conditions (rainy, foggy, clear) at the time of each accident.

iv. **Traffic Volume:** Data on vehicle density on specific highways during different times of the day or week, which may correlate with accident frequency.

The FRSC data, typically available in the form of accident reports and statistical bulletins, serves as the foundation for analyzing the trends, causes, and impacts of highway accidents. These records are comprehensive and systematically compiled, making them suitable for quantitative analysis.

3.2.3 Sampling Techniques

Since it may not be feasible to analyze every recorded accident on Benin - Lagos Road, Benin City Edo State highways, the study employs a purposive sampling technique. This technique involves selecting a representative sample of highway accidents based on specific criteria, such as:

i. **Accident Frequency:** Selecting accidents from highways with the highest recorded number of incidents.

ii. **Severity of Accidents:** Including both minor and severe accidents to provide a balanced analysis of outcomes.

iii. **Time Period:** Focusing on accidents occurring within a defined timeframe (e.g., over the past 5-10 years) to capture recent trends and changes in road safety dynamics.

Location: Ensuring that accidents from different key highways within Benin - Lagos Road, Benin City Edo State is included to reflect the geographic spread.

3.2.4 Data Collection Instruments

For both primary and secondary data, specific instruments are used to ensure accuracy and consistency:

i. **Structured Interview Guide:** For interviews with FRSC officials, a structured guide will be developed to standardize the questions and capture relevant information on road safety challenges and interventions.

ii. **Accident Report Templates:** Pre-existing templates from the FRSC that capture critical details about each accident, including location, cause, and casualty figures, are utilized for secondary data analysis.

iii. **Surveys/Questionnaires (if applicable):** For gathering qualitative insights from drivers and road users, standardized questionnaires will be used.

3.2.5 Ethical Considerations in Data Collection

Ethical considerations are paramount in this study, particularly with regard to the sensitive nature of accident data. The following measures are taken:

i. **Confidentiality:** Personal details of individuals involved in accidents are kept confidential, ensuring that no identifying information is published or misused.

ii. **Data Permission:** Formal permission is sought from the Federal Road Safety Corps (FRSC) to access and use their accident records for this research.

iii. **Consent:** In cases where interviews or surveys are conducted, informed consent is obtained from all participants.

3.3 Data Analysis Methods

The data analysis methods applied in this study are crucial for interpreting the information collected on highway accidents in Benin - Lagos Road, Benin City Edo State. This section outlines the techniques used to process and analyze both qualitative and quantitative data, providing meaningful insights into accident trends, causes, and impacts. The data from the Federal Road Safety Corps (FRSC) forms the backbone of the analysis, and various statistical tools are employed to assess accident frequencies, patterns, and contributing factors.

3.3.1 Descriptive Statistical Analysis

The primary technique used in this study is descriptive statistical analysis, which helps in summarizing and understanding the general characteristics of highway accidents. This includes:

i. **Frequency Distribution:** Calculating the frequency of accidents over specific periods, such as annually or seasonally, to identify patterns or spikes in accident rates.

ii. **Percentages and Ratios:** To illustrate the proportion of accidents caused by specific factors, such as over speeding, bad road conditions, or mechanical failure, and the distribution of accidents across different highways in Edo State.

iii. **Measures of Central Tendency:** Calculating means, medians, and modes to determine average accident rates, casualty figures, and other key variables such as the average number of vehicles involved in each incident.

These descriptive statistics provide an overview of accident data, offering a clear understanding of the scope and scale of highway accidents within the state.

3.4. Data Presentation

The effective presentation of data is essential for conveying the findings of this study in a clear, concise, and visually engaging manner. The data on highway accidents collected from the Federal Road Safety Corps (FRSC) in Edo State will be analyzed and presented using various formats, including tables, charts, graphs, and maps. This section outlines the methods for presenting both quantitative and qualitative data to ensure that the insights are easily understandable and actionable for stakeholders such as policymakers, traffic safety authorities, and road users.

3.4.1 Tables

Tables will be used to present numerical data in a structured format, allowing for easy comparison of different variables related to highway accidents. The tables will include:

i. **Accident Frequency by Year:** A table showing the number of accidents occurring each year, categorized by type (fatal, serious, minor), and highway.

ii. **Causes of Accidents:** A breakdown of the primary causes of accidents, such as over speeding, bad road conditions, mechanical failure, and reckless driving.

iii. **Casualty and Fatality Rates:** A table comparing the number of injuries and fatalities for each highway or accident cause, with columns showing percentages to highlight the severity of certain factors.

By presenting the data in tables, it will be easier to compare figures across different time periods, accident causes, and locations, providing a clear overview of the accident trends in Edo State.

3.4.5 Qualitative Data Presentation

In addition to quantitative data, qualitative findings from interviews with FRSC officials or survey responses (if applicable) will be presented using narrative text and thematic analysis. This includes:

i. **Quotations:** Direct quotes from interviews with road safety officers or drivers, illustrating common issues or challenges faced on highways.

ii. **Thematic Summaries:** Grouping qualitative data into key themes, such as driver behavior, enforcement challenges, or road infrastructure deficiencies. These summaries provide context and deeper insights into the factors contributing to highway accidents, complementing the quantitative data.

3.5 Validity and Reliability of Data

Ensuring the validity and reliability of data is critical in any research, especially when analyzing sensitive information such as highway accidents, where the accuracy of findings can influence policy decisions and safety measures. In this study, steps are taken to guarantee that the data used is both valid (i.e., it accurately reflects what it is intended to measure) and reliable (i.e., the results can be consistently reproduced under similar conditions).

3.5.1 Validity of Data

Validity refers to the extent to which the data collected represents the true situation of highway accidents in Edo State. To ensure the validity of the data in this study, several measures are implemented:

i. **Source of Data:** The primary data source for this study is the Federal Road Safety Corps (FRSC), a reliable and official organization tasked with recording and reporting road accidents. Using data from a credible institution ensures that the information is based on accurate records and comprehensive accident reporting procedures.

ii. **Accurate Measurement of Variables:** Key variables in this study, such as the causes of accidents, accident frequencies, and location data, are carefully selected to reflect the actual conditions on highways. By ensuring that the variables accurately capture the elements of road safety being studied, the findings will be valid. For instance, categories of accident causes (e.g., over speeding, bad road conditions, and reckless driving) are clearly defined and standardized to avoid ambiguity.

iii. **Data Collection Methods:** To enhance the validity of the study, data collection methods align with best practices. Accident reports from the FRSC include verified

records of each incident, detailing the date, location, cause, and severity. This structured data collection approach ensures that the information is reliable and reflects real-world conditions.

iv. **Cross-Verification:** Where possible, data will be cross-verified with other reliable sources, such as hospital records or police reports, to ensure that the accident figures reported by the FRSC correspond to actual occurrences. This verification process helps to eliminate discrepancies or underreporting of incidents.

v. **Ensuring Temporal Validity:** The data used spans several years to ensure that the study captures a broad and consistent pattern of highway accidents. Using data over multiple time periods reduces the risk of drawing conclusions based on an anomalous year or season, ensuring that the findings represent long-term trends rather than isolated events.

3.5.2 Reliability of Data

Reliability refers to the consistency of the data, meaning that repeated measures under similar conditions would yield the same results. To ensure the reliability of the data used in this study, several approaches are adopted:

i. **Consistency of Data Recording by FRSC:** The FRSC uses standardized procedures for recording highway accidents across the country. This ensures that data is consistently gathered according to uniform protocols, which increases the likelihood that the data is reliable. Their trained officers use defined criteria to classify accidents, causes, and outcomes, which minimizes subjective errors and enhances reliability.

ii. **Reproducibility of Results:** The statistical analysis methods used in this study, such as descriptive statistics, correlation analysis, and geospatial mapping, are designed to be replicable. If similar data is analyzed using the same methods, the results should be consistent. For instance, the use of statistical software like SPSS or GIS ensures that the analytical processes are transparent and can be replicated by other researchers.

iii. **Pilot Testing of Analysis Tools:** Before the full data set is analyzed, the statistical tools and models will be pilot tested using a subset of the data to ensure they produce consistent results. If inconsistencies arise, the tools can be adjusted to ensure that they reliably capture the patterns and trends being studied.

iv. **Training and Standardization:** Any personnel involved in the data analysis process are trained to use the statistical software and analytical methods consistently. This training ensures that all members of the research team approach the data in a standardized way, reducing variability in interpretation and increasing the reliability of the results.

3.5.3 Data Cleaning and Preprocessing

To ensure both the validity and reliability of the data, thorough data cleaning and preprocessing will be conducted before analysis. This involves:

i. **Identifying and Handling Missing Data:** Missing data can distort findings. Where possible, missing values will be filled through data imputation techniques, or those entries may be excluded if they are insignificant to the overall dataset.

ii. **Removing Outliers:** Extreme values or outliers that are not representative of the general pattern (such as erroneous data points or cases of underreported accidents) will be removed to ensure they do not skew the analysis.

iii. **Ensuring Data Accuracy:** Double-checking entries to ensure that all records (dates, locations, causes) are accurate and free of transcription errors. Inconsistencies in data entries are corrected before conducting any analysis.

3.5.4 Limitations to Validity and Reliability

While efforts are made to ensure high validity and reliability, it is important to recognize potential limitations:

i. **Underreporting of Accidents**: Some minor accidents may not be reported to the FRSC, leading to possible underrepresentation of certain types of incidents. This could affect the overall validity of the data.

ii. **Subjectivity in Cause Classification:** Although FRSC officers follow standardized protocols, there may be some subjectivity in classifying accident causes (e.g., attributing an accident to over speeding versus reckless driving), which could introduce variability.

iii. **Limited Geographic Coverage**: The study focuses on highways Benin - Lagos Road, Benin City Edo State, which may limit the generalizability of the findings to other regions. However, the specific focus on Edo State ensures that the data reflects local conditions and realities, enhancing the study's validity in this context.

3.6 Discussion

The discussion section is where the findings from the data analysis are interpreted in the context of existing literature, theoretical frameworks, and the specific objectives of the study. It provides an opportunity to critically evaluate the results, draw meaningful conclusions, and explore their implications for road safety policy, practice, and further research. In this section, the findings from the analysis of highway accidents in Benin - Lagos Road, Benin City Edo State will be presented, compared with prior research, and discussed in relation to the study's aims and objectives.

3.6.1 Interpretation of Findings

The interpretation of findings will involve summarizing the key results of the data analysis and explaining their significance. This includes:

i. **Prevalence of Accidents:** Discussing the frequency and trends of highway accidents over the studied period, highlighting any significant increases or decreases in accident rates. For example, if a noticeable spike in accidents was observed during specific months or seasons, this could indicate underlying issues related to weather conditions or increased traffic volumes during those periods.

ii. **Identifying Major Causes:** Analyzing the most common causes of accidents as identified through the data analysis. This could include factors such as speeding, driver error, or poor road conditions. Each identified cause will be discussed in terms of its prevalence and severity, and compared with findings from other studies, allowing for a deeper understanding of how these causes impact highway safety.

iii. **Relationship Between Causes and Severity:** Evaluating the relationship between various causes of accidents and their resulting severity. This could involve discussing how certain behaviors (e.g., drunk driving) correlate with higher fatality rates compared to accidents caused by mechanical failure or adverse weather conditions.

3.6.2 Practical Implications for Road Safety

The practical implications of the findings will be thoroughly examined, focusing on how the insights gained can inform real-world applications and improve road safety. This includes:

i. **Targeted Interventions:** Discussing specific interventions that can be developed in response to the identified causes of accidents. For instance, if speeding is a major contributor, recommendations could include increased enforcement of speed limits, public awareness campaigns on the dangers of speeding, and improvements to road signage.

ii. **Policy Recommendations:** Outlining policy changes that could be enacted based on the findings. This might include stricter regulations on vehicle maintenance, improved road infrastructure, or enhanced driver education programs.

iii. **Stakeholder Engagement:** Emphasizing the importance of collaboration among various stakeholders (e.g., government agencies, law enforcement, community organizations) to implement effective road safety strategies.

3.6.3 Limitations of the Study

While discussing the findings, it is crucial to acknowledge the limitations of the study that may impact the interpretation of results. This includes:

i. **Data Limitations:** Highlighting potential issues with the data quality, such as underreporting of accidents or missing information, which could affect the overall findings.

ii. **Scope Limitations:** Acknowledging that the study focuses specifically on Edo State and that findings may not be generalizable to other regions or contexts.

3.6.6 Suggestions for Future Research

Based on the findings and limitations, this section will propose avenues for future research. This may include:

i. **Longitudinal Studies:** Recommendations for conducting longitudinal studies to track changes in accident trends and the effectiveness of implemented interventions over time.

ii. **Qualitative Research:** Suggesting qualitative research approaches (e.g., interviews, focus groups) to gain deeper insights into driver behavior and perceptions of road safety.

iii. **Broader Geographic Studies:** Proposing studies that include multiple regions to compare and contrast factors contributing to highway accidents across different contexts.

CHAPTER 4

4.0 DATA RESULTS AND DISCUSSION

4.1 Data Presentation

The data presented in table 4.1, 4.2, 4.3 and 4.4 represents the monthly occurrence of Road Traffic crashes for four years. This data was reported and described by Edo State Sector and unit command of the federal road safety Corp in respect of Benin-lagos expressway. For ease of analysis, the data which is in respect of 2022, 2023, 2024 and 2025 are presented in four tables representing the four years under review. Each of the table present the monthly RTC data as they occurred.

4.2 Data Results

Table 4.1 Record of RTC on Benin – Lagos expressway for 2022

Month	No of people injured	No of people killed	Total number of people involved
January	13	0	21
February	0	5	14
March	3	1	31
April	7	0	11
May	3	1	14
June	13	1	18

Month	No of people injured	No of people killed	Total number of people involved
July	21	2	28
August	4	0	6
September	5	1	13
October	1	7	20
November	6	0	22
December	14	0	97
	Total = 90	Total = 18	Total = 295

Table 4.2. Record of RTC on Benin – Lagos expressway for 2023

Month	No of people injured	No of people killed	Total no of people involved
January	14	0	19
February	7	0	11
March	15	1	35
April	6	0	7

May	32	4	77
June	6	2	16
July	18	3	32
August	5	2	15
September	6	0	12
October	2	0	2
November	2	0	7
December	11	3	38
	Total = 124	Total = 15	Total = 271

Table 4.3 Record of RTC on Benin – Lagos expressway for 2024

Month	No of people injured	No of people killed	Total no of people involved
January	46	5	68
February	5	5	22
March	4	7	11
April	18	0	55

May	1	1	4
June	Nil	Nil	Nil
July	1	0	1
August	-	-	-
October	8	1	35
November	26	7	34
December	6	1	31
	Total = 124	Total = 29	Total = 282

4.3 DISCUSSION

FINDINGS

The fatality rate and injuries resulting to deaths in road traffic crashes victims are mostly as a result of total lack or delayed rescue services. Human factor forms 95% of road traffic crashes. This is largely due to the fact that some are untrained or unlicensed drivers while some are psychologically unstable with deficiency in hearing or sight. Apart from this, the attitude of employers of drivers who do not scrutinize drivers' health conditions and level of knowledge of basic safety regulations also contributes to road crashes. Also, training and retraining of drivers is not given priority by employers.

The use of second hand, old and mechanically deficient vehicles is also a contributive factor to road traffic crashes. Such vehicles depend largely on substandard spare parts which are far from serving the purpose of providing the right maintenance needed to keep a vehicle in good condition. Failure to obey traffic rules and regulations by drivers and vehicle owners also contributed to the increasing rate of road traffic crashes in Nigeria. This is in relation with violations like: overloading, over speeding, dangerous overtaking especially at bends, intake of alcohol and drugs. The prevailing bad road conditions across the country contribute immensely to the increasing road crashes. The prevalence of armed robbery on the highways made night journeys to be highly risky. Oftentimes armed robbery attacks resulted into road traffic crashes. FRSC as the lead agency in road traffic management is under-equipped to effectively and efficiently carry out it responsibilities. This is more disturbing especially in the area of clearance of obstructions on the highways which often causes multiple accidents.

There is inadequacy of road side clinics to enhance prompt rescue and medical care during night crashes.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

CONCLUSION

The findings and recommendations in this study are based on the data collected in respect of Benin-lagos expressway which is the focus of this study. However, this have a general application to all Nigerian roads. This is because the road Traffic activities in Nigeria including those related to road traffic crashes at all times and in different places are homogeneous in nature; that which is obtained on the road under study is a reflection of what is obtained on all Nigerian roads.

It will be necessary, however, to point out here that the findings and recommendations presented are just a few out of the very many that could be put forward aimed at minimizing night crashes and their attendant consequences.

To embark on it requires extra care; night drivers should learn to protect themselves from the negative consequences of night journeys.

RECOMMENDATIONS

In regards to the findings reported, the following recommendations are made

1. All road users as well as stakeholders in road traffic related matters should imbibe the culture of good road use and traffic discipline in order to avoid getting involved in road traffic crashes
2. Corporate bodies as well as government at all levels should contribute towards provision of rescue services and road side accident clinics especially on major roads to provide prompt medical attention to victims of road crashes.
3. Employers of drivers should ensure the screening of applicants to confirm their psychological, physical and mental fitness before offer of employment. Also training and retraining of drivers should be given priority since it could keep them informed on contemporary traffic rules and regulations.
4. Second hand vehicles imported into the country should be inspected and certified road worthy before allowed to be on the roads. Aside this, spare parts imported should be confirmed by Standard Organization of Nigeria and agencies like the Nigerian customs Service as having met the stipulated standards. This should also include vehicle tyres.
5. The Federal Road Safety Commission as lead Agency in road traffic management should be adequately funded and well equipped especially with heavy duty tow trucks to facilitate
6. Government should rise up to the challenge of ensuring that existing bad roads are rehabilitated and new ones constructed with adequate road furniture and markings to reduce crashes occasioned by bad tools.

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