T.R.N.C

TURKISH REPUBLIC OF NORTHERN CYPRUS

NEAR EAST UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

THE RELATIONSHIP BETWEEN FATALITY AND INJURY ASSOCIATED WITH ROAD TRAFFIC CRASH PROBABLE CAUSES, INVOLVING COMMERCIAL AND PRIVATE VEHICLES IN NIGERIA (2013-2019).

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Master of Science in Biostatistics

Supervisor:

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THESIS APPROVAL CERTIFICATE

Thesis submitted to the Institute of Graduate Studies of Near East University in partial fulfillment of the requirement for the degree of Master of Science in Biostatistics.

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DECLARATION

I hereby declare that this project was based on my research, findings and gathering of study tools in relation to road traffic crash fatality, injured in relation the probable causes and different vehicle categories . The information I was working with were from some of my original ideas and the ones that were not I made sure to put their references below and l also in declaration are mindful to state that I was careful in abiding by the rules and regulations stated by the thesis committee.

Thank you!!

DEDICATION

This thesis is dedicated to God Almighty, my family and Federal Road Safety Corps (FRSC).

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ABSTRACT

Road traffic crash also known as road traffic accident involves collision of a vehicle in a motion with another vehicle, pedestrian, cyclist, and one of the major risk associated with Road traffic Crash is injury and Fatality rate among those involved. Nigeria is one of the sub-Saharan Africa countries with the highest fatality rate in Road traffic Crash.

Nigeria is a country located in the West African region of Africa, with a land mass of about 923,763square kilometers. It is popularly called the giant of Africa, with approximately 200 million people (Wikipedia.org). It is bordered by Benin Republic, Cameroun, Chad and Niger and Sao Tome and Principe. It is a federal republic comprising of 36 states including Federal Capital Territory, with the states divided into six geopolitical zones namely North East (NE), North West (NW), South West(SW), South East(SE) and South (SS).

Road traffic crash is one of the leading causes of death including Nigeria, it has resulted in more loss of lives than major communicable diseases, thus constitutes a major public health problem.

This study is aimed at examining and analyzing the fatality and injury rate associated with road traffic crash in relation with its probable causes among commercial and private vehicles in Nigeria with a view to suggesting further ways of preventing Road traffic Crash and sustaining the vision of the lead agency involved in road safety management in Nigeria, which is to eradicate road traffic crashes and create a safer motoring environment in Nigeria.

Keywords: Road Traffic Crash (Road Traffic Accident), Fatality (Killed or death), Injured, Commercial, Private, FRSC (Federal Road Safety Commission).

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Road Traffic Crash is an incident that involves the collision of a vehicle with another vehicle or other road users namely: the cyclist, motorcyclist, motor tri-cyclist, animals, or motionless objects (trees, poles or building) that can obstruct vehicular movement.

Road traffic crash occurrence usually leads to injury, mortality or loss and damage to properties.

Notwithstanding the efforts put in place in addressing the menace of a road traffic crash in order to reduce the fatality rate of accidents in Nigeria roads, Nigeria still remains one of the most affected countries in sub-Saharan Africa, that have suffered huge losses to fatal car accidents due to pressure on our roads as a result of the population density (FRSC 2012).

Road traffic crashes have resulted in more waste of lives and property than major communicable diseases (Nigerian Highway code), with the following factors namely the driver, the vehicle and the condition of the road playing a major role in making Road Traffic crashes occur on Nigerian roads.

Road traffic injuries are a major global health issue (Clara, 2016). According to the World Health Organization's (WHO) Global Status Report on Road Safety 2015, road traffic crashes are the major leading cause of death of all age groups, resulting in a global economic burden of $518 billion. The fatality and injury severity has remained consistent, with efforts being put in place through the sustainable development goals 2030 to reduce the economic burden of a road traffic crash in low-middle income countries.

According to World Health Organization's (WHO) Global Status Report on Road Safety 2018, road traffic deaths are now the eighth leading cause of death for all age groups—killing more people than tuberculosis and HIV/AIDS—and the leading cause of death for children and young adults between the ages of 5 and 29 (2).

The number of deaths experienced in African countries is 26.6 per 100,000 people; this happens to be the highest number recorded in the world when compared to the fatality rate as seen in the Americas and Europe. With Road Traffic Accidents Deaths in Nigeria estimated at 40,061 or 2.07% of total deaths (WHO, 2018).

The road traffic fatality on a yearly basis as reported by World Health Organization Global status report on road safety 2018, has climaxed to 1.35 million (WHO, 2018). According to the report, young people between the ages of 5 and 29 years old are the most killed in road accidents, with developing countries being the most affected.

Road traffic crash has led to several injuries and fatalities in Nigeria than communicable diseases.

Road Traffic Crashes have caused physical suffering and substantial economic losses to individuals and the nation (FRSC Publication).

1.2 Types of Road Traffic Crash

Road Traffic Crash can be grouped into three major types namely: fatal, serious and minor.

Each of these categories plays a vital role in the type of severity and casualty that will occur in the event of any crash.

a. Fatal Crash: it is a type of road mishap or crash in which life is lost
b. Serious Crash: In this type of crash, there is a high severity of an injury that will result in hospitalization of the affected victims for either days or months or years.
c. Minor Crash: In this type of crash, the victims of such crash have minor injuries which are usually not life-threatening and do not require hospital admission.

1.3 Background on Federal Road Safety Commission (FRSC).

Fatalities on the roads reached a high proportion in the 80‟s; this resulted in the establishment of Federal Road Safety Corps in 1988. Thus it was established in response to the problem of road traffic crash in Nigeria Roads.

The Federal Road Safety Commission (FRSC) was established by Decree No. 45 of 1988 as amended by decree 35 of 1992 otherwise known as Cap. 141 Laws of the Federation, with effect from 18th February, 1988 now FRSC establishment act, 2007. It is the lead agency for road traffic administration and safety management. FRSC Establishment ACT, 2007). (FRSC Publication 2010-2020).

1.4 Federal Road Safety Commission Statutory Responsibilities:

According to FRSC Establishment ACT, 2007), Federal Road Safety Commission is saddled with the following responsibilities as follows:

a. To prevent or minimize road accident/crashes on the highways;
b. To clear obstructions on the highways;
c. To educate drivers, motorists, and other members of the public generally on the proper use of the highways;
d. To provide prompt attention and care to road crash victims;
e. To conduct researches into the causes of accident/crashes and methods of preventing them as well as putting into use the result of such researches;
f. To determine and enforce speed limits for all categories of roads and vehicles;
g. To cooperate with bodies, agencies and groups engaged in road safety activities on prevention of crashes on the highways.

1.5 Research Question and Hypothesis

The following questions which the study examined were addressed by the hypothesis following each of them as stated below:

a. Does probable cause of Road traffic Crash affect the number of fatality and number injured seen in a particular crash.

   Ho: The probable cause of Road traffic Crash does not affect the number of fatality and number of injured

   H_1: The probable cause of Road traffic Crash affects the number of fatality and number of injured

b. Is there any comparison between the rate of fatality and injury associated with road traffic crash involving the following Vehicle categories (Commercial/Commercial, Commercial/Private and Private/Private Vehicles).

   Ho: There is no difference between the rate of fatality and injury associated with road traffic crash involving the following Vehicle categories (Commercial/Commercial, Commercial/Private and Private/Private).

   H_1: There is a difference between the rate of fatality and injury associated with road traffic crash involving the following Vehicle categories (Commercial/Commercial, Commercial/Private and Private/Private).

c. Is there any difference between the number of people injured and killed among both Genders?

   H_0: There is no difference between the number of people injured and killed among both Genders

   H_1: There is a difference between the number of people injured and killed among both Genders

1.6 Aims and Objectives

The aim of this study is to determine if there is any relationship between the number of people killed, number of people injured and the likely cause of a road traffic crash involving either a commercial or private vehicle in Nigeria.

1.7 Objectives of the Study

This study will be carried out by using existing road traffic crash data from Federal Road Safety commission Nigeria. In which the following will be addressed:

a. To find out if there is any relationship between fatality rate and the number of people injured with respect to vehicle category involved in a crash
b. To determine the relationship between numbers injured number of fatality and the probable causes.
c. To ascertain the relationship between numbers injured number of fatality and the gender and sex.

1.8 Significance of the Study

a. To suggest public policies to reduce road traffic crash thereby enhancing the proactive and preventive measures taken by the lead agency involved in road safety management in Nigeria, towards eradicating road traffic crash in Nigeria.
b. To promote greater awareness of road traffic crash fatality rate among stakeholders to road safety management. Example: Nigerian Union of Road Transport Workers, Road Transport Employee of Nigeria, Nigerian Association of Road Transport Owners etc.
c. To promote greater awareness of road traffic crash fatality rate among drivers, motorist and other road users in Nigeria.
d. To provide knowledge for further literature on road accidents, commonly used univariate and multivariate analysis techniques.

1.9 Definition of Concepts

a. Road Traffic Crash – Also referred to as Road Traffic Accident.

It is an unpleasant or a mishap occurrence affecting an individual in time and space. It is a complicated event which can be avoided; it usually involves interplay of the vehicle, driver, the road condition and the weather.

b. Fatality: This is death as a result of accident. It represents the number of people killed

c. FRSC: Federal Road Safety Commission

CHAPTER 2

LITERATURE REVIEW

Many researchers have carried out research work in the area of road accidents. Some of them have analyzed accident data in different ways. Some of them Identification of Black spot zone. Some of them have developed accident models for forecasting future accident trends. They have also proposed strategies for road safety. In the present study, literature review is carried out covering the different issues related to the following:

a. Global status of Road Traffic Crash as relates to injury and fatality
b. Road traffic crashes ,injuries and deaths in Africa
c. An overview of the statistics of Road traffic crash in Nigeria
d. Major causes of Road Traffic Crash across Nigeria
e. Road Traffic Crash a public health issue.
f. Application of machine learning to Road traffic crash Trend Forecast

2.1 Global Status of Road Traffic Crash as Relates To Injury and Fatality

According to World Health Organization's (WHO), every year the lives of approximately 1.35 million people are cut short as a result of a road traffic crash. The report has it that between 20 and 50 million more people suffer non-fatal injuries, with many incurring a disability as a result of their injury. (1) According to this report injuries due to road traffic crash cause considerable economic losses to individuals, their families, and to nations as a whole, these losses arise from the cost of treatment as well as productivity loss for those killed or disabled by their injuries, and for family members who need to take time off work or school to care for the injured. The report has it that most countries of the world lose 3% of their gross domestic product to Road traffic crashes. (1)

According to WHO 2015, Global status report on road safety, reflecting information from 180 countries, indicates that worldwide the total number of road traffic deaths has plateaued at 1.25 million per year, with the highest road traffic fatality rates in low-income countries. (1)

According to 2018 World Health Organization's (WHO), Global status report on road safety highlights that the number of annual road traffic deaths has reached 1.35 million and Road traffic

injuries are now the leading killer of people aged 5-30 years. This burden is unequally borne by, cyclists, pedestrians and motorcyclists, especially for those living in developing countries. (2)

Naci, H., Chisholm, D., & Baker, T. D. (2009) reviewed the global distribution of road traffic deaths by road user groups(pedestrians, bicyclists, motorcyclists, motorized four-wheeler occupants), in addition to the total number of road traffic fatalities by each group as categorized by the world bank income levels of each country of the world.

Naci H et al (2009), observed that the breakdown of road traffic deaths by road user group varies dramatically across different parts of the world, with the magnitude of pedestrian fatalities ranges from more than half in African sub-region AfrE (55%) to 15% or less in America or Europe.

Naci H et al (2009) also observed that the distribution also varies across low-income, middle-income and high-income countries, 45% of road traffic fatalities in low-income countries are among pedestrians, while 29% and 18% are estimated to be among pedestrians in middle-income and high-income countries respectively.

2.2 Road Traffic Crashes, Injuries and Deaths In Africa

Vissoci JRN, Shogilev DJ, Krebs E, et al (2017) in a systemic review to evaluate the burden of road traffic injury in sub Saharan African countries using a proportion of hospital based data observed that the proportion of road traffic injuries was 32% high , among which 5% were lost to death in the course been hospitalized.

Teferi and Samson (2019) in their study to determine the rates of injuries and fatalities associated with road traffic crash in Ethiopia using the data of a recent national survey observed that the magnitude of road traffic crash casualties was very high in Ethiopia with about 43.8% fatality and 22.8% injury rate per 100,000 population.

Davies et, al (2016), in systemic review and meta-analysis study to ascertain the burden of road traffic injuries and deaths for all road users and among different road user groups in Africa, using a pooled estimates of road traffic injuries and deaths from 39 studies, discovered that road traffic injury accounted for 65.2 per 100000 population (95%CI: 60.8-69.5),while fatality rate was 16.6 per 100000 population(95% CI:15.2-18.0). According to Davies et, al, road traffic injury rate increased from 40.7 to 92.9 per 100000 population between 2010 and 2015, while fatality rate decreased from 19.9 to 9.3 per 100000 population.

In a related communiqué during the fifth UN Global Road Safety Week in Africa, it showed that fatality due to road traffic crash is still on the increase, despite the progress made in different countries of the world, with 1.35 million fatalities recorded annually and road traffic injury a major killer of the young ones. According to this report, Africa has the highest level of road traffic fatalities and injury.

With these statistics and other relevant statistics, it has shown that Nigeria is among the low and middle-income countries affected greatly by road traffic crash and the fatalities. Boboye Oyeyemi, 2016 said that "the death and injuries that result from these crashes cause considerable loss of economic and human resources not only to the victims and their families but the nation at large.

2.3 An Overview of the Statistics of Road Traffic Crash (RTC) In Nigeria

Among countries around the world, Nigeria is said to be ranked the second highest in road traffic crash incidence rate. Nigeria's annual 8,000 to 10,000 traffic accidents deaths between 1980 and 2003 posed a major social and economic problem for the country.

Research shows that the first accident in Nigeria took place in 1906 in Lagos. Since then, the nation has experienced many crashes that have resulted in a high mortality and morbidity rate.

An analysis of road traffic accident data (1960-2010) in Nigeria obtained from the Federal Road Safety Commission (FRSC) showed that there has been an upward trend in accident casualty between 1960 and 2010. Based on this data from FRSC, the number of people killed and the number of people injured stood at 313,832 and 956,331 respectively (Isreal A.Ademiluyi, 2012). According to Isreal et al. (2012) 1,270,163, road traffic crash victims were recorded within this year under review on Nigeria highways, with an average of 24,905 crash per year, average fatality and injury rate per year were 6,154 and 18,752 respectively.

A look at related road traffic crash statistical data analysis in Nigeria from (2010-2019) as reported by Federal Road Safety Corps (FRSC) Nigeria in their yearly annual reports of 2010-2019 revealed as follows:

a. 2010 annual report showed that out of 11,385 reported road traffic crashes, 6,052 number of people were killed (fatality) this was from 2,388 fatal RTC cases reported in that year, while 6,815 RTC and 2,182 RTC were serious and minor cases respectively, resulting to 35,691 number of injured people.

b. 2011 annual report showed that out of 13,196 reported road traffic crashes, 6,054 number of people were killed (fatality) this was from 2,840 fatal RTC cases reported in that year, while 8,357 RTC and 1,999 RTC were serious and minor cases respectively, resulting to 41,165 number of injured people.

c. 2012 annual report showed that out of 13,262 reported road traffic crashes, 6,092 number of people were killed (fatality) this was from 2,935 fatal RTC cases reported in that year, while 8,277 RTC and 2050 RTC were serious and minor cases respectively, resulting to 39,348 number of injured people.

d. 2013 annual report showed that out of 13,583 reported road traffic crashes, 6,544 number of people were killed (fatality) this was from 3,294 fatal RTC cases reported in that year, while 8,589 RTC and 1,700 RTC were serious and minor cases respectively, resulting to 40,057 number of injured people.

e. 2014 annual report showed that out of 10,380 reported road traffic crashes, 5,996 number of people were killed (fatality) this was from 3,117 fatal RTC cases reported in that year, while 6,356 RTC and 907 RTC were serious and minor cases respectively, resulting to 32,063 number of injured people.

f. 2015 annual report showed that out of 9,734 reported road traffic crashes(RTC), 5,440 number of people were killed (fatality) this was from 2,854 fatal RTC cases reported in that year, while 6,039RTC and 841 RTC were serious and minor cases respectively, resulting to 30,478 number of injured people.

g. 2016 annual report showed that out of 9,694 reported road traffic crashes(RTC), 5,053 number of people were killed (fatality) this was from 2,638 fatal RTC cases reported in that year, while 5,633 RTC and 1,423 RTC were serious and minor cases respectively, resulting to 30,105 number of injured people.

h. 2017 annual report showed that out of 9,383 reported road traffic crashes(RTC), 5121 number of people were killed (fatality) this was from 2,587 fatal RTC cases reported in that year, while 5,456 RTC and 1,340 RTC were serious and minor cases respectively, resulting to 31094 number of injured people.

i. 2018 FRSC annual report showed that out of 9,741 reported road traffic crashes(RTC), 5181 number of people were killed (fatality) this was from 2,739 fatal

RTC cases reported in that year, while 5,849 RTC and 1,153 RTC were serious and minor cases respectively, resulting to 32220 number of injured people.

j. 2019 FRSC annual report showed that out of 11,072 reported road traffic crashes(RTC), 5483 number of people were killed (fatality) this was from 2,896 fatal RTC cases reported in that year, while 6,911 RTC and 1,265 RTC were serious and minor cases respectively, resulting to 35,981 number of injured people.

A report released by the Corps Transport Standardization Office department of the Federal Road Safety Corps (FRSC) Nigeria, in 19th October 2019, on Road Traffic Crashes (RTC) involving Tankers and Trailers on Nigeria Roads for a period between 2007 and June 2010. The report indicated that within this period, a total of 4,017 crashes involving Tankers and Trailers were recorded on Nigerian roads with a yearly average of 1,148 RTC cases and a monthly average of 96 crashes. With 607 Tankers/ Trailers crashes recorded in 2007, which increased by 102.47% in 2008(1,229 Trailers/Tankers Crashes recorded). With a decline of 1.3% in 2009 to 1,213 and 968 crashes witnessed by June 2010. Also, a total of 4,076 number of people were killed (fatality) between 2007 and June 2010 in this crashes involving Trailers and Tankers, 805 persons recorded in 2007, while in 2008, it increased by 51.68percent(1,221persons), 1,085 depicting 11.4% reduction and 965 persons were killed in 2009 and 2010. Also, 12,994 persons were reported to be injured between 2007 and June 2010. (FRSC Publication, 2010)

In another report by the Corps Transport Standardization Office department of the Federal Road Safety Corps (FRSC) Nigeria, report published in July 2011, on Road Traffic Crashes (RTC) involving Buses on Nigeria Roads (2007-2010). The report revealed that a total of 5,828 crashes involving buses were recorded on Nigerian roads with a yearly average of 1,457 RTC Cases and a monthly average of 121 crashes. With 37.11% increase from 2007 to 2008(997-1367 number of bus crashes), while 2009 and 2010 witnessed a drastic increase by 23.84% (1693 bus crashes) and 4.61 %(1,771 bus crashes) respectively. According to the report 5,583 numbers of people were killed (fatality) between 2007 and 2010, with 983 deaths in 2007, with an increase in the figure to 1,549 in 2008 representing 57.57% increase. In 2009 and 2010 respectively, 1,567(1.16%) and 1,484 number of people were killed in RTC involving buses. Within this period (2007-2010), 27,791 number of people were injured in Road Traffic Crashes (RTC), involving buses, with a yearly average of 6,948. With the following recordings: 4,654 people in

2007, 7,305 persons in 2008 depicting 93.84% increase, 7,809 people (40.42% increase) in 2009 and 8,203 injured people(2.74% increase).((FRSC Publication,2011).

Table 2. 1 The summary of reported road traffic crashes trends in Nigeria (2010 – 2019)

Year	Fatal Cases	Serious Cases	Minor Cases	Total Cases	No. Killed	No. Injured	Total Casualty
2010	2388	6815	2182	11385	6052	35691	41743
2011	2840	8357	1999	13196	6054	41165	47219
2012	2935	8277	2050	13262	6092	39348	45440
2013	3294	8589	1700	13583	6544	40057	46601
2014	3117	6356	907	10380	5996	32063	38059
2015	2854	6039	841	9734	5440	30478	35918
2016	2638	5633	1423	9694	5053	30105	35158
2017	2587	5456	1340	9383	5121	31094	36215
2018	2739	5849	1153	9741	5181	32220	37401
2019	2896	6911	1265	11072	5483	35981	41464
TOTAL	28288	68282	14860	111430	57016	348202	405218

Source: Federal Road Safety Corps (FRSC, 2019).

2.5 Major Causes of Road Traffic Crash across Africa and Nigeria

Road traffic Crashes in Nigeria as seen from previous researches or articles has always resulted in a painful loss and waste both to the families of victims affected and the Society at large.

Research has shown that the major causes of road traffic Crash can be categorized under three headings namely: Human, Environmental and Mechanical Causes

2.5.1 Human Causes

Studies carried out by Federal Road Safety Corps within this years has shown that 90percent(%) of road traffic crashes that occurs in Nigeria roads are caused by human factor, out of which 80% constitutes Drivers actions. Nigeria Highway Code classified these drivers' action as below:

a. Speeding

One of the most probable causes of road traffic crash is speeding as drivers who drives beyond the prescribed speed limit for a road are prone to be involved in fatal crashes that will lead to more deaths and serious injuries. According to the Federal Road Safety Corps (FRSC) Second quarter 2020 report released on the number of road traffic crashes that occurred in Nigeria between this period, Speed violation accounted for 47% of the causes of the total road crashes reported. Letty et al (2006) in a review of driving speed and the risk of road crashes discovered that larger differences in speed between vehicles are related to a higher crash rate.

Atubi(2010) discovered that more than 90% of road traffic accident in Lagos State could be attributed to recklessness on the part of drivers and over speeding in his study to examine road traffic accident variations in Lagos Nigeria, using secondary accident data records from Nigeria Police Force and FRSC.

b. Overconfidence

The feeling of having mastered the skills of driving and also overrating their ability to maneuver a particular road by some drivers, while undermining the dangers and risks associated with the road.

c. Drivers Fatigue

Ogunleye and Essifil(2016) discovered that drivers and road users depicted that fatigue actually had significant effects on driving and it is a silent and predicator of road accidents in the Cape Coast metropolis.

Drivers fatigue can be caused by the following: lack of sleep or poor sleep, time-on-task, monotonous tasks, intake of medications prior to driving etc Cummings et al (2002) however discovered that crash risk was fourteen times higher for drivers who had reported to have almost fallen asleep behind the wheel.

Hence driving while fatigued increases a driver's risk of involvement in a crash or almost been involved in a crash.

d. Lack of Concentration

This constitutes one of the probable causes of road traffic crashes on part of drivers and is usually as a result of the unsafe practices exhibited by drivers while driving especially use of phones while driving. According to an FRSC publication (2012), more than 15 persons on daily basis are subject to fatality resulting from road traffic crash due to distraction

emanating from either speaking or texting on the phone while driving. Other sources of lack of concentration are tunings of vehicle radio cassettes, discussion with other passengers' and eating while driving.

e. Driving under the influence of Alcohol and Drugs

The statististics of crashes due to drink driving in Nigeria is alarming, as alcohol impairs one's cognitive ability to manage situation and be alert to work.

Chidi and Ema, (2012) in their study to assess the magnitude of drink driving situation in Nigeria, observed that 67.2 percent of drivers admitted to drinking alcohol during the working day. FRSC in a bid to mitigate this trend, started to checkmate drivers' adherence to the prescribed legal limit of 0.05g/100Ml blood alcohol concentration in Nigeria**.** Consumption of some medically prescribed medications as well as intake of illegal stimulating drugs (herbs or otherwise) prior to driving can hamper one's ability to drive safely.

f. Dangerous Overtaking

This is still among the major causes of road traffic crash in Nigeria and according to FRSC dangerous overtaking accounts for 45% of all road crashes in Nigeria.

g. Poor Vehicle Maintenance

Failure to maintain and ensure that vehicles are in good condition by most drivers has resulted to crashes that lead to high fatality and injury rate.

2.5.2 Environmental Causes

These are those features of the roads and its surrounding networks that contribute to road traffic crashes on the roads. These include:

a. Harmattan haze: which leads to poor visibility while driving
b. Heavy rain which can also obscure a driver's visibility and might lead to aquaplaning in some cases.
c. High winds all as a result of changes in weather resulting in a reduction in visibility
d. Broken down vehicles, fallen trees constituting obstructions on the highways
e. Improperly-placed or absence of road signs
f. Potholes on our roads
g. Bad roads (Narrow, rough, dusty and winding roads)
h. Hot sun on roads in desert/savannah area

i. Absence of road markings
j. Collapsed bridges
k. Narrow bridges
l. Slippery surface; (oil spill on the road)
m. River overflow
n. Narrow bridges

2.5.3 Mechanical Causes

Vehicle features contribute immensely to the degree of road traffic crash experienced in Nigerian roads. Especially in Nigeria and other African countries where the realities of the economy have forced many people to resort to the use of second hand vehicles or less reliable vehicles.

The following are the mechanical factor that can lead to road traffic crash if not properly maintained or taken care of in Vehicle. They are as follows:

a. Engine Failure/Malfunction
b. Faulty Steering and Suspension:
c. Burst Tyres: due to worn out, under or over-inflated tyre
d. Smooth tyres: due to worn out thread beyond the approved thread limit indicator
e. Brake failure: mainly as a result of worn-out brake pads and discs, leaking brake and faulty ABS(Antilock Brake System)
f. Failed wipers during the rainy season
g. Spilled oil leading to crashes
h. Exhaust fumes or smokes leading to temporary road blindness
i. Faulty security gadgets
j. Defective lighting system
k. Defective horn
l. Faulty wheel balancing and alignment
m. Absence of rear mirror
n. Leaking fuel that may result to fire outbreak
o. Lack of reflective triangle

It was discovered that there were significant differences among the various causes of accidents and accident cases (Minor, fatal and serious) with respect to types of vehicles involved over the years, with reckless driving, inexperience and mechanical fault and road defects accounted for

30.3%, 21.5% and 21.1%, respectively Out of 5921 accident cases in a study to Analyze Road Traffic Accidents in Nigeria: A Case Study of Obinze/Nekede/Iheagwa Road in Imo State (Ohakwe J, Iwueze I.S and Chikezie D.C, 2011).

2.6 **Road Traffic Crash a Public Health Issue**

Road traffic crash is a public health issue as it constitutes the leading cause of death. Nangana et al (2016) said that road traffic accident (RTA)-related trauma remains a public health issue.

Road traffic accidents are one of the leading epidemiological problems in developed countries as well as in developing countries (Durić and Miladinov-Mikov, 2009). Durić et al. (2009) in their study of the epidemiological characteristics of road traffic injuries in AP Vojvodina, discovered that AP Vojvodina had the highest mortality rate of road traffic injuries per ten thousand vehicles in Europe. As compared to Nigeria were in a study to ascertain the epidemiologies of injuries seen in a Nigeria tertiary hospital revealed that the injury severity score (ISS) of the patients ranged from 1 to 50 with a mean score of 8.9 ± 3.5. Road Traffic Accidents (RTAs) were responsible for 90.8% of patients with Injury Severity Score (ISS) >15.C Onyemaechi, Nwankwo and Ezeadawi (2018). C Onyemaechi et al. (2018) observed that these findings suggest that Road Traffic Accident (RTA) was the leading cause of injury, with traumatic brain injury as the most common cause of injury-related death.

In a study by Ramadani et al. (2017) to determine the characteristics of the socio-medical profile of road traffic accidents in Kosovo, between 2010 and 2015, showed there was a slight decrease in the mortality rate of 0.1% and lethality rate of 0.1% each year, whereas there is an increase of 21.5% for traumatism rate for each year. This portrays the degree of road traffic crash victims been hospitalized on yearly basis in trauma departments.

However, little progress has been made towards addressing the epidemiology of injuries from a road traffic crash in Nigeria, which constitutes a major public health concern to the world.

Road traffic crash should be seen as a matter of urgent national importance and policymakers at the various levels of government need to recognize this growing problem as a public health crisis and design appropriate policy responses that will back up with meticulous implementation. (Onyemaechi and Ofoma 2016).

2.7 Regression Analysis

Regression analysis is an important statistical procedure for the analysis of public health, epidemiological and medical data. It helps to identify and stipulate the type of relationships that exist among multiple factors or variables. In any medical or epidemiological, one of the main purpose of evaluating its data statistically is often to describe relationships between two variables or among several variables. Regression analysis is a type of statistical evaluation that enables three things: Description, Estimation, Prognostication Schneider,etal(2010). Description shows that relationships among the dependent variables and the independent variables can be statistically described by means of regression analysis(Schneider,etal(2010). On the other hand, estimation deals with the values of the dependent variables can be estimated from the observed values of the independent variables Schneider,etal(2010. While, in prognostication, risk factors that influence the outcome can be identified, and individual prognoses can be determined (Schneider, et al. (2010).

Regression model is generally represented is as below:

Y=d+eX1+cX2+…+error

In the above equation α is a constant, while the predictor variables are X1, X2. The difference between the observed and predicted value of γ is called the error term.

2.7.1 Why regression analysis

Regression analysis which aims at studying the relationships between two or more variables and is usually carried for the following purpose:

a. To know if there is any relationship between two or more variables
b. In order to understand in this relationship between these two or more variables, what is the nature of such relationship?
c. It is vital in predicting a given variable when other values are given.
d. It is used to forecast trend, time series and predictor strength in case of cause and effect relationship.

Regression methods can be applied in all epidemiologic study designs so that they represent a universal tool for data analysis in epidemiology Bendel (2009). Research related to cardiorespiratory fitness often uses regression analysis in order to predict cardiorespiratory status or future outcomes Palmer, P. B., & O'Connell(2009).According to Pedhazur,15 regression

analysis has 2 uses in scientific literature: prediction, including classification, and explanation Palmer et al. (2009).

2.7.2 Types of regression models

There are different types of regression model analysis, but the most common types are Linear, Logistic, Poisson and Cox regression etc. It is pertinent to note the type of target variable, shape of the regression line, and the number of independent variables**,** helps to determine the type of regression technique or model to use. For the purpose of this literature, the explanation will be limited to three only, as below:

a. **Linear Regression**: It is used to describe a linear relationship, especially in case of big data set. The predicted variable or dependent is usually continuous examples are blood pressure, weight etc. The predictor is Continuous or categorical
b. **Logistic regression :** It is used when modeling of counting process
c. **Cox Regression (Proportional hazard regression (Cox regression):** Used more in epidemiological data in modeling of survival data. The dependent variables are Survival time (time from diagnosis to event).

2.8 Univariate Analysis

It is a descriptive analysis that aims how cases are distributed, it usually involves a single variable. It can be descriptive or inferential. In descriptive, the measures of central tendency (mean, median and mode), measures of dispersion (range, standard deviation, coefficient of variance and variance) are looked into. While in inferential Univariate analysis e.g. Cross tab and Chi-square. Dr. Soumya (2014).

Cross tabs help us in showing the relationship between two variables (dependent and independent) using descriptive measures. In interpreting the cross tab, it is vital to use the column percentages to do so.

Chi-square helps to examine the relationships and strengths between two or more variables in a given study. It is an extension of crosstabs because it gives more detailed information to buttress the relationship that exists between two variables, without showing the direction in which the relationship exists.

2.8.1 How to know when a chi-square is significant

a. When using hand calculation, chi-square will be significant, if only is the same size as seen in the table is larger than the value shown in the chi-square table.
b. While, if is with SPSS, chi-square will be significant, when the p or significance value is the same size or smaller than your confidence interval level for your study.

2.9 Multivariate Analysis (Multiple Regressions)

It is a type of statistical procedure or technique in which different variables (more than two variables) can be analyzed at once.

It involves two major techniques namely:

a. Dependency

b. Interdependency

Multiple regression falls under the Multivariate Dependency technique, it used in predicting the rate at which the dependent variable will change when the independent variables change too. It helps to explain one phenomenon by using multiple independent variables in running the model.

2.9.1 Multivariate analysis advantages

a. It gives a better understanding of a data set
b. It helps to identify the underlying principal elements of a data distribution
c. It helps in the easy summary of a dataset
d. It reduces the chance of obtaining fake results from a data analysis

Common components of regression results analysis using any statistical program, normally used in the interpretation of regression analysis. They include the odds ratio (OR), confidence interval (CI), R-Square regression coefficient (B), p-value and standard error of coefficient.

2.9.2 Odds Ratio

Odds ratio (OR) can be defined as a measure of the association between an exposure and an outcome Szumilas M. (2010). The odds ratio represents that constant effect an outcome will have, when there is the presence of exposure, compared to the likelihood that the outcome will not occur when there is no exposure. Though used mainly in case-control studies, if modified, it can be used in both cohort study and crossectional study

2.9.3 How to use odds ratio in regression?

In logistic regression, the exponential function of the regression coefficients depicts the odds ratio associated with an increase of one unit in any exposure. Odds ratios are used when comparing the relative odds of the likelihood of an outcome of interest occurring, for instance, disease or disorder, provided there is the presence of exposure to the variable of interest, for instance, health characteristic, aspect of medical history. The odds ratio is often used to ascertain whether a particular exposure is a risk factor for a particular outcome, also to compare the magnitude of various risk factors for that outcome (Szumilas. M (2010).

2.9.4 How to interpret Odds ratio

Odds ratio can be interpreted as below:

a. If the odds ratio (OR) is equal to one, it implies that the risk of exposure does not in any way affect odds of outcome
b. If the odds ratio (OR) is greater than one, it implies that the risk of exposure is associated with higher odds of outcome
c. If the odds ratio (OR) is less than one, it implies that the risk of exposure is associated with lower odds of outcome

2.9.5 Confidence Interval

The confidence interval for odds ratio been used in regression analysis estimates the accuracy of the odds ratio. Thus if the confidence interval is low, it indicates that odds ratio level of accuracy is high, while if the confidence interval is high, it indicates that odds ratio level of accuracy is low. Confidence interval also denotes the presence of statistical significance or not. If the confidence interval covers one (1), it depicts non-significant p-value, while if it does not cover one (1), it is not significant.

Confidence interval and p-value must be considered in showing if the association between an outcome given the presence of exposure is statistically significant, irrespective of whether there is a presence of a positive odds ratio. Kutcher & Szumilas, (2009).

2.9.6 R SQUARE (R^2)

R^2 (R SQUARE): It is the measurement of how best a model data with respect to fitted regression line (actual data value). It helps to measure how well the model replicates observed values, depending on the total number of outcomes variations provided by the model.

Its main purpose is for the prediction of future outcomes or the testing of hypotheses especially in any context of statistical models.

Information about the goodness of fit of a model can be given by R square. In any regression analysis, the R^2 coefficient of determination is a statistical measure of how well the regression predictions approximate the real data points.

It is pertinent to note that when the R^2 value is one(1), it means that the regression predictions perfectly fits the data in question, while when the R^2 value is between zero(0) to one(1), occurs normally when the model fitting is worse than what is obtainable in a horizontal hyperplane that is normal.

To show the goodness of fit of dataset, the normal residual can be used to indicate that, which is normally calculated as the square root of residuals.

Interpretation of R^2 based on values gotten from the above calculation:

a. If the actual (observed) values and estimated (fitted or predicted) values are close together, R^2 is likely closer to 1(100%), it implies that a strong relationship exists between the dependent and independent variables. Thus the model fit is good. This also implies, that the relationship between y (dependent) variable and X (independent v) accounts for 96% of the variation or said yet in another way, that X (independent v) is a good predictor of y (dependent variable) because when the X (independent v) go up so does the y (dependent variable) and vice versa.
b. If the actual values and estimated values are together on the fitted regression line, R^2 is equal to 1(100%), It implies that a very strong relationship between the dependent and independent variables. Thus the model fit is very good.

   In other words, the relationship between y (dependent) variable and X (independent v) accounts for 96% of the variation or said yet in another way, X (independent v) is a good predictor of y (dependent variable) because when the X (independent v) go up so does the y (dependent variable) and vice versa.
c. If there is a large distance between the actual values and estimated values, R^2 score decreases from 1(100%) towards zero, in this case relationship between the dependent and independent variables decreases. Thus the model fit will gradually decrease.

d. If the distance between the actual values and estimated values is very wide, R^2 score approaches zero (0), in this case there is no relationship between the dependent and independent variable. Thus the model fit will not be better.

It is very important to note that if the differences between the observed values and the model's predicted values are small, the model fits the data well.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This highlights the various processes and techniques employed in this research work, it includes the following: the research design, sampling technique, method of data collection, ethical consideration, limitations of data collection and data analysis technique. This methodology goes a long way to address the study's aim, which ascertains the relationship between fatality and injury rate and the probable causes of a road traffic crash involving the different Vehicle categories. Ethics approval from Near University Health Sciences ethical committee and official application for approval to access and use Federal Road Safety Commission, Nigeria Road Traffic Crash Raw (primary) data from 2013 to 2019 were sought and was approved.

3.2 Research Design

This study is a secondary research

3.3 Sample Technique

Random sampling of the total number of road traffic crashes collected from the field within the years under review was done. The sampling was conscious of the variables necessary for this research, with following variables selected: category of vehicle, number injured (adult and child), number killed (adult and child), and categories of probable causes of road traffic crash

3.4 Method of Data Collection

The dataset used for this research was extracted from the primary (raw) data of reported crashes from Federal Road Safety Corps, in Nigeria from 2013 to 2019. Of the total road traffic crashes data collected for the year 2013 to 2019, a sample from all the years were used to constitute the dataset used for this research.

Data cleaning, redefining, recoding into the different variable was done using SPSS IBM, with any data set with no information about the following variables or inconsistencies: category of vehicle, number injured (adult and child), number killed (adult and child) and the total number of people involved in the crash (adult and child) were excluded from the study. Also, data sets involving a motorcycle, tricycle etc and data set without any information on the vehicle category (whether is a commercial or private vehicle or not well categorized) were excluded from the study.

At the end a total of 5104 road traffic crashes of data were utilized for the research analysis. To enhance easy application of different types of statistical analysis to this data set, the independent and dependent variables were further coded into yes or no based on different categorizations as below:

a. The Vehicle category was categorized into private only, commercial only and commercial and private vehicle
b. The probable causes of road traffic crash were further categorized into human, mechanical, environmental, human/mechanical, human/environmental and other causes.
c. The number injured and number killed further classified into yes or no for each of the different variables under name.

3.5 Data Analysis Technique

The following statistical techniques were used in analyzing the selected and collected data:

The chi-square tests

The chi-square tests were used for statistical analysis since the sample size is large and this will test for relationship or association between the vehicle category, probable causes of Road traffic crash and the number of people killed or injured.

Mann-Whitney U test which is a nonparametric test was used to compare the relationship between the continuous quantitative dependent samples of either injured or not injured with respect to the involvement of the different vehicle and probable cause categories, which are independent samples.

The multivariate logistic regression (binomial or multinomial)

Multivariate logistic regression (binomial or multinomial), was also used to predict any relationship between the nominal dependent quantitative variables (number of people killed and number injured) with respect to the probable cause of Road traffic crash and Vehicle Category (Independent categorical nominal variable).

3.6 Limitations of data collection

The following were the challenges encountered in the course of collecting and analyzing the data for this study:

a. Delay in collecting data: As the process of accessing this data requires administrative scrutiny approvals from the appropriate authority in Nigeria, before is released to the researcher.
b. Underreporting of Road traffic crash data in Nigeria: As not all reported road traffic crash are properly recorded due to inadequate surveillance system and manpower in capturing road traffic crash reports in Nigeria.
c. Age of drivers, age of adult and female genders was not captured, which would have provided enough insight in establishing the association of the variables used in this study.
d. Incomplete variables in the dataset due to lack of systematic data synchronization both at the state and national level in Nigeria, leading to its exclusion during the data cleaning process.

CHAPTER 4

RESULTS

This Chapter shows in detail the results gotten from the analysis on the data of the road traffic crash number killed (fatality) and injured in relation to the probable causes and the vehicle category involved in the crash. The data for this analysis was extracted from the data of reported crashes from the Federal Road Safety Corps, Nigeria for the year 2013 to 2019. It was aimed to indicate if there is any relationship between the number of people killed (fatality), the number of people injured in a crash and the likely cause of such road traffic crash involving either a privately, commercially and both commercial and private vehicles in Nigeria.
The probable causes were categorized into human, mechanical, environmental, human & mechanical, human/environmental and other causes. While the vehicle category were private, commercial and commercial & private vehicles respectively.

Out of the total 5104 number of road traffic crashes sampled and selected for this study, the tables (1, 2, 3), below shows the descriptive statistics of the number of injured and number killed with respect to gender and age, the probable causes of crash categories, vehicles involved categories.

Table 4. 1 Descriptive Statistics for the variables

Categories			Frequency	Percentages
Vehicle Categories	Private vehicle			
		Yes	1002	19.6
		No	4102	80.4
	Commercial vehicle			
		Yes	3125	61.2
		No	1979	38.8
	Commercial and Private Vehicle			
		Yes	978	19.2
		No	4126	80.8
Probable Causes	Human Causes			
		Yes	4065	79.6
		No	1039	20.4
	Mechanical Causes			
		Yes	4065	11.3
		No	1039	88.7
	Environmental Causes			
		Yes	38	.7
		No	5066	99.3
	Human and Mechanical Causes			
		Yes	227	4.4
		No	4877	95.6
	Human and Environmental Causes			
		Yes	57	1.1
		No	5047	98.9
	Other Causes			
		Yes	144	2.8
		No	4960	97.2

Table 4.1, shows the descriptive statistics of the independent variables (The vehicle categories and the probable causes categories) in a total of 5047 crashes. The table shows that 79.6% and 11.3% of human and mechanical causes constitute the major causes of road traffic crash in Nigeria with 61.2% of commercial vehicles been the most involved vehicle category in a crash.

Table 4. 2 Descriptive Statistics of Injuries in Road Traffic Crashes

	N (Number of Cases)	Mean	Median	Standard Deviation	Minimum	Maximum
Adult Male	5104	2.53	2.00	3.38	0	48
Adult Female	5104	.73	.00	1.62	0	18
Child Male	5104	.11	.00	.54	0	15
Child female	5104	.10	.00	.66	0	20
Total	5104	3.45	2.00	4.27	0	53

Table 4.2 shows the descriptive statistics in road traffic crash for those injured in different categories. The median and mean for the category that was injured most (adult male) were 2.00 and 2.53 respectively. While the child female was the least injured among the categories with mean and median of .010 and 0.00 respectively.

Table 4. 3 Descriptive Statistics of the Killed in Road Traffic Crashes

	N (Number of Cases)	Mean	Median	Standard Deviation	Minimum	Maximum
Adult Male	5104	.40	.00	.10	0	19
Adult Female	5104	.09	.00	.40	0	6
Child Male	5104	.02	.00	.17	0	5
Child female	5104	.02	.00	.28	0	9
Total	5104	.56	.00	1.40	0	31

Table 3 indicates the descriptive statistics for the different categories of individuals killed in a crash. The median and mean for the most affected category (adult male) were 0.00 and 0.40 respectively. Both Male and female child were the least affected with means and medians of 0.02 and 0.00 respectively

Table 4. 4 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the Involvement of Privately Owned Vehicles

		PRIVATE VEHICLES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	761 (18.9%)	3276 (81.1%)	7.47	**.006**
	No	241 (22.6%)	826 (77.4%)		
Adult Female	Yes	265 (17.4%)	1260 (82.6%)	7.01	**.008**
	No	737 (20.6%)	2842 (79.9%)		
Child Male	Yes	60 (18.2%)	269 (81.8%)	.43	.510
	No	942 (19.7%)	3833 (80.3%)		
Child Female	Yes	54 (19.6%)	221 (80.4%)	.00	.998
	No	948 (19.6%)	3881 (80.4%)		
Total	Yes	827 (19.3%)	3462 (80.7%)	2.08	.149
	No	175 (21.5%)	640 (78.5%)		

$\chi 2$= Pearson chi-square value

Table 4.4 shows the percentage of adult male and female injured when a private vehicle is involved in a road traffic crash is 18.9% and 17.4% respectively, when compared with the number of adult male and female not injured when a private vehicle is involved(81.1% and

82.6%). The decrease in the number injured in both adult male and female were significant (p<.05)

Table 4. 5 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the involvement of Commercially Owned Vehicles

		COMMERCIAL VEHICLES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	2504 (62.0%)	1533 (38.0%)	5.20	**.023**
	No	621 (58.2%)	446 (41.8%)		
Adult Female	Yes	952 (62.4%)	573 (37.6%)	1.32	.251
	No	2173 (60.7%)	1406 (39.3%)		
Child Male	Yes	226 (68.7%)	103 (31.3%)	8.29	**.004**
	No	2899 (60.7%)	1876 (39.3%)		
Child Female	Yes	180 (65.5%)	95 (34.5%)	2.19	.139
	No	2945 (61.0%)	1884 (39.0%)		
Total	Yes	2636 (61.5%)	1653 (38.5%)	.62	.430
	No	489 (60.0%)	326 (40.0%)		

$\chi 2$ =Pearson chi-square value, the bold p-value =statistically significant

Table 4.5 shows that when a commercial vehicle is involved, that more child male and females are injured with percentage of adult male and child male injured is 62.0% and 68.7% respectively, when compared with 38.0% and 31.3% of both gender not injured when a commercial vehicle is involved. This increase in the adult and child male were significant (p<.05).

Table 4. 6 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the involvement of Commercially and Private Owned Vehicles

		COMMERCIAL AND PRIVATE VEHICLES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	773 (19.1%)	3264 (80.9%)	<.01	.962
	No	205 (19.2%)	862 (80.8%)		
Adult Female	Yes	310 (20.3%)	1215 (79.7%)	1.91	.167
	No	668 (18.7%)	2911 (81.3%)		
Child Male	Yes	43 (13.1%)	286 (86.9%)	8.42	**.004**
	No	935 (19.6%)	3840 (80.4%)		
Child Female	Yes	41 (14.9%)	234 (85.1%)	3.39	.065
	No	937 (19.4%)	3892 (80.6%)		
Total	Yes	2636 (61.5%)	1653 (38.5%)	.62	.430
	No	489 (60.0%)	326 (40.0%)		

$\chi 2$=Pearson chi-square value

Table 4.6 shows that there is a significant decrease in child male (13.1%, p<.05) when a commercial and private vehicle are involved in a crash, than when a commercial and private vehicle are not involved (86.9%).

Table 4. 7 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to the involvement of Private Owned Vehicles

		PRIVATE VEHICLES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	164 (13.2%)	1083 (86.8%)	43.91	**<.001**
	No	838 (21.7%)	3019 (78.3%)		
Adult Female	Yes	57 (16.3%)	293 (83.7%)	2.67	.102
	No	945 (19.6%)	3809 (80.1%)		
Child Male	Yes	20 (23.5%)	65 (76.5%)	.83	.362
	No	982 (19.6%)	4037 (80.4%)		
Child Female	Yes	17 (17.7%)	79 (82.3%)	.23	.632
	No	985 (19.7%)	4023 (80.3%)		
Total	Yes	217 (14.5%)	1278 (85.5%)	35.08	**<.001**
	No	785 (21.8%)	2824 (78.2%)		

$\chi 2$ =Pearson chi-square value

Table 4.7 shows that there is a significant decrease in adult male and total number killed (13.2%, <.001 and 14.5%, <.001 respectively), when a private vehicle is involved in a crash, than when a private vehicle is not involved (86.8% and 85.5%).

Table 4. 8 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to the involvement of Commercially Owned Vehicles

		COMMERCIAL VEHICLES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	856 (68.6%)	391 (31.4%)	38.25	**<.001**
	No	2269 (58.8%)	446 (41.8%)		
Adult Female	Yes	233 (66.6%)	117 (33.4%)	4.52	**.033**
	No	2892 (60.8%)	1862 (39.2%)		
Child Male	Yes	47 (55.3%)	38 (44.7%)	1.28	.258
	No	3078 (61.3%)	1941 (38.7%)		
Child Female	Yes	71 (74.0%)	25 (26.0%)	6.68	**.010**
	No	3054 (61.0%)	1954 (39.0%)		
Total	Yes	1015 (67.9%)	480 (32.1%)	39.58	**<.001**
	No	2110 (58.5%)	1499 (41.5%)		

$\chi 2$ =Pearson chi-square value

Table 4.8 shows that there is a significant increase in adult male (68.6%, p<.001), adult female (66.6%, p<.05) and total number killed (67.9%, p<.00), when a private vehicle is involved in a crash, than when a private vehicle is not involved (31.4%, 33.4%and 32.1%).

Table 4. 9 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to the involvement of commercially and Private Owned Vehicles

		COMMERCIAL AND PRIVATE VEHICLES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	226 (18.1%)	1021 (81.9%)	1.14	.284
	No	752 (19.5%)	3105 (80.5%)		
Adult Female	Yes	59 (16.9%)	291 (83.1%)	1.28	.256
	No	919 (19.3%)	3835 (80.7%)		
Child Male	Yes	18 (21.2%)	67 (78.7%)	.23	.634
	No	960 (19.1%)	4059 (80.9%)		
Child Female	Yes	8 (8.3%)	88 (91.7%)	7.40	**.007**
	No	970 (19.4%)	4038 (80.6%)		
Total	Yes	262 (17.5%)	1233 (82.5)	3.65	.056
	No	716 (19.8%)	2893 (80.2%)		

$\chi 2$ =Pearson chi-square value

Table 4.9 shows that there is a significant decrease in child female killed (8.3%, $p<.05$) when a commercial and private vehicle is involved in a crash, than when is not involved (91.7%).

Table 4. 10 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the Human Causes

		HUMAN CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	3251 (80.5%)	786 (19.5%)	9.36	**.002**
	No	814 (76.3%)	253 (23.7%)		
Adult Female	Yes	1170 (76.7%)	355 (23.3%)	11.45	**.001**
	No	2895 (80.9%)	684 (19.1%)		
Child Male	Yes	244 (74.2%)	85 (25.8%)	6.51	**.011**
	No	3821 (80.0%)	954 (20.0%)		
Child Female	Yes	196 71.3%)	79 (28.7%)	12.56	**<.001**
	No	3869 (80.1%)	960 (19.9%)		
Total	Yes	3443 (80.3%)	846 (19.7%)	6.61	**.010**
	No	622 (76.3%)	193 (23.7%)		

$\chi 2$=Pearson chi-square value

Table 4.10 shows that there is a significant increase in all the gender and age category (80.5% ,76.7%, 74.2%, 71.3%,80.3%). when the cause of a crash is human, than when is not (19.5% ,23.3%, 25.8%, 28.7%, 19.7%).

Table 4. 11 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the Mechanical Causes

		MECHANICAL CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	430 (10.7%)	3607 (89.3%)	7.28	**.007**
	No	145 (13.6%)	922 (86.4%)		
Adult Female	Yes	190 (12,5%)	1335 (87.5%)	3.09	.078
	No	385 (10.8%)	3194 (89.2%)		
Child Male	Yes	45 (13.7%)	284 (86.3%)	2.04	.153
	No	530 (11.1%)	4245 (88.9%)		
Child Female	Yes	44 (16.0%)	231 (84.0%)	6.51	**.011**
	No	531 (11.0%)	4298 (89.9%)		
Total	Yes	461 (10.7%)	3828 (89.3%)	7.18	**.007**
	No	114 (14.0%)	701 (86.0%)		

$\chi 2$=Pearson chi-square value

Table 4.11 shows that there is a significant decrease in adult male (10.7%, $p<.05$) , child female (16.0%,$p<.05$) and total number injured (10.7%, $p<.05$), when the cause of a crash is mechanical, than when is not (89.3% ,84.0%and 89.3%).

Table 4. 12 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the Environmental Causes

		ENVIRONMENTAL CAUSES			
		Yes	No	$\chi 2$	**p-value**
	Yes	22 (.5%)	4015 (99.5%)		
Adult Male				10.40	**.001**
	No	16 (1.5%)	1051 (98.5%)		
	Yes	14 (.9%)	1511 (99.1%)		
Adult Female					.347
	No	38 (.7%)	3555 (99.3%)	.88	
	Yes	3 (.9%)	326 (99.1%)		
Child Male				1.33	.715
	No	35 (.7%)	4740 (99.3%)		
	Yes	2 (.7%)	273 (99.3%)		
Child Female				<.01	.973
	No	36 (.7%)	4793 (99.3%)		
	Yes	27 (.6%)	4262 (99.4%)		
Total				4.80	**.028**
	No	11 (1.3%)	804 (98.7%)		

$\chi 2$ =Pearson chi-square value

Table 4.12 shows that there is a significant decrease in Adult male (.5%, p<.001) and total injured (.6%, p<.05), when the cause of a crash is environmental than when is not (99.5% and 99.4%)

Table 4. 13 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the Human and Mechanical Causes

		HUMAN AND MECHANICAL CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	191 (4.7%)	3846 (95.3%)		
	No	36 (3.4%)	1031 (96.6%)	3.65	.056
Adult Female	Yes	105 (6.9%)	1420 (93.1%)		
	No	122 (3.4%)	3457 (96.6%)	30.41	**<.001**
Child Male	Yes	26 (7.9%)	303 (92.1%)		
	No	201 (4.2%)	4574 (95.8%)	9.87	**.002**
Child Female	Yes	29 (10.5%)	246 (89.5%)		
	No	198 (4.1%)	4631 (95.9%)	25.43	**<.001**
Total	Yes	204 (4.8%)	4085 (95.2%)		
	No	23 (2.8%)	792 (97.2%)	6.02	**.014**

$\chi 2$ =Pearson chi-square value

Table 4.13 shows that there is a significant decrease in adult female (6.9%, p<.001) , child male (7.9%,p<.05), child female (10.5%, p<.001) and total injured (4.8%, p<.05), when the cause of a crash is both human and mechanical than when is not (93.1% , 92.1%, 89.5% and 95.2%)

Table 4. 14 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the Human and Environmental Causes

		HUMAN AND ENVIRONMENTAL CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	50 (1.2%)	3987 (98.8%)	2.59	.107
	No	7 (.7%)	1060 (99.3%)		
Adult Female	Yes	25 (1.6%)	1500 (98.4%)	5.37	**.020**
	No	32 (.9%)	3457 (99.1%)		
Child Male	Yes	6 (1.8%)	323 (98.2%)	1.59	.207
	No	51 (1.1%)	4724 (98.9%)		
Child Female	Yes	2 (.7%)	273 (99.3%)	.39	.527
	No	55 (1.1%)	4774 (98.9%)		
Total	Yes	53 (1.2%)	4236 (98.8%)	3.44	.064
	No	4 (.5%)	811 (99.5%)		

$\chi 2$ =Pearson chi-square value

Table 4.14 shows that there is a significant decrease in Adult female injured (1.6%, $p<.05$), when the cause of a crash is human and environmental than when is not (98.4%)

Table 4. 15 Comparison of Occurrence of Injuries in Gender and Age Subgroups with respect to the Other Causes

		OTHER CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	93 (2.3%)	3944 (97.7%)	18.87	**<.001**
	No	51 (4.8%)	1016 (95.2%)		
Adult Female	Yes	16 (1.0%)	1509 (99.0%)	24.91	**<.001**
	No	128 (3.6%)	3451 (96.4%)		
Child Male	Yes	8 (2.4%)	321 (97.6%)	.19	.659
	No	136 (2.8%)	4639 (97.2%)		
Child Female	Yes	0 (0%)	275 (100%)	8.43	**.004**
	No	144 (3.0%)	4685 (97.0%)		
Total	Yes	104 (2.4%)	4185 (97.6%)	15.40	**<.001**
	No	40 (4.9%)	775 (97.2%)		

$\chi 2$ =Pearson chi-square value

Table 4.15 shows that there is a significant decrease in adult male (2.3%, p<.001), adult female (1.0%,p<.001), child female (0%, p<.05) and total injured (2.4%, p<.05), when the cause of a crash is other causes than when is not (97.7%, 99.0%, 100% and 97.6%).

Table 4. 16 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to Human Causes

		HUMAN CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	991 (79.6%)	256 (20.4%)	.03	.862
	No	3074 (79.7%)	783 (20.3%)		
Adult Female	Yes	271 (77.4%)	79 (22.6%)	1.13	.286
	No	3794 (79.8%)	960 (20.2%)		
Child Male	Yes	65 (76.5%)	20 (23.5%)	.54	.464
	No	4000 (79.7%)	1019 (20.3%)		
Child Female	Yes	75 (78.1%)	21 (21.9%)	.14	.709
	No	3990 (79.7%)	1018 (20.3%)		
Total	Yes	1178 (78.8%)	317 (21.2%)	.94	.333
	No	2887 (80.0%)	722 (20.0%)		

$\chi 2$=Pearson chi-square value

Table 4.16 shows that there is a non significant increase(79.6%,77.4%,76.5%,78.1% , 78.8% and p>0.5) in all the gender and age subgroups when the cause of a crash is human, than when is not (20.4%,22.6%,23.5%,21.9% , 21.2% and p>.05).

Table 4. 17 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to Mechanical Causes

		MECHANICAL CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	121 (9.7%)	1126 (90.3%)	4.03	**.045**
	No	454 (11.8%)	3403 (88.2%)		
Adult Female	Yes	41 (11.7%)	309 (88.3%)	.07	.783
	No	534 (11.2%)	4220 (88.7%)		
Child Male	Yes	563 (11.2%)	73 (85.9%)	.70	.402
	No	575 (11.3%)	4456 (88.8%)		
Child Female	Yes	75 (8.3%)	88 (91.7%)	.84	.359
	No	567 (11.3%)	4441 (88.7%)		
Total	Yes	155 (78.8%)	1340 (89.6%)	1.70	.192
	No	420 (11.6%)	3189 (88.4%)		

$\chi 2$ =Pearson chi-square value

Table 4.17 shows that there is a significant decrease in adult male (9.7%, $p<.05$), when the cause of a crash is mechanical, than when is not (89.4%).

Table 4. 18 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to Environmental Causes

		ENVIRONMENTAL CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	6 (.5%)	1241 (99.5%)	1.54	.213
	No	32 (.8%)	3825 (99.2%)		
Adult Female	Yes	1 (.3%)	349 (99.7%)	1.07	.301
	No	37 (.8%)	4717 (99.2%)		
Child Male	Yes	0 (.0%)	85 (100%)	.64	.421
	No	38 (.8%)	4981 (99.2%)		
Child Female	Yes	0 (.0%)	96 (100.0%)	.73	.392
	No	3 (.8%)	4970 (99.2%)		
Total	Yes	6 (.4%)	1489 (99.6%)	3.37	.066
	No	38 (.7%)	3577 (99.1%)		

$\chi 2$ =Pearson chi-square value

Table 4.18 shows that there is a non significant decrease (.5%, .3%, .0%, .0%, 4% and p>0.5) in all the gender and age subgroups when the cause of a crash is environmental, than when is not (99.5%, 99.7%, 100%.100%, 99.6% and p>.05).

Table 4. 19 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to Human and Mechanical Causes

		HUMAN AND MECHANICAL CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	56 (4.5%)	1191(95.5%)		
	No	171 (4.4%)	3686 (95.6%)	.01	.932
Adult Female	Yes	23 (6.6%)	327(93.4%)		
	No	204 (4.3%)	4550 (95.7%)	3.98	**.046**
Child Male	Yes	7 (8.2%)	78 (91.8%)		
	No	220 4.4%)	4799 (95.6%)	2.91	.088
Child Female	Yes	9 (9.4%)	87 (90.6%)		
	No	227 (4.4%)	4970 (95.6%)	.5.59	**.018**
Total	Yes	73 (4.9%)	1422 (95.1%)		
	No	154 (4.3%)	4877 (95.6%)	.94	.331

$\chi 2$ =Pearson chi-square value

Table 4.19 shows that there is a significant decrease in adult female (6.6%, $p<.05$) and child female (9.4%, $p<.05$), when the cause of a crash is human and mechanical, than when is not (93.4%, 90.6%).

Table 4. 20 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to Human/Environmental Causes

		HUMAN AND ENVIRONMENTAL CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	14 (1.1%)	1233(98.9%)	.00	.982
	No	43(1.1%)	3814(98.9%)		
Adult Female	Yes	1(.3%)	349(99.7%)	2.35	.125
	No	56(1.2%)	4698(98.8%)		
Child Male	Yes	0(.0%)	85(100.0%)	.97	.323
	No	57(1.1%)	4962(98.9%)		
Child Female	Yes	1 (1.0%)	95(99.0%)	.01	.944
	No	56(1.1%)	4952(98.9%)		
Total	Yes	15(1.0%)	1480(99.0%)	.24	.620
	No	42(1.2%)	3567(98.8%)		

$\chi 2$ =Pearson chi-square value

Table 4.20 shows that there is a non significant decrease (1.1%, .3%, .0%, 1.0%, 1.0% and p>0.5) in all the gender and age subgroups when the cause of a crash is human and environmental, than when is not (98.9%, 99.7%, 100%.99.0%, 99.0% and p>.05).

Table 4. 21 Comparison of Occurrence of Killed in Gender and Age Subgroups with respect to Other Causes

		OTHER CAUSES			
		Yes	No	$\chi 2$	**p-value**
Adult Male	Yes	56 (4.5%)	1191(95.5%)	16.77	**<.001**
	No	88(2.3%)	3769(97.7%)		
Adult Female	Yes	9(2.6%)	341(97.4%)	0.86	.770
	No	135(2.8%)	4619(97.2%)		
Child Male	Yes	0(.0%)	85(100.0%)	2.51	.113
	No	144(2.9%)	4875(97.1%)		
Child Female	Yes	3(3.1%)	93(96.9%)	.03	.856
	No	141(2.8%)	4867(97.2%)		
Total	Yes	64(4.3%)	1431(95.7%)	16.42	**<.001**
	No	80(2.2%)	3529(97.8%)		

$\chi 2$ =Pearson chi-square value

Table 4.21 shows that there is a significant decrease in adult male (4.5%, p<.001) and total (4.3%, p<.001), when the cause of a crash is other causes, than when is not (95.5%, 95.7%).

Table 4. 22 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to the Involvement of Privately Owned Vehicles

	INVOLVEMENT OF PRIVATE VEHICLES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	1.67±1.78	1.00 (0-13)	2.74±3.62	2.00 (0-48)	1.71[b]	**<.001**
Adult Female	.51±1.24	.00 (0-16)	.79±1.69	.00 (0-18)	1.93[b]	**<.001**
Child Male	.08±36	.00 (0-4)	.11±.57	.00 (0-15)	2.04[b]	.530
Child Female	.08±.38	.00 (0-4)	.11±.71	.00 (0-23)	2.05[b]	.874
Total	2.34±2.56	2.00 (0-24)	3.73±4.55	2.00 (0-53)	1.72[b]	**<.001**

U=Mann Whitney Test Statistic

Table 4.22 indicates that when there is an involvement of a private vehicle, the number injured (Median=1.00) was slightly less than when a private vehicle is not involved (Median=2.00), $p<.001$ as seen in the Adult male category. This difference is statistically significant in adult male and female, Total injured.

Table 4. 23 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to the Involvement of Commercially Owned Vehicles

	INVOLVEMENT OF COMMERCIAL VEHICLES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	2.89±3.87	2.00 (0-48)	1.96±2.28	1.00 (0-18)	2.66	**<.001**
Adult Female	.80±1.71	.00 (0-17)	.63±1.44	.00 (0-18)	3.01	<.054
Child Male	.13±.60	.00 (0-15)	.08±.44	.00 (0-9)	3.03	**.004**
Child Female	.12±.77	.00 (0-20)	.08±.45	.00 (0-9)	3.07	.257
Total	3.90±4.76	2.00 (0-53)	2.74±3.23	2.00 (0-34)	2.67	**<.001**

U=Mann Whitney Test Statistic

Table 4.23 shows that when there is an involvement of commercial vehicle, the number injured (Median=2.00), was greater than when a commercial vehicle is not involved (Median=1.00), $p<.001$ as seen in the Adult male category. This difference is statistically significant in adult male, child male and total injured.

Table 4. 24 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to the Involvement of Commercially and Privately Owned Vehicles

	INVOLVEMENT OF COMMERCIAL AND PRIVATE VEHICLES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	2.26±2.67	1.00 (0-18)	2.60±3.52	2.00 (0-48)	1.93[E]	**.040**
Adult Female	.76±1.62	.00 (0-18)	.73±1.61	.00 (0-17)	1.97[E]	.173
Child Male	.08±.51	.00 (0-9)	.11±.54	.00 (0-15)	1.96[E]	**.003**
Child Female	.08±.50	.00 (0-9)	.11±.70	.00 (0-20)	1.99[E]	.116
Total	3.17±3.75	2.00 (0-34)	3.52±4.38	2.00 (0-53)	1.94[E]	.077

U=Mann Whitney Test Statistic

Table 4.24 shows that when there is an involvement of commercial/private vehicle, the number injured (Median=1.00), was slightly less than when a commercial/private vehicle is not involved (Median=2.00), $p<.05$ as seen in the Adult male category. This difference is statistically significant in adult male and child male.

Table 4. 25 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to the Involvement of Privately Owned Vehicles

	INVOLVEMENT OF PRIVATE VEHICLES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.24±.36	.00 (0-19)	.44±1.03	.00 (0-17)	1.84[E]	**<.001**
Adult Female	.07±.36	.00 (0-6)	.01±.40	.00 (0-6)	2.02[E]	.103
Child Male	.03±.21	.00 (0-4)	.02±.15	.00 (0-5)	2.04[E]	.184
Child Female	.02±.15	.00 (0-2)	.02±.24	.00 (0-9)	2.05[E]	.852
Total	.37±1.07	.00 (0-19)	.60±1.41	.00 (0-31)	1.85[E]	**<.001**

U=Mann Whitney Test Statistic

Table 4.25 shows that when there is an involvement of private vehicle, the number killed (Median=0.00), was equal to when a private vehicle is not involved (Median=0.00), $p<.001$ as seen in the Adult male category. This is statistically significant in adult male and Total killed.

Table 4. 26 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to the Involvement of Commercially Owned Vehicles

	INVOLVEMENT OF COMMERCIAL VEHICLES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.46±1.06	.00 (0-17)	.31±.88	.00 (0-19)	2.84[E]	**<.001**
Adult Female	.10±.42	.00 (0-6)	.08±.40	.00 (0-6)	3.04[E]	.046
Child Male	.01±.14	.00 (0-5)	.02±.18	.00 (0-4)	3.07[E]	.077
Child Female	.03±.27	.00 (0-9)	.01±.12	.00 (0-2)	3.06[E]	**.025**
Total	.63±1.50	.00 (0-31)	.43±1.12	.00 (0-19)	2.82[E]	**<.001**

U=Mann Whitney Test Statistic

Table 4.26 shows that when there is an involvement of commercial vehicle, the number killed (Median=0.00), was equal to when a commercial vehicle vehicle is not involved (Median=0.00), $p<.001$ as seen in the Adult male category. This is statistically significant in adult male and Total killed.

Table 4. 27 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to the Involvement of Commercially and Privately Owned Vehicles

	INVOLVEMENT OF COMMERCIAL AND PRIVATE VEHICLES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.37±.91	.00 (0-12)	.41±1.01	.00 (0-19)	1.98[E]	.249
Adult Female	.08±.36	.00 (0-4)	.09±.40	.00 (0-6)	2.00[E]	.333
Child Male	.02±.16	.00 (0-2)	.02±.16	.00 (0-5)	2.01[E]	.400
Child Female	.01±.08	.00 (0-9)	.03±.24	.00 (0-9)	1.99[E]	**.010**
Total	.49±1.17	.00 (0-13)	.57±1.41	.00 (0-31)	1.95[E]	**.050**

U=Mann Whitney Test Statistic

Table 4.27 shows that when there is an involvement of commercial and private vehicle, the number killed (Median=0.00), was equal to when a commercial and private vehicle is not involved (Median=0.00), $p>.05$ as seen in the Adult male category. This is not statistically significant except in child female and Total killed.

Table 4. 28 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to Human Causes

	HUMAN CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	2.50±3.20	2.00 (0-38)	2.67±3.98	2.00 (0-48)	2.07[b]	.410
Adult Female	.68±1.52	.00 (0-18)	.95±1.91	.00 (0-17)	1.97[b]	**<.001**
Child Male	.10±.51	.00 (0-15)	.15±.61	.00 (0-7)	2.06[b]	**.006**
Child Female	.09±.63	.00 (0-20)	.15±.76	.00 (0-12)	2.04[b]	**<.001**
Total	3.34±4.02	2.00 (0-38)	3.91±5.12	2.00 (0-53)	2.06[b]	.304

U=Mann Whitney Test Statistic

Table 4.28 shows that when there is a human cause, the number injured (Median=2.00), was equal to when there was no human cause (Median=2.00), $p<.05$ as seen in the Adult male category. This is statistically significant in all except the Total injured

Table 4. 29 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to Mechanical Causes

	MECHANICAL CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	2.88±4.60	2.00 (0-48)	2.49±3.18	2.00 (0-38)	1.29[E]	.810
Adult Female	.98±2.12	.00 (0-17)	.70±1.53	.00 (0-18)	1.24[E]	**.030**
Child Male	.15±.61	.00 (0-7)	.10±.526	.00 (0-15)	1.26[E]	**.010**
Child Female	.16±.82	.00 (0-12)	.10±.63	.00 (0-20)	1.27[E]	**.003**
Total	4.15±5.72	2.00 (0-53)	3.37±4.04	2.00 (0-38)	1.24[E]	.350

U=Mann Whitney Test Statistic

Table 4.29 shows that when there is a mechanical cause, the number injured (Median=2.00), was equal to when there was no mechanical cause (Median=2.00), $p>.05$ as seen in the Adult male category. This is not statistically significant in all except in adult female, child male and female.

Table 4. 30 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to Environmental Causes

	ENVIRONMENTAL CAUSES					
		YES		NO	*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	1.79±2.57	1.00 (0-12)	2.54±3.38	2.00 (0-48)	7.75[4]	**.035**
Adult Female	1.00±1.78	.00 (0-7)	.73±1.61	.00 (0-18)	8.83[4]	.277
Child Male	.16±.61	.00 (0-3)	.11±.536	.00 (0-15)	9.46[4]	.672
Child Female	.05±.22	.00 (0-1)	.10±.66	.00 (0-20)	9.61[4]	.986
Total	3.00±4.15	1.50 (0-17)	3.46±4.27	2.00 (0-53)	8.32[4]	.147

U=Mann Whitney Test Statistic

Table 4.30 shows that when there is a environmental causes, the number injured (Median=1.00), was slightly less than when there was no environmental cause (Median=2.00), $p<.05$ as seen in the Adult male category. This difference is statistically significant.

Table 4. 31 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to Human and Mechanical Causes

	HUMAN/MECHANICAL CAUSES					
		YES		NO	*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	2.87±2.94	2.00 (0-15)	2.52±3.39	2.00 (0-48)	4.89[5]	**.003**
Adult Female	1.26±1.80	.00 (0-9)	.71±3.39	.00 (0-18)	4.45[5]	**<.001**
Child Male	.22±.77	.00 (0-6)	.10±.52	.00 (0-15)	5.23[5]	**.001**
Child Female	.26±.88	.00 (0-9)	.10±.65	.00 (0-20)	5.11[5]	**<.001**
Total	4.60±4.39	3.00 (0-23)	3.40±4.26	2.00 (0-53)	4.40[5]	**<.001**

U=Mann Whitney Test Statistic

Table 4.31 shows that when there is a human/mechanical cause, the number injured (Median=2.00), was equal to when there was no human/mechanical cause (Median=2.00), $p<.05$ as seen in the Adult male category. This is statistically significant in all categories.

Table 4. 32 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to Human and Environmental Causes

	HUMAN/ ENVIRONMENTAL CAUSES					
		YES		NO	*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	2.81±3.80	2.00 (0-26)	2.53±3.39	2.00 (0-48)	1.32[5]	.286
Adult Female	1.14±1.86	.00 (0-8)	.73±1.61	.00 (0-18)	1.24[e]	**.027**
Child Male	.12±.77	.00 (0-2)	.11±.53	.00 (0-15)	1.38[5]	.213
Child Female	.05±.39	.00 (0-3)	.10±.66	.00 (0-20)	1.39[5]	.260
Total	4.12±4.84	2.00 (0-30)	3.45±4.26	2.00 (0-53)	1,28[5]	.151

U=Mann Whitney Test Statistic

Table 4.32 shows that when there is a human/environmental cause, the number injured (Median=2.00), was equal to when there was no human/environmental cause (Median=2.00), $p>.05$ as seen in the Adult male category. This is only statistically significant in adult female.

Table 4. 33 Comparison of Number of Individuals Injured in Each Gender-Age Subgroup with Respect to Other Causes

	OTHER CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	1.50±2.45	1.00 (0-22)	2.56±3.39	.00 (0-48)	2.63[b]	**<.001**
Adult Female	.15±.54	.00 (0-5)	.75±1.63	.00 (0-18)	2.84[b]	**<.001**
Child Male	.06±.27	.00 (0-2)	.11±.54	.00 (0-15)	3.53[b]	.652
Child Female	.00±.00	.00 (0-0)	.11±.67	.00 (0-20)	3.38[b]	**.005**
Total	1.73±2.55	1.00 (0-22)	3.50±4.3	2.00 (0-53)	2.42[b]	**<.001**

U=Mann Whitney Test Statistic

Table 4.33 shows that when there is a other cause, the number injured (Median=1.00), was slightly greater than when there was no other cause (Median=0.00), $p<.001$ as seen in the Adult male category. This difference is only statistically significant in all, except the child female.

Table 4. 34 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to Human Causes

	HUMAN CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.40±.97	.00 (0-19)	.39±1.08	.00 (0-17)	2.10[E]	.922
Adult Female	.09±.37	.00 (0-6)	.11±.48	.00 (0-6)	2.08[E]	.189
Child Male	.02±.17	.00 (0-5)	.02±.14	.00 (0-2)	2.10[E]	.255
Child Female	.02±.19	.00 (0-7)	.03±.32	.00 (0-9)	2.10[E]	.315
Total	.55±1.36	.00 (0-31)	.56±1.40	.00 (0-19)	2.89[E]	.500

U=Mann Whitney Test Statistic

Table 4.34 shows that when there is a human cause, the number killed (Median=0.00), was equal to when there was no human cause (Median=0.00), $p>.05$ as seen in the entire category. This is not statistically significant in all the categories.

Table 4. 35 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to Mechanical Causes

	MECHANICAL CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.32±.97	.00 (0-16)	.41±1.00	.00 (0-19)	1.24	**.027**
Adult Female	.09±.35	.00 (0-4)	.09±.40	.00 (0-6)	1.29	.757
Child Male	.02±.15	.00 (0-2)	.02±.16	.00 (0-5)	1.29	.325
Child Female	.02±.16	.00 (0-3)	.02±.23	.00 (0-9)	1.29	.585
Total	.45±1.14	.00 (0-16)	.57±1.39	.00 (0-31)	1.26	.119

U=Mann Whitney Test Statistic

Table 4.35 shows that when there is a mechanical cause, the number killed (Median=0.00), was equal to when there was no mechanical cause (Median=0.00), $p<.05$ as seen in the Adult male category. This is statistically significant.

Table 4. 36 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to Environmental Causes

	ENVIRONMENTAL CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.37±.97	.00 (0-4)	.40±.99	.00 (0-19)	8.93[4]	.309
Adult Female	.03±.16	.00 (0-1)	.09±.40	.00 (0-6)	9.23[4]	.316
Child Male	.00±.00	.00 (0-0)	.02±.16	.00 (0-5)	9.28[4]	.453
Child Female	.02±.00	.00 (0-0)	.02±.23	.00 (0-9)	9.46[4]	.421
Total	.39±1.00	.00 (0-4)	.56±1.37	.00 (0-31)	8.52[4]	.129

U=Mann Whitney Test Statistic

Table 4.36 shows that when there is a environmental causes, the number killed (Median=0.00), was equal than when there was no environmental cause (Median=0.00), $p>.05$ as seen in all the category. This is not statistically significant in all the categories.

Table 4. 37 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to Human and Mechanical Causes

	HUMAN AND MECHANICAL CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.49±1.50	.00 (0-17)	.40±.96	.00 (0-19)	5.55[5]	.855
Adult Female	.19±.73	.00 (0-6)	.09±.37	.00 (0-6)	5.32[5]	**.025**
Child Male	.03±.17	.00 (0-1)	.02±.16	.00 (0-5)	5.44[5]	**.036**
Child Female	.02±.00	.00 (0-9)	.02±.18	.00 (0-7)	5.40[5]	**.005**
Total	.79±2.13	.00 (0-19)	.54±1.32	.00 (0-31)	5.33[5]	.239

U=Mann Whitney Test Statistic

Table 4.37 shows that when there is a human/mechanical cause, the number killed (Median=0.00), was equal to when there was no human/mechanical cause (Median=0.00), $p>.05$ as seen in the Adult male category. This is only statistically significant in all Adult female, child male and female.

Table 4. 38 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to Human and Environmental Causes

	HUMAN and ENVIRONMENTAL CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.37±.74	.00 (0-3)	.40±1.00	.00 (0-19)	1.36[5]	.964
Adult Female	.04±.26	.00 (0-2)	.09±.40	.00 (0-6)	1.41[5]	.144
Child Male	.00±.00	.00 (0-0)	.02±.16	.00 (0-5)	1.43[5]	.357
Child Female	.02±.13	.00 (0-1)	.02±.22	.00 (0-9)	1.39[5]	.960
Total	.42±.82	.00 (0-3)	.56±1.37	.00 (0-31)	1.41[5]	.636

U=Mann Whitney Test Statistic

Table 4.38 shows that when there is a human/environmental cause, the number injured (Median=0.00), was equal to when there was no human/environmental cause (Median=0.00), $p>.05$ as seen in the Adult male category. This is not statistically significant in all the categories.

Table 4. 39 Comparison of Number of Individuals Killed in Each Gender-Age Subgroup with Respect to Other Causes

	OTHER CAUSES					
	YES		NO		*U*	**p value**
	Mean ±SD	Median (min-max)	Mean ± SD	Median (min-max)		
Adult Male	.49±.74	.00 (0-5)	.40±1.00	.00 (0-19)	3.09[5]	**<.001**
Adult Female	.10±.48	.00 (0-4)	.09±.40	.00 (0-6)	3.55[5]	.874
Child Male	.00±.00	.00 (0-0)	.02±.16	.00 (0-5)	3.51[5]	.140
Child Female	.02±.14	.00 (0-1)	.02±.22	.00 (0-9)	3.55[5]	.694
Total	.62±1.01	.00 (0-7)	.55±1.38	.00 (0-31)	3.18[5]	**<.001**

U=Mann Whitney Test Statistic

Table 4.39 shows that when there is other causes, the number injured (Median=0.00), was equal to when there was no other cause (Median=0.00), p**<.**001 as seen in the Adult male category. This is statistically significant in adult male and total killed.

Table 4. 40 Simple Logistic Regression Models for the Injured Category for Four Independent Variables: Commercial Vehicle, Private, Human and Mechanical Causes.

Variables/Source	B	S.E	Odds ratio	95% CI of OR	*p-value*
Commercial Vehicle *R-squared = <.001*	-0.61	.078	0.94	0.81-1.09	.433
Private Vehicles *R-squared= .001*	0.13	0.94	1.14	0.95-1.38	.149
Human Causes *R-squared =.002*	-0.23	0.09	0.79	0.66-.94	**.010**
Mechanical Causes *R-squared = .002*	0.30	0.11	1.35	1.08-1.68	**.008**

Table 4.40 shows the four different models of simple logistic regression for four independent variables for those injured in road traffic crash, among the four models predicted for each of the independent variable, is the human and mechanical causes are significant p<.05 ,OR (odds ratio): 0.79,1.35 *CI* confidence interval of odds ratio (0 .66-0.94) and (1.08-1.68) respectively. Commercial and Private Vehicle causes have no significance.

Table 4. 41 Multiple Logistic Regression Model for the Injured Category for Four Independent Variables Together: Private, Commercial Vehicle, Human and Mechanical Causes.

Variables/Source	B	S.E	Odds ratio	95% CI of OR	*p-value*
Private Vehicle	0.13	0.12	1.14	0.90-1.44	.273
Commercial Vehicles	-0.01	0.10	0.98	0.80-1.20	.894
Human Causes	-.12	0.13	0.87	0.68-1.13	.327
Mechanical Causes	0.19	0.16	1.21	0.88-1.66	.232
R-squared = .003					

Table 4.41 shows the multiple logistic regressions for the four independent variables together for those injured in road traffic crash; none has any significance have any significance.

Table 4. 42 Simple Logistic Regression Models for the Killed Category for Four Independent Variables: Commercial Vehicle, Private, Human and Mechanical Causes.

Variables/Source	B	S.E	Odds ratio	95% CI of OR	*p-value*
Commercial Vehicle *R-squared = .011*	-4.07	0.06	0.66	0.58-0.75	***< .001***
Private Vehicles *R-squared= .010*	0.49	0.84	1.63	1.38-1.92	***< .001***
Human Causes *R-squared =<.001*	-0.73	0.76	1.07	0.98-1.24	.333
Mechanical Causes *R-squared = <.001*	0.13	0.99	1.13	0.93-1.38	.192

Table 4.42 shows the four different models of simple logistic regression for four independent variables for those killed in road traffic crash, among the four models predicted for each of the independent variable, is only the commercial and private vehicles that are significant(p<.001 ,OR (odds ratio): 0.66, *CI* (0.58-0.75) and p<.001 ,OR (odds ratio): 1.63, *CI* (1.38-1.92) respectively. Human and Mechanical causes have no significance.

Table 4. 43 Multiple Logistic Regression Model for the Killed Category for Four Independent Variables Together: Private, Commercial Vehicle, Human and Mechanical Causes.

Variables/Source	B	S.E	Odds ratio	95% CI of OR	*p-value*
Private Vehicle	0.29	0.10	1.34	1.09-1.64	**.005**
Commercial Vehicles	-0.26	0.08	0.77	0.65-0.90	**.001**
Human Causes	0.25	0.10	1.28	1.05-1.57	**.015**
Mechanical Causes	0.39	0.13	1.49	1.14-1.94	**.003**
R-squared = .003					

Table 4.43 shows the multiple logistic regressions for the four independent variables together for those injured in road traffic crash; all the independent variables are significant with odds ratio at p<.001 and p<.05.

CHAPTER 5

CONCLUSIONS

5.1 Discussions of Findings

From the data analysis carried out in chapter four of this study, the following were discovered:

a. The study revealed that out of all the categories of probable causes of the 5104 road traffic crash, human causes accounts for the highest frequency (79.6%) (table 4.1) This was corroborated by FRSC publications (2010-2019) which showed that 90% of the road traffic accident that occurred in Nigeria are attributed to human causes. While among the vehicle category, it showed that road traffic crash involving commercial vehicles accounted for 61.2% (Table 4.1).
b. Out of the 5104 road traffic crashes among the gender and sex category, the adult male has the highest injury rate (Median and mean (2.00 and 2.53) and fatality (killed) (0.00 and 0.40) (Table 4.2 and Table 4.3 respectively).
c. In using chi-square to compare the relationship between the vehicle categories and the rate of injury among the gender and age subgroup category showed that there is a higher relationship between commercial vehicle involvement in crash and injury rate reported among adult male and female. In which the injury increased significantly (62.0% and 68.7%, $p<.05$) (Table 4.5). This result agrees with that of Emmanuel (2010) in his analysis using the chi-square test of independence, in which he discovered that number of people injured in road traffic accident is dependent on the vehicle category.
d. In using chi-square to compare the relationship between the vehicle categories and the rate of fatality (number killed) among the gender and age subgroup category showed that there is a higher relationship between commercial vehicle involvement in crash and fatality rate reported among the entire gender and sex category except for the child male. In which the fatality rate increased significantly (68.6%, 66.6%, 74%, 67.9% and $p<.001$, $p<.05$, $p<.001$) (Table 4.8). This is also in support of Emmanuel (2010) study that numbers killed in an accident is dependent on the vehicle type involved.
e. In using chi-square to compare the relationship between the probable causes of road traffic crash category and the rate of injury among the gender and age subgroup category showed that there is a higher marginally significant relationship between human causes

and injury rate reported among all the gender and sex category. In which the injury rate increased significantly (80.5%, 76.7%, 74.2%, 71.3%, 80.3% and $p<.001$, $p<.05$, $p<.001$ and $p<.05$). The study revealed that male gender and adults were injured. (Table 4.10). According to M labinjo et al (2009), his study revealed that increased risk of injury rate was associated with male gender aged 18-44 years when compared to the female gender. Also, Erenler and Gümüş (2010) observed using chi-square in their study that Male are more likely to be exposed to injuries related to a road traffic crash than female.

f. In using chi-square to compare the relationship between the probable causes of road traffic crash category and the fatality rate (killed) among the gender and age subgroup category showed that there is a non-significant relationship between human causes and injury rate reported among the entire gender and sex category. Though the cause of this could not be ascertained, it calls for more study in which the specific ages of road traffic crash victims should be included.

g. Mann Whitney u test when used to assess the relationship between the vehicle categories and the rate of injury among the gender and age subcategory also showed that there is a significantly higher relationship between commercial vehicle involvement in crash and fatality rate reported among the entire gender and sex category. In all the three categories of vehicle, it showed that the adult male was the most significantly injured ($p<.001$). (Table 4.22, 4.23 and 4.24)

h. Using Mann Whitney u test when used to compare the relationship between the vehicle categories and the fatality rate among the gender and age subcategory also showed that there is a marginal relationship between commercial vehicle involvement in crash and fatality rate reported among the entire gender and sex category. In all the three categories of vehicle involvement, it showed that the adult male and child female were the most significantly killed ($p<.001$ and $p<.05$). (Table 4.25, 4.26 and 4.27)

i. The Mann Whitney u test when used to compare the relationship between the probable causes of road traffic crash category and the rate of injury among the gender and age subgroup category showed that there is a higher marginally significant relationship between human causes, mechanical causes and both with respect to injury rate reported among all the gender and sex category. In which the injury rate increased significantly ($p<.05$ and $p<.001$). (Table 4.28, 4.29and 4.31). Meaning that human and mechanical

causes are significantly related to the number of adults, female injured in a road accident. This is similar to the findings in FRSC publications (2010-2019), Ohakwe J et al (2011) and Atubi (2010).

j. The Mann Whitney u test when used to compare the relationship between the probable causes of road traffic crash category and the fatality rate among the gender and age subgroup category showed that there is a marginally significant relationship between human and mechanical causes and the fatality rate reported among gender and sex category. (Table 4.37). According to this study, it shows that human and mechanical causes among the probable causes of road traffic crash accounts were significantly associated with fatality occurrence in both genders.

k. For the relationship between the probable causes of road traffic crash category (human and Mechanical), vehicle category (commercial and private) and the rate of injury, simple logistic regression was performed for the four independent categories against the dependent variable. This was used to examine the statistical relationship between the two variables. The R square of the models (<.001,.001,.002 and .002 respectively) were very low. (Table 4.40). Thus was not able to explain the variation between the injury rate and the four independent variables (commercial vehicles, private vehicles, human causes and mechanical causes. This could be attributed to the lack of other explanatory variables in the data that might have given a higher percentage of variance, as such yield more significant model fitting.

   In terms of statistical significance of the four different models of simple logistic regression for the rate of injury and the four independent variables, the result of the study suggests that the human causes and mechanical causes are statistically significant at $p<.05$.(Table 4.40), and so the changes make a strong contribution towards the dependent variable(injury rate). The results suggest that human and mechanical causes are significantly related to the number of people injured in a road traffic crash.

l. For the multiple comparison using multiple logistic regression to predict the relationship the probable causes of road traffic crash category (human and Mechanical), vehicle category (commercial and private) and the rate of injury, showed there was no statistically significant relationship. (Table 4.41). This may be attributed to lack of enough explanatory variables etc.

m. To determine the statistical relationship between the probable causes of road traffic crash category (human and Mechanical), vehicle category (commercial and private) and the rate of fatality or killed, simple logistic regression was performed for the four independent categories against the dependent variable. The R square of the models were very low (.011, .010, <.001and <.001 respectively) were very low (Table 4.42), therefore could not be used to explain the variation between the fatality rate and the four independent variables (commercial vehicles, private vehicles, human causes and mechanical causes). This could be attributed to the lack of other explanatory variables in the data that might have given a higher percentage of variance, as such yield more significant model fitting. In terms of statistical significance of the four different models for the rate of fatality and the four independent variables, the result of the study suggests that the commercial and private vehicle categories are statistically significant at p<.001(Table 4.42) and therefore the changes make a unique contribution towards the dependent variable(fatality rate or killed). The results suggest that vehicle type or category (commercial and private vehicle) causes are significantly related to the number of people killed in a road traffic accident.

n. The multiple comparison using multiple logistic regression to predict the relationship between the probable causes of road traffic crash category (human and Mechanical), vehicle category (commercial and private) and the fatality rate or killed, showed there was a statistically significant relationship for all the four independent variables (private vehicles, commercial vehicles, human and mechanical causes at p<.00 and p<.05 respectively. (Table 4.43). The results suggest that commercial vehicle, private vehicles, human causes and mechanical causes are predicted to lead to more number of people killed in any given road traffic crash. With odds ratio showing that the higher risk for the number of people killed when these independent variables are involved. (Table 4.43).

Therefore, it can be concluded in all the reported fatality and injuries of a road traffic crash in Nigeria within the years under this study that the following relationship exists:

a. The probable cause of Road traffic Crash affects the number of fatalities and the number of injured

b. There is a difference between the rate of fatality and injury associated with road traffic crash involving the following Vehicle categories (Commercial/Commercial, Commercial/Private and Private/Private).
c. There is a difference between the number of people injured and killed among both Genders.

Also that human, mechanical cause and commercial vehicle involvement accounts for the most significant relationship with the number of fatality and injuries recorded in road traffic crash in Nigeria as revealed with the chi-square, Mann Whitney u test, logistic regression statistical techniques used.

5.2 Implications and Recommendations for Further Research

From this study, the significance of previous literature on road traffic crash, its effect, causes, application or utilization of univariate and multivariate analysis can be enhanced with necessary adaption gained from the knowledge. Also, the importance and the interpretation of commonly used univariate and multivariate analysis is briefly discussed to gain the knowledge on its application as a statistical technique.

For the government agencies in Nigeria responsible for road traffic administration and management in Nigeria, this will assist them in enhancing their strategic goals towards road safety.

Based on the study, there are several aspects that can be improved on, in other to enhance the accuracy of future research on this topic. More variables like the speed of the vehicle, age of drivers, if reported in any road traffic crash can be included. Also, research on others to compare other predictive models with the inclusion of other variables can be conducted.

5.3 Recommendations

a) There is need for more robust and enhanced public enlightenment strategy for the motoring public. This is as result of our findings that showed that human and mechanical causes are associated with high fatality and injury rate. Awareness on the need to avoid the following: fatigue, over speeding, alcoholic or stimulating drug intake, over confidence, improper overtaking, while driving. Also drivers should ensure proper maintenance of their vehicles.

b) There is need to have periodic mental history and blood alcohol content/concentration(BAC) for drivers especially commercial drivers, as this present study showed that commercial vehicles category when involved in crash leads to higher record of fatality and injury rate.

c) The need to capture the following in Federal Road Safety Commission Road traffic crash data collection; road quality, presence of traffic lights, experience period of the drivers, age of driver, age of passenger, age of vehicle and speed of the vehicle, As this will increase the explanatory variables required to enhance further researches on road traffic crash in Nigeria.

5.4 Conclusions

Road traffic accident occurrences have constituted a major menace resulting in revenue loss, loss of manpower resources and public health threat in the third world countries, Nigeria, inclusive.

Beyond the economic loss, this study has revealed that there is a relationship between the probable causes of a road traffic crash, the type of vehicle involved in the crash and the injuries, disabilities, and deaths which results from it.

The need for policymakers in Nigeria to take proactive measures to effect policy designs and decision makings on roads and transportation aimed at minimizing and preventing road traffic crash in Nigeria, as this will go a long way in reducing the number of fatality and injury experienced on Nigeria roads.

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