ROAD TRANSPORT SAFETY IN ABUJA, NIGERIA: AN ANALYSIS USING A TRAFFIC CONFLICT TECHNIQUE

By

UCHENNA NNABUIHE UHEGBU

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Department of Civil Engineering
School of Engineering
College of Engineering and Physical Science
The University of Birmingham
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Abstract

An estimated 1.35 million lives are lost to Road Traffic Crashes (RTC) annually, with about 20 – 50 million people sustaining non – fatal injuries, of which many are left with temporary or permanent disabilities. Developing countries like Nigeria, account for 85% of these global road fatalities, and 90% of Disability Adjusted Life Years (DALY), despite having only about 54% of available world vehicles. With a steady increase in the number of vehicles on Nigerian roads, over dependence on road transport for the movement of 90% of freight and passengers, which is primarily due to the near absence and neglect of other transportation modes in Nigeria, road safety is therefore of great concern, and deserves more attention than it currently gets. To date, the reliance on historical crash data in the analysis of traffic safety problems has been criticised due to the ethical issues associated with waiting for crashes to occur in order to collect sufficient crash data, as well as low quality or a complete unavailability of crash data in developing countries. To this end, the use of surrogate safety indicators as alternatives or complements of crash – based safety evaluations is therefore very necessary. There has not been a comprehensive non – crash based, but safety – related evaluation of unsafe traffic interactions and traffic conflicts with the potential of resulting in a traffic crash in Nigeria's capital city, Abuja. The advancement of Traffic Conflict Techniques (TCT) motivated the utilisation of the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) to investigate the safety issues in Abuja, Nigeria, and the results from this research would be beneficial, as it aims to understand the underlying unsafe behaviours and interactions of road users, contributing to high RTC and road fatalities in Abuja. To achieve this, relevant literature on non – crash based Traffic Safety Evaluation (TSE) and its replicability in developing countries were reviewed to inform the choice of methodology adopted for the study. TCT works best when complemented with crash analysis as well as behavioural studies, the methodology therefore consists of three major components: the trend analysis of Nigeria's available crash data (1990 – 2016) provided by the Federal Road Safety Corps (FRSC). It provided an understanding of the road safety condition in Nigeria, and the progresses made towards achieving the goals of the United Nations Decade of Action for Road Safety 2011 – 2020, and the Sustainable Development Goals (SDG) Goal 3, target 6, which is a 50% reduction in crash fatalities by the end of 2020. Based on the trend analysis, questionnaires were designed and administered to road users in Abuja Nigeria, as well as interviews with representatives of the FRSC and the Federal Ministry of Transportation. This helped seek the opinion of road users on the causes of relatively high levels of Road Traffic Crashes in Abuja.

Abuja, despite having a majority of educated residents, the best road network and available paved roads in Nigeria, consistently has one of the worst annual crash statistics in Nigeria. Traffic conflicts observations were therefore conducted in Abuja, to observe traffic behaviours and conflicts using a Traffic Conflict Technique (TCT). This research observed and identified various traffic conflicts at 6 study locations in Abuja, using the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) technique. The results from the crash analysis (trend analysis) shows that Nigeria is far off from achieving the United Nations Decade of Action for Road Safety 2011 – 2020, and the SDG Goal 3, target 6, by the end of 2020. With respect to the goal of the United Nations Decade of Action for Road Safety 2011 – 2020, an effective 50% reduction in the year 2011 estimates of crash fatalities (6,054 fatalities) in Nigeria, implies that by the end of 2020, crash fatalities are expected to drop to below 3,027 crash fatalities. However, the FRSC reports a 16.5% decline in road fatalities from 2011 – 2016 (a drop from 6,054 to 5,053 road fatalities, although increases were experienced in 2012, and 2013), which is still 33.5% off the 50% target by the end of 2020. The research also identified behavioural risk factors in Abuja, including; poor use of seatbelts, drink driving, and use of mobile phones while driving. Unsafe driving behaviours identified also include; not using indicators, driving without a seatbelt, and tailgating. From the interviews, over speeding, driving against the flow of traffic and lack of pedestrian bridges at junctions as well as pedestrians crossing at undesignated areas were identified as the major causes of RTC in Abuja. From the study sites, the observed conflicts were mainly same direction (right turn, slow vehicle, and lane change), cross traffic (through, left turn and right turn), and pedestrian conflicts. Based on the severity of the conflicts, slight conflicts (conflicts of severity 1 and 2), were predominant at all locations. The most severe conflicts (conflicts with severity score of 5 which is regarded as a near miss and could have potentially resulted in a crash) range from 7.0% of the total number of observed conflicts at Bolingo Junction to a maximum 8.3% of the total number of observed conflicts at Julius Berger roundabout. This research proposed crash reduction methods including; strict enforcement of traffic laws, road safety enlightenment, improved road design, effective traffic management and road safety education. The application of DOCTOR in Abuja, Nigeria, is novel. The traffic conflict observations done in this research were done manually and not via video recordings, however, this research provides road safety investigators the foundation and opportunity to utilise surrogate safety evaluations using video recordings for future applications, so as to complement traffic safety evaluations in cases where crash based approaches seem unreliable.

Dedication

This PhD dissertation is dedicated to the over 1.35 million people killed annually from road traffic crashes and to the 20 – 50 million people seriously injured or permanently disabled on world roads annually. May their deaths inspire the rest of us towards achieving zero roadway deaths by 2050, and may their memories be for a blessing.

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List of Abbreviations

ACM: Assistant Corps Marshal

AMAC: Abuja Municipal Area Council

ATC: Automatic Traffic Count

BAC: Blood Alcohol Concentration

CBD: Central Business District

CBN: Central Bank of Nigeria

CIA: Central Intelligence Agency

CS: Conflicting Speed

DALY: Disability – Adjusted Life Years

DCM: Deputy Corps Marshal

DfT: Department for Transport

DOCTOR: Dutch Objective Conflict Technique for Operation and Research

FCT: Federal Capital Territory

FCTA: Federal Capital Territory Administration

FGN: Federal Government of Nigeria

FRSC: Federal Road Safety Corps

GDP: Gross Domestic Product

GNI: Gross National Income

HIC: High Income Countries

IMF: International Monetary Fund

INSEE: National Institute for Statistics and Economic Studies

iRAP: the International Road Assessment Programme

IRTAD: International Road Traffic and Accident Database

KPI: Key performance Indicators

LGA: Local Government Area

LMIC: Low and Middle Income Countries

MDA: Ministries, Departments and Agencies

NBS: National Bureau of Statistics

NNPC: Nigerian National Petroleum Corporation

NPC: National Population Commission

NTP: National Transport Policy

OECD: Organisation for Economic Co-operation and Development

OPEC: Organization of the Petroleum Exporting Countries

PET: Post Encroachment Time

PSMS: Canadian Probabilistic Surrogate Measures of Safety

ROC: Risk of Collision

RSA: Road Safety Audit

RSI: Road Safety Inspection

RSSP: Road Safety Strategic Plan

RTC: Road Traffic Crashes

SDG: Sustainable Development Goals

SPSS: Statistical Package for the Social Sciences

TCT: Traffic Conflicts Technique

TSE: Traffic Safety Evaluation

TTC: Time to Collision

TTCmin: Minimum Time To Collision

TVC: Traffic Volume Count

UN: United Nations

WHO: World Health Organization

Glossary of Key Terms

The following keys words would be encountered throughout this dissertation:

- **Road Traffic Crash**: A road traffic crash refers to an event having led to personal injury or damage to property that has taken place in an area intended for public transport or generally used for transport and in which at least one of the involved parties has been in or on a moving vehicle. According to the National Institute for Statistics and Economic Studies (INSEE), this excludes intentional acts such as murder and suicide, and other natural disasters (INSEE, 2016).
- **Road Fatality:** A road fatality or road death refers to death due to a road traffic crash. A road fatality could occur immediately a road traffic crash occurs or within 30 days as a result of the injuries sustained from a road traffic crash (OECD, 2016). However, this definition varies from country to country and applies to only 80 countries including Nigeria (WHO, 2009). For example, in Latvia, road fatalities refer to persons who die within 7 days or at the scene of a crash, while later fatalities are recorded as injured (OECD, 2019).
- **Road Traffic Injury:** A road traffic injury occurs when a person sustains an injury but was not killed as a result of a road traffic crash. Road traffic injuries are classified as serious injuries or slight injuries (OECD, 2019).
- **Traffic Conflict Technique:** According to Shinar, (1984), Traffic Conflict Technique (TCT) refers to the formal procedure of recording near – misses or near – crashes and the evaluation of unsafe traffic conditions. The assumption is that causes of near misses, traffic conflicts, and traffic crashes are similar. Since traffic conflicts occur with a much greater frequency than traffic crashes, observing traffic conflicts could help predict traffic crashes within shorter time and with minimal efforts. A traffic conflict is a traffic interaction involving two or more road users, leading to a collision risk in the absence of an evasive action.

Preface

Parts of the ideas in this final dissertation have been discussed and presented in conferences and symposiums.

The presentations include:

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Uhegbu, U. N., Tight, M., and Burrow, M. (2017b). Road Safety Challenges Inhibiting the Actualisation of a Sustainable Transportation System in Nigeria's Federal Capital Territory (FCT). In **Proceeding of the 11th University of Birmingham/Westmere University Graduate School Research Poster Conference**, Birmingham, West Midlands, United Kingdom. June 15, 2017.

Journal paper(s) in progress:

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CHAPTER ONE
INTRODUCTION

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1.1 Introduction

With road traffic injuries as the leading cause of death among children and adults between the ages of 5 – 29 years (WHO, 2018), and ranked the ninth leading cause of death globally (Wales, 2017), drastic measures need to be taken in order to prevent and reduce these avoidable deaths attributed to road traffic crashes. By 2030, injuries from road traffic crashes are projected to be the 7th leading cause of deaths worldwide (WHO, 2018). An estimated 1.35 million people die annually and approximately 20 – 50 million people sustain non – fatal injuries as a result of these crashes, with many left with temporary or permanent disabilities (Dharmaratne et al., 2015).

In Low and Middle Income Countries (LMIC), the economic and societal costs associated with the burden of road traffic crashes continue to rise (Ameratunga et al., 2006). This is relatively consistent with the opinion of Gopalakrishnan, (2012), that, 90% of Disability – Adjusted Life Years (DALY) and 85% of global road deaths from road traffic injuries happen in developing countries. In contrast, these countries have over 54% of the available world vehicles (Wales, 2017). Similarly, the African continent has been hard hit by the global road safety crisis, accounting for over 16% of global road fatalities, despite having only 2% of the world's vehicles (International Transport Forum, 2017; Uzondu et al., 2019).

The Federal Government of Nigeria (FGN) is committed to reducing road traffic crashes as well as making roads safer for all classes of road users. The Nigerian Government through the Federal Road Safety Corps (FRSC) and the Federal Ministry of Transportation play strategic and pivotal roles in Road Safety Policy Development. They also partner various stakeholders towards the realisation of the objectives of the United Nations Decade of Action on Road Safety

2011 – 2020 and the Sustainable Development Goals (SDG) goal 3, target 6. The United Nations Decade of Action for Road Safety 2011 – 2020, and the Sustainable Development Goals (SDG) Goal 3, target 6, aim at stabilising and reducing the forecast levels of road traffic deaths, and a 50% reduction in the number of global road traffic deaths and injuries by 2020 respectively. However, despite these laudable efforts by the Government, Nigeria still has one of the highest road fatalities per 10,000 vehicles in the world (Sheriff, 2009). According to the 2013 Global Status Report on Road Safety "Supporting a Decade of Action", Nigeria's fatality rate per 10,000 vehicles is 48.4, with a set target of 3.2 deaths per 10,000 by the end of 2020 (WHO, 2013).This is very high when compared to 0.5 in the United Kingdom, 0.5 in Japan, 1.5 in the United States of America, 0.3 in Norway, 15 in Bhutan, 8 in Fiji, or 13.3 in South Africa (WHO, 2013, IRTAD, 2019). The road safety management efforts of the Nigerian Government has gained limited success, which is evident in the increasing rate of road traffic crashes, and a pointer to the fact that the country is yet to get it right (Sumaila, 2013; Uzondu et al., 2019; Siyan et al., 2019). According to Sumaila (2013), and FRSC, (2012), a seemingly contributory factor to Road Traffic Crashes (RTC) is the steady increase in the number of vehicles on Nigerian roads. The Infrastructure Concession Regulatory Commission (ICRC), (2017), estimates Nigeria's total road length at about 195,000 km, out of which a proportion of about 32,000 km are federal roads, 31,000 km are state roads, while 132,000 km are local roads. Of the available 195,000km, only 60,000 km are paved, leaving 135,000 km unpaved. A large proportion of the paved road is in very poor unacceptable condition due to insufficient investment and lack of adequate maintenance (ICRC, 2017). The National Bureau of Statistics (NBS), (2018a), estimates that as at 2018, Nigeria had 11,760,871 officially registered vehicles, with commercial vehicles at 6,785,956 (57.7%); private vehicles 4,819,251 (40.9%); government owned vehicles 149,470 (1.3 %); and Diplomatic vehicles 6,194 (0.1 %). Nigeria's vehicle per population ratio is 0.06 (NBS, 2018a). Nigeria's population density however, varies in rural areas (51.7%) and urban areas (48.3%), translating to a population – road ratio of about 860 persons per square kilometre. This is an indication of intense traffic pressure on the available paved road network which contributes to the high road traffic crashes in Nigeria (Sumaila, 2013; FRSC, 2012).

In 2016, the World Health Organization (WHO) estimated the road traffic death rate (per 100,000 population) in Nigeria at 21.4, with 35,641 deaths recorded (WHO, 2016). When compared to official government figures from the Federal Road Safety Corps (FRSC), 5,053 persons were killed (FRSC, 2016), which points to a gross underreporting of road traffic related deaths, thus causing an underrepresentation of the actual scale of road deaths in Nigeria. This is a great concern to the general public as well as the Government (Farah, 2017). Although likely underreported, statistics from the Federal Road Safety Corps (FRSC) indicate that for the period of 2011 – 2016, 69,941 crashes have been recorded on Nigerian roads resulting to 35,179 deaths (FRSC, 2016). This translates to 1 death in every 2 road traffic crashes, or an average of 16 road traffic deaths daily. Of the 5,053 persons killed in 2016, 4,696 (93%) were adults, while 357 (7%) were children (FRSC, 2016). 3,970 (79%) were male while 1,083 (21%) were female (FRSC, 2016). It is important to note that Nigeria has no available data on the actual number of daily road users (road traffic participation) on Nigerian roads. To produce the global status report on road safety, the World Health Organization (WHO) utilises data from 3 sources: data reported by countries and secondary sources; adjusted data to accommodate the 30 – day definition of a road traffic death in order to facilitate comparability; and modelled estimated numbers. With respect to the modelled estimates, the WHO uses a regression model based on reported road traffic deaths for countries classified as having good vital registration (VR) systems (a marker of good statistical systems), plus a set of covariates to predict yearly road traffic fatalities. The quality issues associated with the FRSC data is evident in the yearly fluctuation of crashes and fatalities due to a non – systematic crash data collection system.

In view of these growing concerns, road transportation safety research in Nigeria is gaining the desired attention it deserves, due to the number and frequency of road traffic crashes experienced on Nigerian roads. This challenge is made worse by the major over dependence on road transportation for the movement of 90% of freight and passengers, which is as a result of the near absence of other transportation modes (Siyan et al., 2019; Sumaila, 2013), as well as the total disregard for walking and cycling and the neglected rail system which has only recently gained the attention of the Federal Ministry of Transportation (Uzondu et al., 2019; Ademiluyi and Dina, 2011; Agbaeze and Onwuka, 2014; Afolabi and Gbadamosi, 2017).

Previous studies on road traffic safety in Nigeria have been registry – based and relied on road traffic crash data from the FRSC as their main road traffic crash data source (Oyetubo et al., 2018; Aderamo, 2012a), however, the FRSC data has been shown to have serious limitations and biases. These limitations (which are also common in most Low and Middle Income Countries and indeed African countries where traffic crash data are deemed insufficient), include; underreporting of crashes, missing data on minor crashes, lack of details of the few reported crashes and an omission of information about the processes that resulted in the crash (Adeloye et al., 2016; Iyanda, 2019; Asogwa, 1992; Mohan, and Tiwari, 1998; Udomah and Edafiogho, 1990). There is no obligation for members of the public to report all crashes to the FRSC, most especially crashes without personal injury or fatalities, however, a considerable amount of both fatal and non – fatal crashes occurring in rural areas without the presence of FRSC marshals and patrol teams, are mostly not reported to the Federal Road Safety Corps (FRSC). Some religious faiths also believe in burying their dead's within 24 hours without ample time for enquiries into the causes of the crash and fatality, thus contributing to underreporting. Therefore, the FRSC data is not an actual representation of all crashes and fatalities in Nigeria. Both the general public and the FRSC have a shared responsibility of reporting crashes immediately they occur, however, with respect to missing data, and a lack of causative factors leading to a crash, the FRSC remains solely responsible. In the United Kingdom, the police reported data (Stats 19) is assessed using alternative sources such as the national travel survey, hospital episodes statistics, compensation recovery unit data, motor insurance claims statistics and the road traffic statistics. Road traffic crashes involving personal injuries in Great Britain, are reported to the police using the STATS19 reporting system. Due to the likely underreporting of the crash data from the FRSC, this research therefore explores the use of an alternative non – crash based but safety – related evaluation of unsafe traffic interactions with the potential of resulting in a traffic crash.

In this research, the Traffic Conflicts Technique (TCT) was adopted as an alternative to crash records based Traffic Safety Evaluations (TSE), not only due to the likely underreporting from the FRSC, but also, the ethical issues associated with waiting for road traffic crashes to occur, in order to collect more reliable crash data. De Ceunynck, (2017) suggests that the practice of waiting for road traffic crashes to occur in good numbers before assessing the safety of road transport, poses an ethical problem, and is only a reactive way of evaluating road safety. According to Hydén, (1987) traffic conflict techniques work best with methods such as behavioural studies, crash analysis, traffic interactions studies, as well as interviews with road users, which the research method adopts and is presented in chapter 3 of this dissertation.

There are other traffic conflict techniques which are discussed in details in Chapters 2 and 3, however, for the purpose of this research, the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) was applied in the observation of traffic conflicts in select locations in Abuja, Nigeria. DOCTOR was combined with a crash data analysis and a road user and road administrator survey study of road users in Abuja. In ideal road design situations, the aforementioned analyses are best done prior to a road being built, which is a rather proactive than reactive approach. However, the DOCTOR technique used in this study, is also a proactive approach, and is used in the observation of traffic conflicts on already built and existing roads, thus cannot be used prior to a road being built.

The adopted methodological steps are further discussed in Chapter 3 and the research findings presented in Chapter 4.

1.2 Study area

Nigeria is Africa's most populous country and the most populous black Nation on earth. Going by current estimates, Nigeria has an estimated population size of over 200 million people and is ranked 7th on the list of most populous countries in the world. The population of Nigeria was estimated at 193 million in 2016, an indication the country experiences an average of 2.6% population growth annually (NBS, 2018b). Nigeria is located in West Africa, and has a total area of 923,768 km^2, of which 13,000 km^2 is covered by water and 910,768 km^2 covered by land (CIA, 2019). The country is bordered to the North by Niger republic, to the west by Benin republic, to the east by Cameroon, Chad in the North – East, and the Atlantic Ocean down south. The country comprises of 774 Local Government Areas (LGAs), 36 States and Abuja, the Federal Capital Territory (FCT). Nigeria is also divided into 6 geo – political zones (North – East, North – West, North Central, South – East, South – West and South -South) which all 36 States and Abuja fall under. The major urban centres are Abuja and Minna in the North Central, Lagos and Ibadan in the South – West, Kano and Kaduna in the North West, Port Harcourt, Warri, Calabar and Benin in the South – South, Enugu and Onitsha in the South - East, and Maiduguri in the North – East.

The country is a democracy and has experienced uninterrupted democratic rule since the return of democracy to the country in 1999. Nigeria is a Federal Republic with a presidential system of government, and elections are held every 4 years, which sees various eligible political parties and candidates vie for elective offices. The Federal Government of Nigeria (FGN) comprises of three arms: the executive, a bicameral legislature and the judiciary, with the President as the head of the central government and commander in chief of the armed forces.

With a Gross Domestic Product (GDP) of $404.65 billion in 2016, and a Gross National Income (GNI) per capita of $2,470, the World Bank classifies Nigeria as a middle income country (World Bank, 2017b). According to the International Monetary Fund (IMF), Nigeria is the largest economy in Africa (World Bank, 2017a), which is a reason why it is referred to as the giant of Africa due to her robust economy and very large population. Nigeria is a major producer and exporter of oil and natural gas, and is a member of the Organization of the Petroleum Exporting Countries (OPEC). The petroleum sector is Nigeria's main source of foreign exchange, accounting for about 95% of total foreign earnings and about 80% of Federal Government revenue accrued to Nigeria, however, it accounts for only about 10% of Nigeria's GDP (Nweze and Edame, 2016). Agriculture and primary production account for about 40 percent of Nigeria's GDP, and employs around 70% of the country (Farah, 2017). While agricultural production is domiciled primarily in the north, the south houses most of the country's industrial hubs and is home to all the oil and gas reserves of the country.

The transportation of goods and people down south and up north are done primarily by road transport, via arterial roads running from North to South. According to the draft National Transport Policy (NTP), the country has a total of 193,200 km of roads, with 34,123 km as Federal roads, 30,500 km as state roads and 129,577 km as local government roads, with over 50% of the roads in a very bad state (FGN, 2010). It is hoped that with the gradual revival of the long neglected and moribund railway system in Nigeria, the burden of overreliance on road transport as the primary mode of transportation will be lifted and shared with the railways in Nigeria.

At present, Abuja has arguably the best road transport system in Nigeria which might be due to its status as the capital city, its master plan and design, and the painstaking efforts committed to the development of the city, prior to it becoming the capital city. Salisu, (2017), describes Abuja as a purpose built capital city, situated in a central location, and a tolerable climate.

By military decree No. 6 of February 5, 1976, the Federal Capital Territory (FCT) – Abuja was created and promulgated by the Gen. Murtala Mohammed led Federal Military Government, in response to the security challenges that were facing the former capital city of Lagos. According to the Military Government, a country's capital should be located in a hinterland in order to deal with internal uprisings and external attacks (Salisu, 2017). After years of planning and construction, it was on December 12, 1991 under the Military Government of Ibrahim Badamosi Babangida that Abuja officially became Nigeria's capital city, thus, replacing Lagos, the previous capital. Sumaila, (2013), opines that *"the relocation of the FCT was to put an end to the transportation issues in Lagos"*.

Abuja is situated in the middle of Nigeria, as shown in Figure 1.1, and lies between latitudes 7° 25' N and 9° 20' N of the Equator and longitude 5° 45' E and 7° 39' E of the meridian, spanning a landmass area of 7,315 square kilometres. Abuja is bordered by four states, Nassarawa State to the east, Niger State to the west, Kaduna State to the north, and Kogi State to the southwest.

Data from Nigeria's National Population Commission (NPC) show that in 2016, the population of the FCT was estimated to be 3.5 million persons (NBS, 2018b). According to the United Nations, the city of Abuja grew by 139.7% between the years 2000 and 2010, thus making Abuja the fastest growing city in Africa and in the world (Salisu, 2017). By 2015 estimates, Abuja experiences a minimum annual growth of 35%, thus retaining its position as the fastest growing African city (Abubakar, 2020).

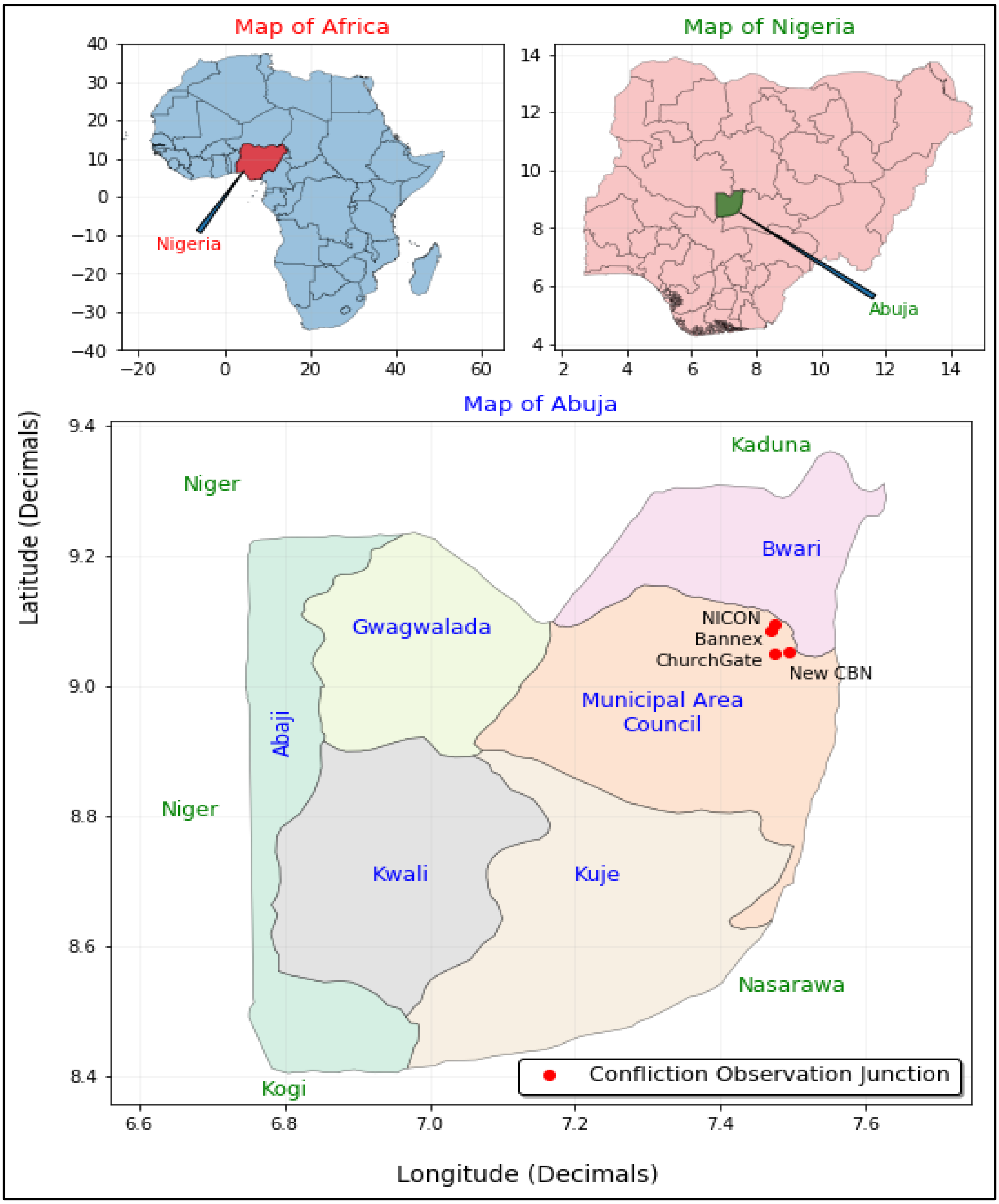


Figure 1.1: Map of Nigeria's Federal Capital Territory (FCT) – Abuja.

Nigeria is located in the tropics, with the country's general weather best described as a "tropical wet and dry climate". It has two seasons, rainy season and dry season. The temperatures vary according to these seasons. The daily average maximum and minimum temperatures in Abuja are 33 °C and 24 °C respectively. The rainy season in Nigeria starts from the end of March/early

April to late October/early November, while the dry season runs from November to March. During the rainy season months, the climate is quite humid, with temperatures dropping to as low as 20°C. The minimum temperatures occur around the months of August and September, while the maximum temperatures occur between the months of January and March. The mean rainfall and humidity in Abuja are about 119.2 mm and 58.4% respectively. The highest rainfall occurs in the month of August, while the lowest occurs between the months of November and March annually (Olajuyigbe et al., 2014).

As shown in Figure 1.1, the Federal Capital Territory (FCT) comprises six area councils namely: Abaji, Bwari, Gwagwalada, Kuje, Kwali and Municipal area councils. The Municipal area council is the main urban centre and the most developed of the rest area councils, comprising of five main districts; Asokoro, Central Business District, Garki, Maitama and Wuse. The Municipal area council houses the Central Business District and Three Arms Zone which is home to the seat of power, foreign embassies and most of the Ministries Departments and Agencies (MDAs) of the Federal Government, which include the National Assembly, the Legislative quarters, the Central Bank of Nigeria, Nigerian National Petroleum Corporation (NNPC) towers, the Federal Secretariat, the Presidential Villa (Aso Rock) among other things.

From the forgoing, the choice of Abuja for this study is due to its existing and known traffic problems, as the city currently experiences one of the worst annual rates of road traffic crashes and injuries in Nigeria (FRSC, 2016). From FRSC records, (FRSC, 2016), Abuja had the highest number of people involved in road traffic crashes in 2016. In 2016, 6,965 people were involved in road traffic crashes in Abuja, compared to 3,244 in Lagos, 5,392 in Kaduna and 2,359 in Kogi State. Abuja also had the highest road traffic deaths per 100,000 population in Nigeria in 2016 (13.13) compared to 7.5 in Nassarawa, 6.03 in Kaduna and 5.43 in Ogun State. This is also consistent with the average number of road traffic deaths per 100,000 population experienced in Abuja, from 2006 – 2016 (20.54), compared to 6.56 in Kaduna or 11.02 in Nassarawa State (FRSC, 2016).

The high living cost in Nigeria's capital city has seen most government workers migrating to more affordable neighbouring States (Kaduna, Nassarawa, Kogi and Niger), from where they commute very long distances to work daily, thus contributing to the road traffic deaths on the highways linking these States to Abuja. Also, with the challenge of ethical and successful data collection in Nigeria, the ease of collecting data as well as the relative security in Abuja when compared to other Nigerian cities, makes it a preferred study area. It is important to note that Abuja cannot be exclusively designated a proxy for the other 36 states in Nigeria, however, the causes of road traffic crashes, road user behaviours, traffic conflicts, road designs and general traffic safety issues experienced in Abuja, are similar to what is obtainable in other Nigerian states. Also, Nigeria's lead road safety agency, the Federal Road Safety Corps (FRSC) oversees traffic management and traffic data collection for all 36 States and Abuja, therefore, it is imperative to state that the successful implementation of the recommendations of this study in Abuja, can be easily and successfully replicated in other Nigerian states.

1.3 Research problem

The current trend of road traffic crashes, road traffic injuries and road traffic deaths in Abuja (despite relative improvements in traffic infrastructure, safer vehicles and improved education of road users), is a confirmation that road traffic safety in Nigeria deserves more attention than it currently gets, as the magnitude of the problem outweighs government's efforts towards stemming the trend (Olajuyigbe et al., 2014). Road traffic crashes in Nigeria are caused by multiple factors (see sections 2.2.1, 2.2.6 and 4.3.6), therefore, approaches towards solving road traffic crash problems ought to be multifaceted to achieve the desired results (Olajuyigbe et al., 2014).

From the foregoing, this research does not seek to replicate already available research on road traffic safety in Nigeria, as the road safety issues in Nigeria is replete with literature (Siyan et al., 2019; Aderamo, 2012b; Osawe and Osawe, 2010; Aderamo, 2012c; Asiyanbola et al., 2012; Atubi, 2010; Nwankwo and Nwaigwe, 2015; Korter et al., 2014; Adejugbagbe et al., 2015; Olamigoke and Adebayo, 2013; Ntaji, 2014). However, irrespective of these studies, there is minimal research and published literature, that assesses Nigeria's performance (successes or otherwise) with respect to the United Nations Decade of Action 2011 – 2020, road user behaviours and attitudes contributing to Road Traffic Crashes, as well as using traffic conflict techniques (TCT) to study safety problems on Nigerian roads. Prior to this study, only the studies by Uzondu et al., (2019), and Uzondu et al., (2018) have adopted a traffic conflict technique to investigate unsafe road user behaviours and the unsafe road locations associated with increasing traffic conflicts or crashes in Nigeria. The author was unable to find any previous study using DOCTOR as a Traffic Conflict Technique (TCT) in studying the road traffic safety situation in Nigeria's capital city Abuja or in any other Nigerian city. This study is different, as it also went beyond just being a conflict study by adopting interviews and questionnaire data to contribute to the existing knowledge of the safety issues currently bedevilling road transport in Abuja, Nigeria.

The research problem therefore is the identification and evaluation of the causes of road traffic crashes in Abuja, Nigeria, using an alternative non – crash based but safety – related evaluation of unsafe traffic interactions (traffic conflicts) with the potential of resulting in a traffic crash. These traffic conflicts are identified and classified in Chapter 4. Consequently, the research also involved carrying out an overview of the traffic situation in Nigeria, a questionnaire based investigation of road user behaviours in Abuja's urban centre, interview with the Federal Ministry of Transportation and the Federal Road Safety Corps on the challenges faced in their efforts towards reducing road traffic injuries and road traffic deaths.

1.4 Research aim

The aim of this dissertation is to understand the underlying unsafe behaviours and interactions of road users, causing the high frequency of Road Traffic Crashes (RTC) in Abuja, Nigeria. The outcomes of this research are important in the planning of effective crash reduction and prevention measures, which require the obtaining of accurate information about traffic conflicts.

1.5 Research objectives

To achieve the above aim, the objectives of this dissertation are:

- To assess Nigeria's overall performance with respect to the United Nations Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goals (SDG) Goal 3 target 6. Both aim at stabilising and reducing by 50%, the forecast levels of global road traffic deaths and injuries by the end of 2020.
- To identify and evaluate the major traffic safety issues causing increased Road Traffic Crashes (RTC) in the urban areas of Abuja, Nigeria.
- To evaluate the inadequacies of the road crash data from Nigeria's Federal Road Safety Corps (FRSC), stemming from high degree underreporting of crashes, lack of details of the few reported crashes, as well as a total lack of information about the processes that resulted in the crash.
- To understand road – user behaviour and attitudes to road safety issues in Abuja, Nigeria.
- To apply the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) in observing and identifying traffic conflicts in Abuja, having above normal severity levels and occurring frequently enough in sufficient amounts within some reasonable amount of time, thus indicating potential (un)safety problems which are capable of causing RTC.

1.6 Original contribution

Although the problem of high frequency of road traffic crashes is well known and has negative impacts on the safety of road transportation, there are still many research gaps in understanding its causes, evaluation and prevention. Previous studies focused on crash history as the main and only data source for Traffic Safety Evaluation (TSE) with little focus on the major causes of road crashes and the traffic interactions with potential to end in a crash, if not prevented by evasive actions. This is why a key part of this research adopts a non – crash based but safety – related evaluation of these overlooked traffic interactions.

As explained in the previous section (see section 1.3), the only available records of using surrogate safety measures “Traffic Conflict Techniques” to study traffic safety in Nigeria, are the studies by Uzondu et al., (2019) and Uzondu et al., (2018), which was carried out in Owerri, Imo State. The TCT adopted by Uzondu et al., (2018) and Uzondu et al., (2019), has the semblance of the Swedish TCT which they used in identifying unsafe behaviours like incorrect use of indicators, tailgating, and passenger scouting, amongst others at 3 different locations in owerri, Imo State. This study is original as it is the pioneer study adopting the Dutch Objective Conflict Technique for Operation and Research “DOCTOR” as a surrogate traffic safety evaluation technique, to study traffic conflicts at six locations in Abuja, Nigeria. It also went beyond just conflict studies with the aim of coherently combining other approaches of crash analysis, administering questionnaires and conducting interviews with road users in order to contribute to the knowledge of road safety in Abuja, Nigeria. The findings of this research aim to contribute towards the reduction of road traffic crashes in Nigeria. Furthermore, this research also assesses Nigeria’s overall performance with respect to the United Nations Decade of Action for Road Safety 2011 – 2020 whose goal is a 50% reduction in road traffic deaths and injuries by 2020, just as the deadline for the global goal approaches.

1.7 Dissertation Structure

This PhD dissertation is divided into six chapters as follows:

Chapter One: Introduction

Chapter one introduces the research, followed by a description of the study area, as well as the reasons for adopting Abuja as the case study. This chapter also gives an overview of the research problem, the originality of the research, and the research aim and objectives. This chapter concludes with the dissertation structure.

Chapter Two: Literature review

Chapter two is a literature review of studies relevant to this research. The literature review chapter covers the major causes of road traffic crashes and the scale of traffic safety issues in different countries, with a special focus on Nigeria. The literature review also covers measures for crash prevention and injury severity reduction. The chapter discusses the United Nations Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goals (SDG) Goal 3 target 6, and Nigeria's performance with respect to the set targets. The chapter also evaluates the road traffic crash data collection methods in Nigeria, and the limitations of data and data quality issues associated with developing countries like Nigeria. The state of the art with reference to the research problem, reviews different studies on Traffic Safety Evaluation (TSE) methods applied in developing countries, specifically non – crash based safety evaluations. Finally, the chapter identifies and highlights the key findings from the reviewed studies.

Chapter 3: Methodology

Chapter three is the research methodology chapter. This chapter provides a clear description of the methodological approach and specific steps adopted for the purpose of data collection for this research. The processes taken to get full ethical approval from the Science, Technology, Engineering and Mathematics (STEM) ethical review committee of the University of

Birmingham, is presented in this Chapter. The research adopts a mixed methods approach. Data collected include secondary road traffic crash data from the Federal Road Safety Corps (FRSC), registered vehicles from the National Bureau of Statistics (NBS) and population data on a state by state basis from the National Population Commission (NPC). Primary data was also obtained from field surveys via questionnaires and interviews, as well as from the traffic conflicts observations carried out in Abuja. In addition, the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) and the classification of unsafe traffic behaviours according to DOCTOR are discussed in this chapter.

Chapter 4: Results

Chapter four is the results chapter. The research findings are presented and interpreted in this chapter. The chapter begins with an introduction, followed by the findings of the research which are presented in three key sections. The road traffic crash data projection gives an overview of the transport safety situation in Nigeria and how far off Nigeria is with respect to meeting the goals of the United Nations Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goals (SDG) Goal 3, target 6, which is presented in the second section. The crash data provided by the FRSC was analysed using time series graphs, choropleth maps and bar charts. The second aspect of the findings is the analysis of the responses from the questionnaires and interviews. The questionnaires and interview responses were analysed using univariate and bivariate analysis which are presented in the form of bar and pie charts, cross tabulations, and Chi – Square tests. Furthermore, the traffic conflicts observation for all study locations, and a classification of the conflicts severity for the junctions are analysed and presented in the fourth section of this chapter.

Chapter 5: Discussion

The interpretation and overall implications of the findings from chapter four are further discussed in this chapter.

Chapter 6: Conclusion and Recommendation

This chapter summarises the key findings of this research and highlights the limitations encountered in the conduct of the research. Recommendations for further research are also made in this chapter.

CHAPTER TWO
LITERATURE REVIEW

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The challenge of Road Traffic Crashes is particularly critical in Low and Middle Income Countries, as records from the World Health Organization have shown that about 93% of worldwide road traffic fatalities occur in low and middle income countries even though, these countries have only around 60% of the world's vehicles but account for 85% of the total World population as shown in Figure 2.1 (WHO, 2018).

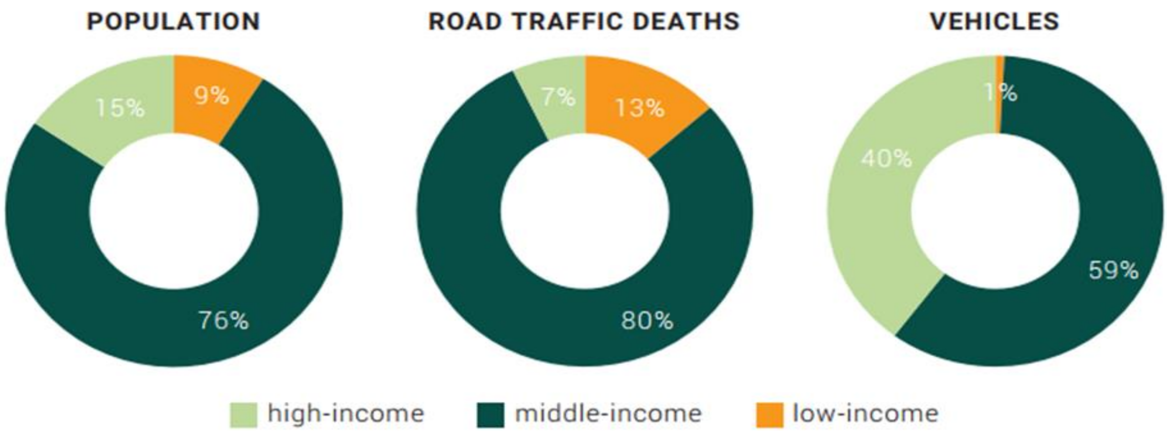


Figure 2.1: Population, Road traffic deaths and number of vehicles registered in low, middle and high income countries (WHO, 2018).

Petridou and Moustaki, (2000), showed that "*human factors collectively represent the principal cause of three out of five road traffic crashes*", and contribute to the causation of about 95% of all crashes.

Several Traffic Safety Evaluation methods have been used by various researchers to understand the causes of RTCs, and in proffering measures for the reduction of RTCs, however, these methods encountered a number of limitations (Mahmud et al., 2018; Archer, 2005; Elvik, 2008; Yang et al., 2012; St – Aubin, 2011). The first limitation has to do with the fact that Road

Traffic Crashes and fatalities typically have to occur before road safety issues can be understood and reduction measures proposed. The second limitation is that large historical datasets on Road Traffic Crashes and fatalities are required to understand the nature of the problems, and this is a challenge in Low and Middle Income Countries, as some of the countries have no reliable historical Road Traffic Crash data, or in cases where data exists, the number of cases of traffic crashes and injuries are usually underreported which might be unintentional and beyond the control of the traffic officers (Yang, 2012), however, in some cases, non – fatal cases (minor crashes) are usually overlooked. These challenges have led researchers to the use of non – crash based Traffic Safety Evaluation methods in understanding traffic interactions and proffering suggestions for the prevention and reduction of Road Traffic Crashes.

2.2 Road Traffic Crashes

The 2016 global causes of death released by the World Health Organization (WHO) showed that more people died from Road Traffic Crashes than from HIV, kidney disease, tuberculosis and hypertensive heart disease (WHO, 2018). Road injury was ranked eighth in the global causes of death in 2016 as shown in Figure 2.2, but it is predicted to rank higher in coming years, as other causes of death are likely to be solved to a greater extent, just as a growth in traffic is expected.

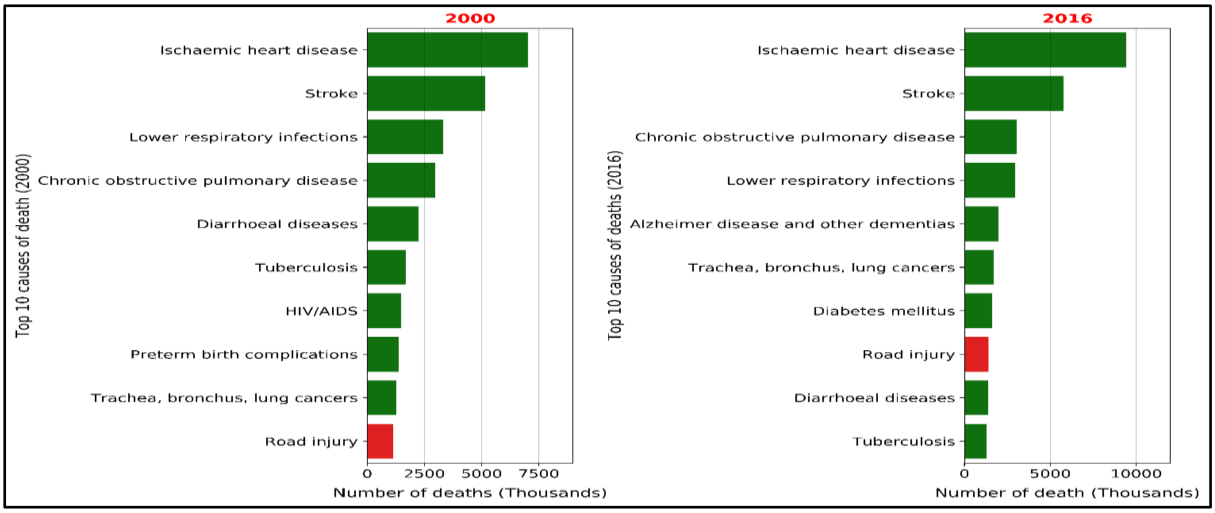


Figure 2.2: Top 10 causes of death in 2016 and 2000 (WHO, 2018).

It is also predicted that road traffic injuries could be the seventh leading cause of death by the year 2030 (WHO, 2015). There were approximately 1.25 million deaths worldwide due to Road Traffic Crashes in 2013, and the number of road traffic deaths continue to rise annually as shown in Figure 2.3, reaching 1.35 million deaths in 2016 which accounted for 2.4% of the total deaths globally. However, the fatality rate per 100,000 population has fallen slightly over the same period (from 18.8 to 18.2 as shown in Figure 2.3).

The persistent rise in the number of road traffic deaths has been a growing issue for many years but it was in 2003 that the United Nations recognised road traffic deaths as a major global issue and not just a transportation issue (Ward, 2009). In 2016, road injury was the leading cause of death for children and young adults aged 5 – 29. It was estimated by the WHO that 456,943 children and young adults aged 5 – 29 died as a result of Road Traffic Crashes which accounted for 33.8% of the people who died from Road Traffic Crashes. The high death rate especially among children and young people, shows that the Sustainable Development Goal (SDG) target 3.6 is far from being achieved by 2020. The SDG target 3.6 seeks to reduce road traffic deaths and injuries by half by the end of 2020.

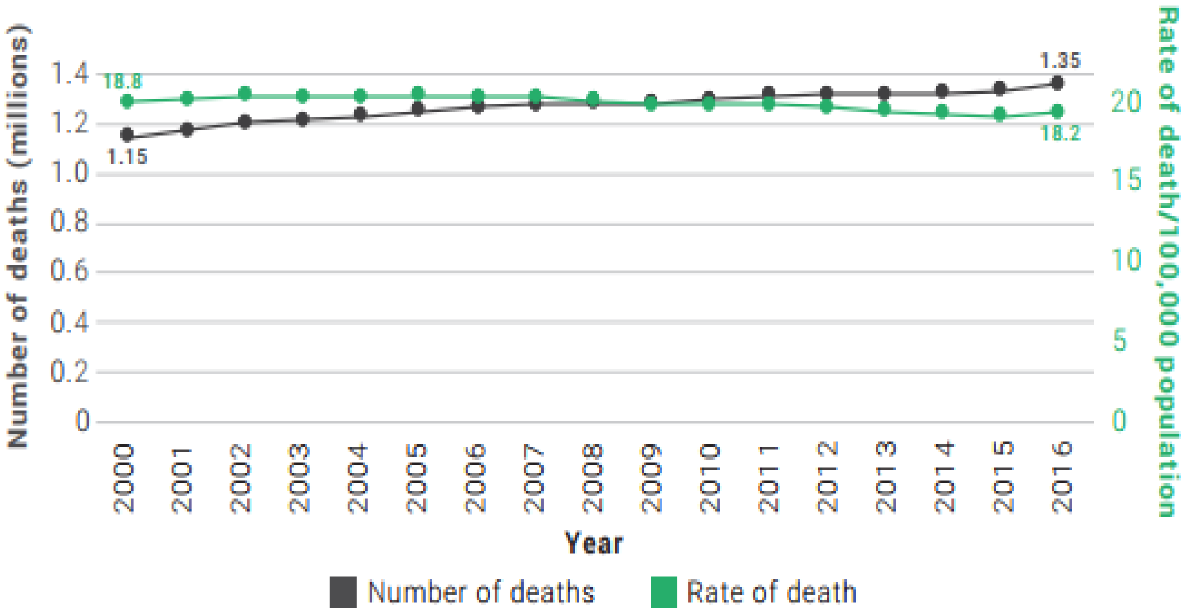


Figure 2.3: Number of deaths due to Road Traffic Crashes (WHO, 2018).

In terms of risk of death from Road Traffic Crashes, the fatalities per 100,000 population globally have been relatively constant around 18 fatalities per 100,000 population, but saw an increase from 17.4 in 2013 to 18.2 in 2016.

In 2003, the United Nations recognized Road Traffic Crashes as a global issue and not just a transportation issue. The report in 2009 on the global Road Safety crisis by the United Nations Secretary General revealed that the magnitude of Road Traffic Crashes is far greater than the effort and resources allocated in reducing Road Traffic Crashes.

At the 64th General Assembly of the United Nations on March 2, 2010; the Decade of Action for Road Safety 2011 – 2020 was proclaimed. The goal of the Decade of Action was to stabilise and reduce the forecast level of Road Traffic Crashes globally at the end of 2020 by half. Programmes and Strategies were setup by the United Nations for Countries to follow in order to help them achieve their targets through a series of indicators.

These programmes and strategies focused on improving road safety are known as the Pillars of Actions as shown in Figure 2.4 and they include road safety management, safer roads and mobility, safer vehicles, safer road users and post – crash response.

Pillar 1	Pillar 2	Pillar 3	Pillar 4	Pillar 5
Road safety management	Safer roads and mobility	Safer vehicles	Safer road users	Post-crash response

Figure 2.4: United Nations five Pillars of Actions (WHO, 2015).

Data from both National Road Safety agencies and the WHO show that most Low and Middle Income Countries (LMIC) will not achieve the Decade of Action goal for reducing the fatalities by half in 2020, as most Low and Middle Income Countries are showing an increase in fatalities, even those with decreasing fatalities like the Democratic republic of Congo and

Benin Republic are still far from achieving the Decade of Action goal for Road Safety (World Bank, 2015; WHO, 2016). The performance of Nigeria with respect to the decade of action has seen a fair progress in achieving its goals (IRTAD, 2017; IRTAD, 2018; IRTAD 2019). The five pillars used to evaluate the performance of the decade of action have each seen progress made so far. In terms of road safety management, the country has a leading agency that has been tasked with the road safety of the citizens, even though the data collection method and management has not been efficiently done. This is evident in the number of road traffic deaths reported by the Federal Road Safety Corps (FRSC) and the estimated road fatalities reported by the World Health Organization. Major discrepancies still exist in the number of road traffic deaths reported by FRSC and the WHO, which indicates underreporting by the FRSC. In terms of reducing the number of fatalities, the data from FRSC shows that there is a slight reduction followed by an increase in the number of road traffic fatalities in recent years but these figures contradict the estimated number of fatalities by the WHO, as data from the WHO shows that the fatalities continually increase. In terms of safety of cars, majority of the cars on Nigerian roads are still second hand cars that do not have the updated safety features (Oke, 2012).

2.2.1 General causes of Road Traffic Crashes

Road Traffic Crashes are responsible for the loss of lives and property that run into billions of dollars. The causes of Road Traffic Crashes can be mainly attributed to human behavioural factors (inexperience, excessive speeding, use of drugs etc.) both in young and older drivers. Petridou and Moustaki, (2000), suggest that three out of five Road Traffic Crashes can be attributed to driver behavioural factors. Treat et al., (1979) in their study reported that 90% of examined Road Traffic Crashes were definitely or probably caused by human errors and deficiencies, while the rest are caused by unsafe roads, environmental factors and vehicle conditions. Table 2.1 summarises a few identified causes of road traffic crashes and suggested ways of overcoming these causes.

Table 2.1: Summary of causes of Road Traffic Crashes and possible reduction measures

S/N	Causes	Examples	Reduction Measures
1	**Human factors**	Speeding, drink driving, driving under the influence of alcohol and other psychoactive substances, negligence, inexperience, risky and dangerous driving, pedestrian in road, law enforcement agent in road, distracted driving, unlicensed driving, driver error, fatigue, poor vision, age.	Driver education and training, enlightenment of road users, provision of pedestrian walk ways, pedestrian crossings and designated crossing areas, enforcement of traffic regulations, random testing of the blood alcohol levels of private and commercial drivers for, stricter drivers licensing process, update of outdated traffic laws and regulations.
2	**Vehicle/mechanical factors**	Design or mechanical faults including lack of maintenance, tyre burst, faulty brakes, defective lights, engine failure.	Motor vehicle testing and compulsory routine vehicle inspection.
3	**Road and Environment factors**	Poor road signage and road lighting, road design, road maintenance, construction work, broken down and abandoned vehicle, presence of animals on road, bad road, weather conditions.	Improved road designs, installation of clear road and traffic signs, installation of proper functioning street lights, installation of traffic lights and speed cameras, installation of speed bumps.

Rolison et al., (2018) suggests that the causes of Road Traffic Crashes are complex but mainly depend on the behaviour of the drivers. It has been reported in several studies that behaviours such as inexperience, excessive speeding and use of drugs exhibited by younger drivers tend to make them get involved in Road Traffic Crashes. McGwin and Brown, (1999), suggest that the skill level, inexperience and risk taking behaviours which cause Road Traffic Crashes are particularly common among young drivers. Lam, (2003), reported that young drivers with learner and provisional drivers' licenses have an increased chance of being involved in a traffic crash due to unusual and unexpected road features.

Speeding has been a major cause of Road Traffic Crashes in most countries especially in young drivers, and speeding accounted for majority of the road traffic fatalities in the World. Ansari et al., (2000), reported that speeding was the cause of 50% of the Road Traffic Crashes in Saudi Arabia. Excessive speeding among young drivers has also been a major contributing factor to road traffic crashes (Gonzales et al., 2005). Finch et al., (1994), suggests that an increase in the mean speed of 1% can result in a 4% increase in a fatal crash risk and a 3% increase in serious crash risk.

Studies have also shown that many Road Traffic Crashes and fatalities are caused by the intake of harmful drugs by young drivers. Bingham et al., (2008), reported that the use of illegal recreational drugs and alcohol are more associated with young drivers. Valen et al., (2017) also reported that the highest drug use among drivers in Norway was amongst drivers of less than 30 years. Kweon and Kockelman, (2003), reported that young male drivers are more likely to be involved in a fatal Road Traffic Crash than females due to their drugs use. Begg and Langley, (2004), also confirmed that more young male drivers are likely to be involved in Road Traffic Crashes than young female drivers due to their use of drugs. Although the higher crash rate for young males compared to young females is not solely due to illicit drug use, Drummer, (2008), suggests that the use of illicit drugs tends to reduce performance on divided attention tasks, it causes tunnel vision as well as an increase in risk taking, which is a trait common with young male drivers, thus, increasing the risk of crashes. The use of drugs such as benzodiazepines, opioid, cannabinoid and amphetamine are more predominant among drivers in High Income Countries than in Low and Middle Income Countries. Drummer, (2008), in a study of the role of drugs in road safety, surveyed about 500 injured drivers admitted to a major road trauma hospital in Australia, and reported that 46% of the drivers tested positive for cannabis products, 11% tested positive for opioid analgesics, and 4% tested positive for amphetamines. Cannabis (only second to alcohol) is the second most common drug found in

15% of fatalities in Victoria, Australia (Drummer, 2008). Marquet et al., (1998), carried out a collaborative study of the prevalence of drugs of abuse in urine of drivers involved in road accidents in France. From the emergency department of five hospitals in France, 296 drivers within the ages of 18 – 35, and 278 non – traumatic patients within the ages of 18 – 35 were recruited for the study, of which 28.4% of the drivers and 44.2% of the patients were females. Marquet et al., (1998), reported that 13.9% of drivers (16.0% of males and 8.3% females) tested positive for cannabinoids, while 10.5% of drivers tested positive for opiates. The risk of fatal crashes increases by five times when drivers take amphetamine while the risk for a non – fatal crash is increased by six times.

Elevated level of alcohol in the driver's blood can result in Road Traffic Crashes (RTC). Shyhalla, (2014), suggests that driving after drinking alcohol can significantly increase chances of getting involved in a crash and also increase the severity of the crash. Various countries have set National limits for Blood Alcohol Concentration yet this continues to be a major cause of road traffic crashes. IRTAD, (2019), attributes 15% of all fatal crashes in Norway in 2018 to the use of alcohol and attributes 7.3% of all road fatalities in Germany to alcohol. Fujita et al., (2014), in their study of the factors contributing to driver choice after hitting a pedestrian in Japan, reported that young drivers, drunk drivers, and drivers with no valid license are more likely to engage in hit and run, due to impulsiveness (Dahlen et al., 2005), risk – taking (Turner et al., 2004) and short – sightedness (Machin and Shankey, 2008). According to Fujita et al., (2014), drunk drivers were 8.20 times more likely to hit – and – run. This is not different in LMICs like Nigeria, although underreported due to a lack of breathalyser tests, the FRSC reports that only 1% of all fatal crashes are due to drink driving (FRSC, 2017; IRTAD, 2018).

The human behavioural factors that causes road crashes in older drivers are quite opposite from what is experienced in younger drivers. Older drivers tend to have difficulties in identifying traffic signs and estimating the correct distance of objects in front of them. Langford and

Koppel, (2006), reported that older drivers are more often prone to make errors at intersections and when making turns, therefore this behaviour could lead to road traffic crashes. Huiqin et al., (2009), also confirmed in their study that older drivers are mostly involved in intersection crashes. McGwin and Brown, (1999), found out that older drivers could not see clearly and identify objects in front of them. The problem of visual, cognitive and mobility functions of older drivers worsens with age and medical conditions of the drivers (Hu et al., 1998).

Other factors that contribute to road crashes such as safety of the roads and condition of transportation aid (vehicle, motorcycle etc.) are less frequently observed in developed countries. These factors are more predominant in Low and Middle Income Countries, as bad roads and the use of second hand vehicles which lack safety features e.g. airbags and crash avoidance systems are still very common on most roads. Most African countries serve as dumping grounds for used or crashed cars from High Income Countries (Ezeoha et al., 2018; Akloweg et al., 2011; Agbo, 2011) as shown in Figure 2.5.

Figure 2.5: A crashed and discarded car that would be repaired and used in Nigeria (Tokunbocars.ng, 2020).

The majority of cars being used in most African countries are repaired crashed cars imported from developed countries, without some required safety features such as airbags that would help in preventing fatality in case of road traffic crashes (Akloweg et al., 2011). Coupled with the use of repaired crashed cars, most drivers in Low and Middle Income Countries do not maintain their cars on a regular basis. Gbadamosi and Adenigbo, (2017), investigated the *"contributions of vehicle inspection operations to traffic system in Abuja, Nigeria*". According to Gbadamosi and Adenigbo, (2017), routine vehicle inspection is necessary to ensure vehicles are road – worthy and meet minimum safety standards. However, the two major challenges facing vehicle inspection services in Abuja is inadequate funding for vehicle inspection operations (Aruwa, 2014), and the over focusing on revenue generation at the expense of vehicle safety in Nigeria (Alade, 2012). Conclusively, vehicles are occasionally tested in Nigeria. In cases where vehicles get tested, the focus remains revenue generation (Alade, 2012).

Sobngwi – Tambekou et al., (2010), confirmed in their study that the major cause of fatal road crashes in Yaoundé – Douala road section, Cameroon was due to mechanical failure of vehicles. They reported that 28% of fatal road crashes in their study was directly attributed to tyre problems of the vehicles. Odero et al., (2003), also attributed vehicle effect (defective brake, tyre burst etc.) as the second major cause of road traffic crashes in Kenya, while human factors were considered to be the major cause of road crashes. The road state and design also contribute to road traffic crashes but its effect is not as severe as human factors and faulty transportation aid (vehicle). In Lagos Nigeria, common sights like the picture shown in Figure 2.6, are usually encountered on a daily basis in the country.

Figure 2.6: Heavy duty vehicles on bad roads in Nigeria (Vanguard, 2018).

A number of cases of road traffic crashes were attributed to heavy vehicles falling on lighter vehicles due to the bad road conditions. Other bad road designs that cause road traffic crashes in most Low and Middle Income Countries are sharp turns in the road, roads designed without safety signals, and no guard railing at the edges of the road.

2.2.2 Reduction of Road Traffic Crashes

The Global Status Report on Road Safety (WHO, 2018), stated that there are five major practises that can help reduce traffic crashes on the road. These practises include, managing of driver speed, testing driver blood for alcohol content, the use of seatbelts, the use of helmets and child restraints.

The speed at which one drives a car is directly correlated with the perceived risk of getting involved in a traffic crash, and increases the severity of injury or death if a crash is to occur (Vadeby and Forsman, 2018). Adeoye et al., (2014), in their study reported that the main contributing factor to road traffic crashes in Nigeria is over speeding. An example of Road

Traffic Crash (RTC) caused by speeding in Abuja, is shown in Figure 2.7. This is a common occurrence in Abuja where the roads are wide and free.

Figure 2.7: Resultant of speeding on Abuja's airport road (The Sun, 2018).

IRTAD, (2019) reported that inappropriate speed was the major cause of road traffic crashes in Nigeria in 2017. Excessive speed accounted for 44% of the fatal crashes in Nigeria in 2017 (IRTAD, 2019). Managing speed is one preventive measure that can be taken to reduce the number of road traffic crashes. Bachani, (2017), suggests that a small reduction in the speed of vehicles significantly reduces the chances of a fatal crash. WHO, (2017), reported that a 5% reduction in the average speed of vehicles can decrease the number of traffic deaths by 30%. A number of measures have been employed in managing speed and one such measure is setting of national speed limits. Most countries have set their speed limits for vehicles driving in urban areas to be 50km/hr and in residential areas to be 30km/hr. Enforcement of speed limits have been successful in High Income Countries but have not be quite successful in Low and Middle Income Countries. Enforcement of speed limits using automated or manual method will significantly increase the probability of detecting speed violators (Jurewicz et al., 2016). Bong – Min and Jinhyun, (2003), in their study reported that the number of crashes and fatalities reduced by 28% and 60% respectively in areas that had high fatality rates due to the fact that cameras were installed in those areas. Some of the issues which have made enforcement of speed limits unsuccessful in Low and Middle Income Countries are that road safety officers do not have the required tools e.g. speed guns to measure the speed of the vehicles and even if traffic offenders are caught they are rarely prosecuted for violating the national speed limits. Akple and Biscoff, (2012), reported in their study that installing hump ridge ramps (speed ramps) with pedestrian crossing road signs, forces drivers to reduce their speed and they recommended that hump ridge ramps (speed ramps) are better for managing of speed limit of driver in communities than in town.

Control of drink driving is also another important measure needed to be enforced in order to reduce traffic crashes. WHO, (2018), reported that 5% - 35% of all traffic fatalities are related to driving under the influence of alcohol. Elvik, et al., (2009), reported that driving under the influence of alcohol significantly increases your risk of getting involved in a traffic crash. Most countries have national limits for alcohol levels expected to be found in the blood of drivers. Japan set their Blood Alcohol Concentration (BAC) limit to be 0.25mg/l for breath and 0.5mg/ml for blood, Norway set their BAC limit to be 0.2g/l for blood and Nigeria set their BAC limit to be 0.5g/l for general drivers and 0.2g/l for professional drivers. A number of campaigns have been done to enlighten drivers about the effects of drink driving such as advertising the effects, hosting radio shows and road campaigns. These campaigns have helped to slightly reduce the number of cases of drink – driving. Other measures against drink – driving include conducting random tests on drivers to check their BAC level but these practises are rarely used in Low and Middle Income Countries including Nigeria.

Western Pacific and South East Asia recorded the highest fatality rate for 2 and 3 wheel vehicles in 2016. Global Status Report (WHO, 2018) reported that 43% of fatalities were recorded among 2 and 3 wheel vehicles in South East Asia while 36% were recorded in the

Western Pacific. Most people who get involved in traffic crashes in 2 and 3 wheel vehicles usually suffer from head injuries (MacLeod et al., 2010). Chalya et al., (2012) in their study reported that 58% of traffic crashes in the North – western part of Tanzania were attributed to motorcycles. They also reported that 52.1% of the injuries recorded due to motorcycle crashes were head injuries. Head injuries can be significantly reduced by the use of helmets. Liu et al., (2008), reported that 42% of fatal injuries and 69% of head injuries can be reduced by the use of a helmet.

Wearing of seatbelts is one of the cheapest measures that can prevent injuries and fatalities from traffic crashes yet most drivers do not like wearing their seatbelts. Enforcement of wearing of seatbelts in most Low and Middle Income Countries is weak, as most drivers and passengers do not regularly use their seatbelts. In Nigeria, the use of seatbelts in the front seat of vehicles has been compulsory since 1997 (but enforcement only started in 2002), in contrast, the enforcement of the use of seatbelts at the back seats have not yet started, owing to the ongoing amendment of the FRSC Establishment Act 2007 (FRSC, 2017; IRTAD, 2018). Popoola, et al., (2013) carried out a 24 hour observational study of compliance with seat belt usage among vehicle occupants in Makurdi, Nigeria. From the 500 vehicles observed in their study, overall compliance of seatbelt usage was 57.0%. In contrast to the findings by Popoola et al., (2013), from the studies by Sangowawa et al., (2010); Ismaila and Akanbi, (2010); Iribhogbe and Osime, (2008), seatbelt compliance in Nigeria ranges from 18.7% to 44.5% which is a confirmation of the very low compliance to seatbelt usage in Nigeria. According to Popoola et al., (2013), seatbelt compliance is low and enforcement is weak because of the insufficient manpower and patrol vehicles available to the FRSC for effective coverage. Although *"the law is silent on the provision of seatbelt in vehicles"* (Popoola et al., 2013), the information available on the FRSC website (https://frsc.gov.ng/offences-penalties-2/), prescribes a penalty of 2000 Naira (N2000) for driving without a seatbelt. Elvik et al., (2009) stated that wearing of seatbelts can reduce the risk of fatality among drivers and front seat passengers by up to 45% - 50% and reduce the risk of injuries to back seat passengers by 25%. In a study by Bong – Min and Jinhyun, (2003), they reported that there was a significant improvement in seatbelt wearing among drivers in Korea due to police enforcement. They reported that the seatbelt wearing increased from 23% to 98%, which was among the highest in the World.

Child restraint is also another preventive measure that can help to reduce fatalities in the event of a road traffic crash. Jakobson et al., (2005), reported that 60% of traffic fatalities can be reduced by using a child restraint. According to the UK law for child car seats, restraints and seatbelts, children must use child car seats until they turn 12 years or 135cm in height, whichever comes first. Children older than 12 or taller than 135cm must wear seatbelts (DfT, 2019b).

2.2.3 Road Safety in Developed Countries

Previous records on road fatalities have shown that there is a strong relationship between road fatalities and income level of countries as shown in Figures 2.8 and 2.9. Records have also shown that more road fatalities occur in Low and Middle Income Countries than in High Income Countries. According to the United Nations, a country is considered to be developed when its Gross Domestic Product (GDP) per capita per year is in excess of $12,000. The GDP is the total number of goods and services produced in a country for a calendar year and serves as a means, albeit felt to be flawed by many, to determine the wealth of a country. Apart from the GDP used for classification, other classification factors include; if the country is highly industrialized, if there is a good number of women in the workforce, and if the birth and death rate in the country is stable. According to the World Bank group, in 2019, there were 81 countries classified as High Income Countries. Countries with high GDP and income tend to have the lowest rates of road traffic crashes.

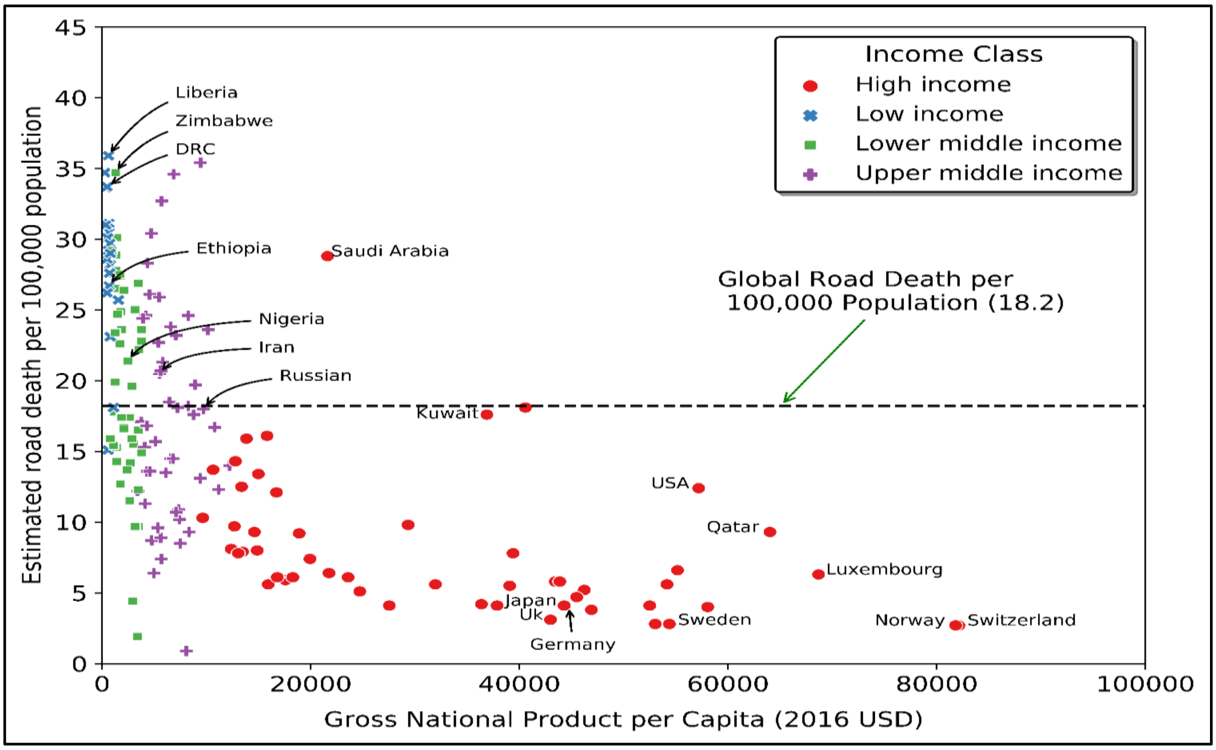


Figure 2.8: Fatality per 100,000 population against Gross National Income for various countries (WHO, 2018).

Norway, a developed country with a GDP per capita of $82,096 and a population of about 5.3 million people is considered to have one of the safest road networks in the World in terms of having the lowest rate of road traffic fatalities. Oslo, Norway, has a population density of 1533 inhabitants per km^2, compared to about 6,871 residents per km^2 obtainable in Lagos, Nigeria. Fatalities per 100,000 population in Norway was 3.8 in 2013 but declined to 2.7 in 2016 (WHO, 2018). The fatalities per 100,000 population in 2018 was 2 (IRTAD, 2019) compared to 7.6 fatalities per 100,000 population recorded in 2000. The long term trend of road traffic fatalities in Norway has been on the decline for the past two decades, as the fatality rate per 100,000 population has reduced by 73% between 2000 and 2018. The lowest number of fatalities in Norway's history was recorded in 2017, with 106 road deaths (IRTAD, 2019). In 2018, the highest fatalities among road users in Norway was recorded among passenger car users, who accounted for more than 57% of the total road deaths recorded in 2018. From the report by the WHO, Norway had the lowest numbers of fatalities among road users of age 18 – 25 in 2018. Excessive speeding and the use of alcohol were the two main factors that contributed to road traffic crashes in Norway in 2018. IRTAD, (2019), identified that 18% of fatal crashes in 2018 were attributed to the use of alcohol. In a study done by Valen et al., (2017), they reported that the use of drugs also contributed to road traffic crashes in Norway. They also reported that the number of positive drug tests for drivers increased by 60% from 2000 – 2015, which might be due to improved testing. The highest rate of drug use was among young persons below the age of 30. Valen et al., (2017), also reported that another common factor that contributed to road traffic crashes in 2018 was fatigue and sleepiness. They reported that 13% of the total fatal crashes were attributed to fatigue and falling asleep while driving.

Germany had a GDP per capita of $48,275 in 2018. Road traffic crashes have been on a decline since the year 2000 in Germany. In 2018, it was recorded that about 3,275 lives were lost to road traffic crashes (IRTAD, 2019), which was slightly higher (by 95 deaths), than the fatalities recorded in 2017. The fatality per 100,000 population was 4.3 in 2013, without any significant reduction in the fatalities per 100,000 population in recent years. In 2016, the fatalities per 100,000 population was 4.1 and in 2018 the fatalities per 100,000 population was 4, this shows a reasonably constant rate in the fatalities per 100,000 population. In terms of risk of death from RTC, the long term trend shows that the fatalities per 100,000 inhabitants has reduced by 57% from 2000 – 2018. Richter et al., (2004), reported that a high number of RTC in Germany were associated with passengers cars. According to IRTAD, (2019), passenger cars had the highest contribution to road traffic crashes. It was also reported that 48% of the total road deaths in Germany, were associated with passenger cars. Richter et al., (2004), reported that the elderly are the most affected by RTC. Yang and Otte, (2007), agreed also in their study that the elderly pedestrians in Germany were the most affected by road traffic deaths. Road traffic crashes in Germany are usually caused by inappropriate speed and elevated levels of alcohol in the driver's blood.

Japan and Switzerland which are also developed countries have seen a reduction in the number of road traffic fatalities in the past two decades. Japan recorded 3.5 fatalities per 100,000 inhabitants in 2017 while Switzerland recorded 2.7 fatalities per 100,000 inhabitants in 2018. Both countries have seen significant decline in the number of Road Traffic Crashes and also in the fatalities per 100,000 inhabitants. Both countries have seen more than a 55% reduction in the fatalities per 100,000 inhabitants from 2000 – 2018 (IRTAD, 2019).

Sweden has also seen a significant reduction in the number of fatalities per 100,000 population. In 2018, the fatalities per 100,000 population recorded was 3.2, which was a significant improvement from the year 2000 that recorded 6.7 fatalities per 100,000 population (IRTAD, 2019).

In the United Kingdom, there has been a significant reduction in the number of road fatalities in the last decade. The road fatalities per 100,000 population recorded in 2013 was 2.9 but there was an increase in the fatality rate to 3.1 in 2016. As at 2017, the fatalities per 100,000 population recorded in the United Kingdom was 2.8. There has been a 48% reduction in the annual road fatalities from 2000 – 2017 (IRTAD, 2019). The United Kingdom is currently among the top 10 leading countries with the least road fatalities per 100,000 population. Occupants of passenger cars recorded the highest number of fatalities. Car occupants in 2018, accounted for 44% of total fatalities, and 59% of total casualties. Pedestrians accounted for 26%, motorcyclists 20%, and pedal cyclists 6% (DfT, 2019a).

Most developed countries show that the elderly are the most affected by Road Traffic Crashes. Similar trends were observed for most developed countries, as the number of crashes and fatalities per 100,000 inhabitants have been on the decline as shown in Table 2.2.

Table 2.2: Fatality per 100,000 population for some Developed Countries

S/No	Country	2015 GDP per capita	Country Status	Fatality/100,000 population		Fatality Status
				2013	2016	
1	Norway	74,355.5	Developed	3.8	2.7	Decreased
2	Switzerland	82,081.6	Developed	3.3	2.7	Decreased
3	Sweden	51,397.2	Developed	2.8	2.8	Constant
4	Singapore	55,646.6	Developed	3.6	2.8	Decreased
5	Netherlands	45,175.2	Developed	3.4	3.8	Increased
6	Denmark	53,254.9	Developed	3.5	4	Increased
7	Spain	25,732	Developed	3.7	4.1	Increased
8	Japan	34,524.5	Developed	4.7	4.1	Decreased
9	Ireland	61,995.4	Developed	4.1	4.1	Constant
10	Germany	41,139.5	Developed	4.3	4.1	Decreased
11	Israel	35,776.8	Developed	3.6	4.2	Increased
12	Finland	42,811.2	Developed	4.8	4.7	Decreased
13	Cyprus	23,333.7	Developed	5.2	5.1	Decreased
14	Austria	44,178	Developed	5.4	5.2	Decreased

Source: World Bank, (2015) and WHO, (2016).

This decline in Road Traffic Crashes and road deaths, show significant progress towards achieving the goal of the UN Decade of Action for road safety, aimed at having safer roads around the World which will ultimately reduce the number of deaths due to Road Traffic Crashes.

2.2.4 Road Safety in Developing Countries

The Global Status Report, (WHO, 2018) reported that Low and Middle Income Countries contributed 97% to global road traffic fatalities in 2018. Most African countries including Nigeria are regarded as Low and Middle Income Countries and they contributed the most to the global fatality rate. The top three fatality rates per 100,000 population in 2016 (see Figure 2.9) were recorded in African countries, with Liberia having a fatality rate of 35.9 followed by Democratic Republic of Congo with a fatality rate of 33.7. Nine out of the top 10 countries having the highest fatality rates are African countries. African countries recorded traffic injuries 40% more than other Low and Middle Income Countries and 50% higher than the global average (Hailemichae et al., 2014; Fekede et al., 2014).

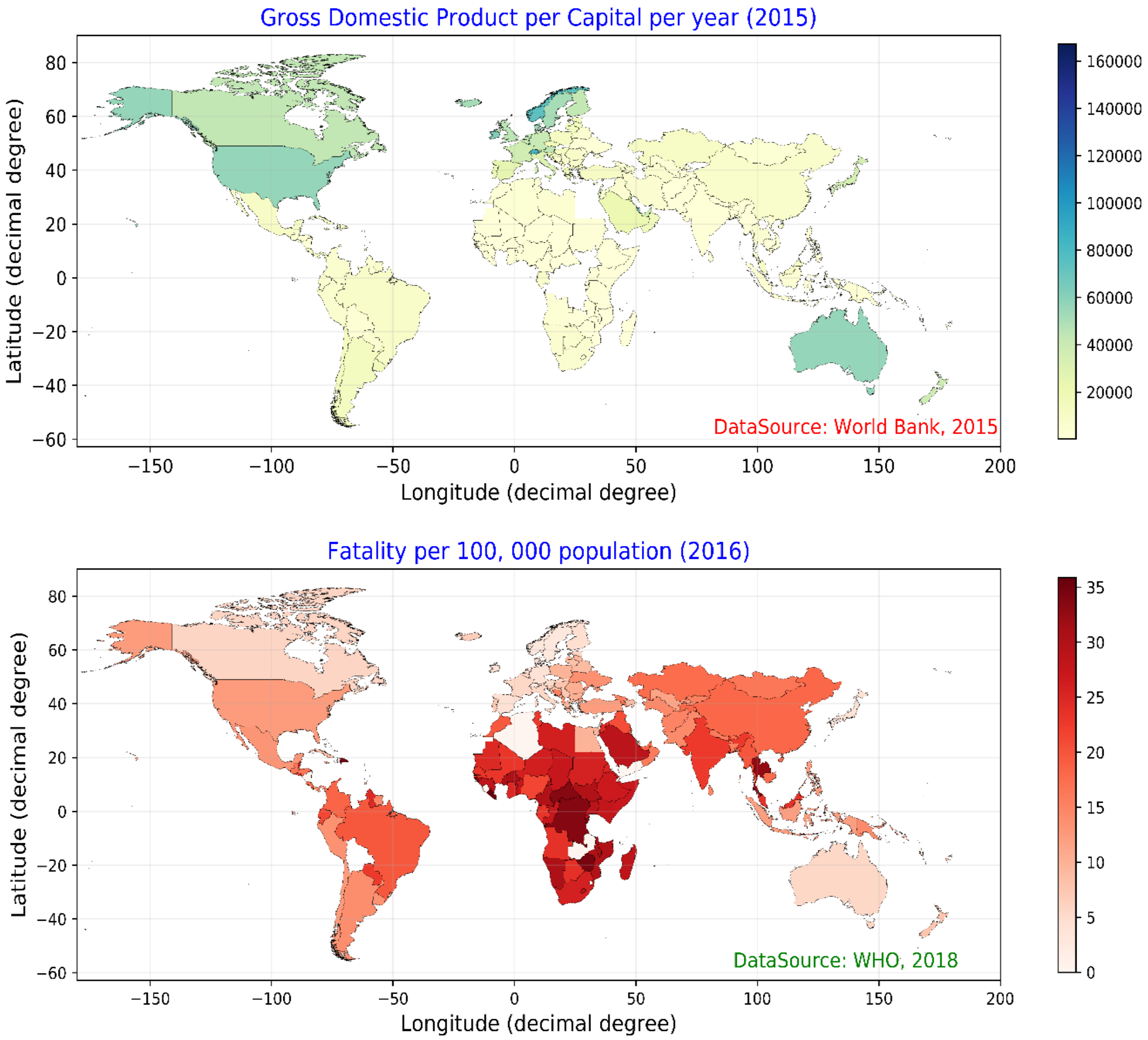


Figure 2.9: Gross Domestic Product (GDP) per capital per year and Fatality per 100,000 population (World Bank, 2015 and WHO, 2018).

African countries still record such high fatality rates due to several reasons including but not limited to a lack of post – crash treatment facilities, emergency response units, exposure, road user behaviours, condition of roads and vehicles. Hordofa et al., (2018) in their study emphasised that the high road fatalities indicate a lack of emergency medical care services and lack of post – crash hospitals. Most of the fatalities recorded in Africa involve vulnerable road users. Ogendi and Ayisi, (2011), reported in their study that 38% of all African road deaths occur among pedestrians. Road Traffic Crashes in most Low and Middle Income Countries have not significantly decreased over the last two decades rather it was reported that 77 Low and Middle Income Countries saw the number of road traffic fatalities increase in 2016 (WHO, 2018).

In 2016, the risk of death from road traffic crashes was higher in low and middle countries than high income countries. The fatalities per 100,000 population was three times higher in low and middle income countries than in high income countries. The average deaths per 100,000 population in low and middle income countries was 27.5 compared to 8.3 deaths per 100,000 population in high income countries. Africa and South East Asia were the regions with the highest fatalities per 100,000 population with 26.6 and 20.7 deaths per 100,000 population respectively while Europe had the lowest fatalities per 100,000 population with 9.3 deaths per 100,000 population (WHO, 2018). Vulnerable road users e.g. pedestrians, cyclists and motorcyclists were the most affected, as they account for more than half of the deaths attributed to road traffic crashes. Africa had the highest proportion of pedestrian and cyclist mortalities with 44% deaths (WHO, 2018). Many high income countries have succeeded in reducing road traffic crashes and deaths, but in many low and middle income countries, there have been challenges in creating policies and enforcing the policies that would help in reducing road traffic crashes.

In Iran, Road Traffic Crashes were the third leading cause of death after coronary heart disease and stroke (Meskarpour_Amiri, et al., 2017; Saadat et al., 2015). Road traffic crashes have been a major cause of death in Iran over the last two decades and the country ranks among the top 10 countries with the highest fatalities due to road traffic crashes. Rasouli et al., (2008), reported that as high as 209,923 road fatalities were recorded in the country in 2006. The fatality rate per 100,000 population in that year was 39.1 but there has been a sharp decline in recent years. The fatality rate per 100,000 population recorded in 2013 was 32.1 but dropped to 20.5 in 2016. Despite the rapid drop in the fatality rate, Iran still has a fatality rate higher than the global fatality rate of 18.2. In 2016, the highest fatality rate was recorded among occupants of 4 wheel cars.

Ethiopia is ranked 27th on the list of countries with the highest road traffic fatalities. The fatality rate per 100,000 population has been on the increase for the past 15 years. In 2013, the fatality rate per 100,000 population was 25.3 but increased to 26.7 in 2016 (WHO, 2018). Teferi and Samson, (2019), in their study reported that approximately 47.1% of the causalities of Road Traffic Crashes are between the ages of 15 – 27. They reported that 15.3% of the people involved in Road Traffic Crashes were either minors under the age of 15 or seniors over the age of 64years. The Global Status Report on Road Safety, (WHO, 2018), also reported that 37% of the people involved in Road Traffic Crashes in Ethiopia were pedestrians. Abegaz and Gebremedhin, (2019), claim that 65% of the victims involved in Road Traffic Crashes in Ethiopia were male.

Despite the continuous long term reduction in the fatality rate in Russia in the last decade, Russia has continuously ranked in the top five countries with the highest fatality rates in the WHO European region. In 2016, Russia had the highest fatality rate per 100,000 population followed by Armenia. The Global Status Report on Road Safety, (WHO, 2018) reported that there were 25,969 road traffic fatalities in the country. Russia recorded 18.9 fatalities per 100,000 population in 2013 but saw a reduction in the fatality rate to 18.0 in 2016.

The general trend in most Low and Middle Income Countries has seen the number of Road Traffic Crashes and road deaths on the rise in recent years (see Table 2.3).

Table 2.3: Fatality per 100,000 population for some Developing Countries.

S/No	Country	2015 GDP per capita	Country Status	Fatality/100,000 population		Fatality Status
				2013	2016	
1	Liberia	710.4	Developing	33.7	35.9	Increased
2	Zimbabwe	1,445.1	Developing	28.2	34.7	Increased
3	Burundi	305.5	Developing	31.3	34.7	Increased
4	Dominican Republic	6,921.5	Developing	29.3	34.6	Increased
5	Central African Republic	377.3	Developing	32.4	33.6	Increased
6	Thailand	5,840	Developing	36.2	32.7	Decreased
7	Guinea-Bissau	603.2	Developing	27.5	31.1	Increased
8	Malawi	380.6	Developing	35	31	Decreased
9	Burkina Faso	575.3	Developing	30	30.5	Increased
10	Namibia	5,032.9	Developing	23.9	30.4	Increased
11	Mozambique	589.9	Developing	31.6	30.1	Decreased
12	Cameroon	1,327	Developing	27.6	30.1	Increased
13	Rwanda	728.1	Developing	32.1	29.7	Decreased
14	Togo	570.7	Developing	31.1	29.2	Decreased
15	Uganda	709	Developing	27.4	29	Increased
16	Nigeria	2,730.4	Developing	20.5	21.4	Increased

Source: World Bank, (2015) and WHO, (2016).

Most Low and Middle Income Countries have the fatality rates exceeding the global average number of fatalities per 100,000 population of 18.2 (as shown earlier in Figure 2.3). The issue of Road Safety is a major concern in Low and Middle Income Countries as most of the challenges that contribute to Road Traffic Crashes have not yet been fully addressed which is evident in the increasing number of traffic crashes and fatalities in recent years, as shown in Table 2.3. Some of the challenges experienced in Low and Middle Income Countries are poor infrastructure, weak road safety institutions, lack of enforcement of road traffic safety laws, behavioural issues of the road users, and underreporting of Road Traffic Crashes.

The issue with infrastructure is that many of the roads in Low and Middle Income Countries are poorly designed and without sufficient (and clear) signage on the roads, especially in African countries like Nigeria (Ezeibe et al., 2019). Most roads found in Low and Middle Income Countries are usually narrow and they contribute to Road Traffic Crashes. Adejugbagbe et al., (2015) in their study reported that most traffic crashes that occur in Ibadan in Nigeria were on narrow roads and bad portions of tarred roads. Another infrastructure problem encountered on roads in Low and Middle Income Countries are unguarded medians on highways (Mandar and Pradip, 2014) as seen in Figure 2.10. Mandar and Pradip, (2014) reported that a good number of roads found in India do not have any barriers at the median, and this could lead to traffic crashes if a driver losses control and ends up at the other lane of the road. Other infrastructure issues that contribute to Road Traffic Crashes are the lack of pedestrian bridges on roads with vehicles moving at very high speed. Annie et al., (2016), in their study witnessed a pedestrian get hit by a bus while trying to cross the road. Other poor infrastructural road designs seen in Low and Middle Income Countries include sharp turns on roads, abrupt drop of lanes and short entry lengths for merging traffic.

Weak traffic safety institutions have also been a challenge of road safety in Low and Middle Income Countries. Most Low and Middle Income Countries have a lead agency that is responsible for traffic safety but these agencies do not significantly contribute to the reduction of traffic crashes due to a number of issues. One major issue that affects most traffic agencies responsible for traffic safety is lack of funding, as most of the agencies lack the necessary equipment that would aid them in carrying out their jobs effectively. Another issue these agencies face is the poor enforcement of traffic laws as well as the inability to prosecute traffic offenders, because the violation of traffic rules remain common, since their enforcement is very lax in Developing Countries (Khanal and Sarkar, 2014; Afukaar, 2010; Assum, 1998).

Figure 2.10: Median drain with steep slope (Source: Mandar and Pradip, 2014).

The socio economic issue has been a challenge of road safety in Low and Middle Income Countries for quite a long time. The economy of most Low and Middle Income Countries have forced citizens to neglect essential things like car maintenance, and purchasing of vehicles with updated safety features due to the lack of funds available to them. Bhatti et al., (2009), in their study attributed the main cause of road traffic crashes in Yaounde – Doula in Cameroon was due to mechanical failure (tyre bursting etc.). It was reported that 28% of the road traffic crashes recorded were due to tyre bursting. Due to the cost implications, drivers in Low and Middle Income Countries do not see the need to change their car tyres or maintain their vehicles, provided the vehicles can still move.

The behavioural attitude of drivers in Low and Middle Income Countries is another major challenge. Most commercial drivers in Nigeria have this habit of driving against the direction of traffic in order to beat traffic, which poses as a serious traffic safety challenge. Another major behavioural attitude that drivers in Low and Middle Income Countries exhibit, is the lack of discipline to stay on a single lane, thus regularly changing lanes in order to beat traffic thereby increasing the possibility of getting involved in a crash. The poor seatbelt compliance among drivers (Woldegebriel et al., 2019; Sadeghnejad et al., 2014; Afukaar et al., 2010; Simons and Edunyah, 2014; Popoola et al., 2013; Sangowawa et al., 2010) and use of mobile phones while driving (Omolase, 2008; Shabeer and Wahidabanu, 2012; Shi et al., 2016; Zhou et al., 2016) are also common in Low and Middle Income Countries.

2.2.5 Transfer of Road Safety best practices to Developing Countries

According to the Global Status Report on Road Safety (WHO, 2018), the WHO utilises negative binomial modelling to provide estimates of fatalities in both developed and developing countries. According to the WHO, based on official Road Safety data collection sources, there is an 88% reporting accuracy of reported road fatalities in High Income Countries, in contrast, the reporting accuracy is estimated to be 52% in LMIC and 17% in LIC (Heydari et al., 2019). Although underreporting in LMIC might be unintentional, it can also be due to a number of factors including the utilisation of paper records for the collection of crash data against the electronic means utilised in High Income Countries (Bonnet et al., 2017). The focus on mainly crashes resulting in injuries, or involving the loss of life or property, due to the limited capacity of the police force and safety agencies in most developing countries also contributes to the underreporting of road crashes (Magoola et al., 2018; Samuel et al., 2012; Bhatti et al., 2011).

To improve the quality and accuracy of road crash data collection, it is important for developing countries to apply lessons from successful Road Safety campaigns and interventions in developed countries. However, it is important to note that "*the challenges and issues involved in improving Road Safety in developed countries are likely to be different in developing* *countries*" (Heydari et al., 2019; Wang et al., 2013), therefore, in the process of replicating ideas from developed countries, the realities in developing countries should be factored – in. Heydari et al., 2019, suggests that an engineering intervention could possibly result in different scales of successful Road Safety improvements even with similar traffic legislation, traffic exposures, infrastructure improvements, and roadway characteristics. There is also the belief that although the effectiveness of an intervention could be marred by factors including the difference in road user behaviours, it would not entirely render the engineering interventions ineffective (Heydari et al., 2019).

In improving the quality and accuracy of Road Traffic Crash data, several studies have combined police records with that of patients admitted in the hospital due to Road Traffic Crashes. Most of these studies (Amoros et al., 2007, Amoros et al., 2018, Bauer et al., 2018, Broughton et al., 2010, Conderino et al., 2017, Alsop and Langley, 2001, Meuleners et al., 2006, Watson et al., 2015, Ma et al., 2012) were in developed countries in Europe, Australia, America and Asia. In contrast, only a few studies in Africa (Abegaz et al., 2014, Sango et al., 2016, Magoola et al., 2018) assess underreporting of crash data by comparing police and hospital data, using the capture – recapture analysis method which is mostly used in rectifying inaccuracies associated with road crash reporting (Heydari et al., 2019). In cases where improving the quality of crash data seems impossible due to data quality issues and limitations, alternative proactive approaches to obtain data are suggested. Observing unsafe road user behaviours (see section 2.3.1.2), is capable of addressing underlying road safety issues prior to crashes occurring (Chang et al., 2017).

Heydari et al., (2019), summarises under three broad themes of Education, Enforcement and Engineering (3Es), policy interventions to impact Road Safety positively in developing countries. Education, enforcement and engineering (road design, traffic management) are all relevant to this research. This summary focuses more on those Road Safety interventions which might usefully be learned from the experiences of developed countries in general and can be applied to the Road Safety problems in Africa and more specifically Nigeria.

Road Safety education and awareness campaigns are the most replicable Road Safety interventions in Low and Middle Income Countries (Esperato et al., 2012). For this single reason, Salmon and Eckersley, (2010), suggest the transfer of Road Safety education from developed to developing countries. Legislating and enforcing the regular education of road users, especially children and students about Road Safety and proper road user behaviours could effectively impact and help reduce the number and severity of Road Traffic Crashes (Heydari et al., 2019; Zimmerman et al., 2015; Staton et al., 2016). However, families and communities are expected to influence children and young road users, as well as the incorporation of Road Safety education into formal school curriculums and programmes (Bachani et al., 2017). The major challenges however, in transferring educational practices and awareness from developed to developing countries, remains the difference in literacy levels, educational systems, teaching methods, technology, exposure to risks and traffic regulations (Heydari et al., 2019). Road safety education is suggested to be carried out using local languages, to reach audience with a difficulty in understanding English. The enforcement of Road Safety legislations have been earlier highlighted in section 2.2.2 above.

2.2.6 Road Safety in Nigeria

Nigeria is heavily reliant on road transportation as the primary means of getting from one place to another, and it accounts for about 80% of how freight and humans move from one place to another (Badejo, 2007). The over reliance on road transport as the primary means of transportation is due to the inadequacy of other means of transportation (rail and water). The other viable means of transportation is air transport, but this is relatively expensive for most Nigerians. The over – reliance on road transportation as the primary means of transportation has resulted in the increase in the number of Road Traffic Crashes.

The problem of road traffic crashes in Nigeria can be traced to 1913, when the first transport law (the Highway Ordinance Law) was passed in order to help reduce road traffic crashes to the barest minimum (Afolabi and Gbadamosi, 2017). Several laws have been passed (including the nation – wide ordinance in 1916 after the 1914 amalgamation of the southern and northern protectorates; the 1940 and 1945 law, reviewed and modelled after the United Kingdom Road Traffic Act of 1930; the Road Traffic Act; The Federal Highway Act; The Law of Carriage; The Federal Road Safety Commission Decree of 1988, and the amendment of the FRSC decree in 2007), but still, the problem of Road Traffic Crashes continue to persist despite the series of reviews and amendments in transport laws (Afolabi and Gbadamosi, 2017).

The average fatalities per 100,000 population in Nigeria from 1976 – 1980 was 10.1, however, the fatality figures per 100,000 population has continued to increase as the number of vehicles in the country increases. In 2013, the Federal Road Safety Corps (FRSC) reported that there were 6,544 fatal crashes in the country, and in 2016 the number decreased to 5,053 which was an underestimation of the World Health Organization (WHO) records. For example, in 2013, the WHO estimated that the road fatalities in Nigeria were 35,641, and increased to 39,802 in 2016. The reports from FRSC and WHO showed a big discrepancy in the number of fatal crashes which indicates data reliability issues in Nigeria. It has been well stated in several studies that most Low and Middle Income Countries underreport their road crash numbers due to inconsistent, unreliable and poorly funded reporting systems (Hordofa et al., 2018; Asogwa, 1992). As explained in the previous chapter (see section 1.1), the World Health Organization (WHO) utilises data reported by countries and secondary sources, adjusted data accommodating the 30 – day definition of a road traffic death and modelled estimated numbers using a regression model to provide estimates of fatalities in both developed and developing countries.

The sharp rise and fall of the number of road fatalities reported by the FRSC particularly in year 2001 and 2005 as shown in Figure 2.11 questions the reliability of the FRSC crash data. Asogwa, (1992), reported that crash data is usually underreported in Nigeria, particularly non – fatal crashes. In 2013, the WHO reported that the fatality rate per 100,000 population was 20.5, but increased by 4.2% in 2016. In 2016, Nigeria ranked as the sixty second country with the deadliest roads in the World. Asogwa, (1992), reported that young adults were the most affected in road traffic crashes. Adeoye et al., (2014), in their study also confirmed that young adult males were the most affected due to road traffic crashes. They reported that three quarters of the victims of road traffic crashes were young adults. Global Status Report on Road Safety (WHO, 2018), reported that young adults and particularly children are mostly affected by RTC. It was also reported that 80% of the victims of road traffic fatalities were males.

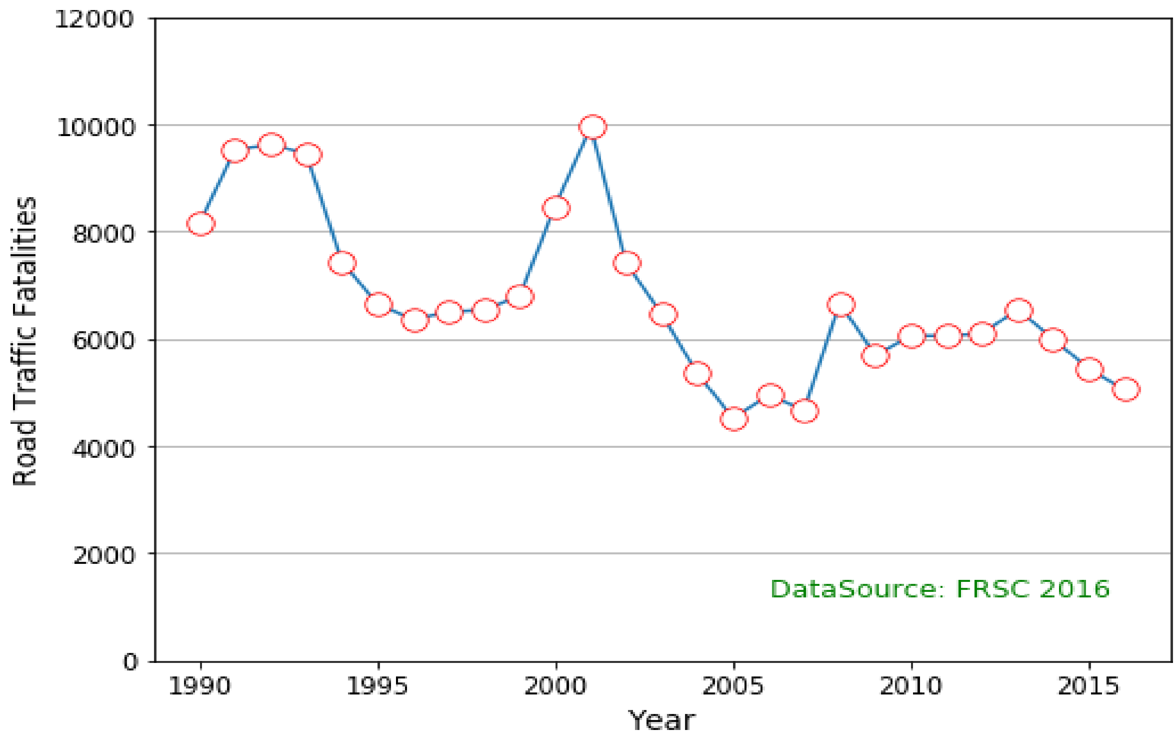


Figure 2.11: Trends of road traffic fatalities in Nigeria from 1990 to 2016 (FRSC, 2016).

Adeoye et al., (2014), in their study of Nigeria reported that the major factors contributing to Road Traffic Crashes were over speeding, driver misjudgement and sleeping drivers. They reported that 80% of the road crashes in their study were attributed to over speeding, driver misjudgement and sleeping drivers, with strong links to bad road designs and poor traffic management. Adejugbagbe et al., (2015), in their study attributed Road Traffic Crashes to substance abuse (e.g. kolanut, alcohol and cigarettes) by young commercial vehicle drivers who engage in long trips.

2.2.7 Limitations of Road Traffic Crash data collection in Nigeria

The setting up of an efficient data management system is mandatory for all countries, if the goal of the Decade of Action is to be achieved. Effective data collection, the management of crashes, injuries, and fatalities as well as categorising vehicles involved in crashes is important in understanding the traffic situation and proffering solutions to traffic challenges.

Several studies have reported that Road Traffic Crashes (RTC) and fatalities are heavily underreported in most Low and Middle Income Countries (Asogwa, 1992; Sobngwi – Tambekou, et al., 2010; Hordofa et al., 2018). In Nigeria, road traffic data were solely collected by the Nigerian Police from 1960 to 1988 (Asogwa, 1992), however, with the formation of the Federal Road Safety Commission (now Federal Road Safety Corps) in 1988, the Federal Road Safety Corps (FRSC) is now responsible for the collection of road traffic data nationwide.

As explained in the previous chapter (see section 1.1), there is no obligation for members of the public to report all crashes to the Federal Road Service. In Nigeria, traffic crashes that do not result in death are likely not to be reported and documented by the FRSC (Asogwa, 1992). Another factor that encourages underreporting is that the parties involved in a crash may agree without the need for an intermediary, thus, handling medical bills and repair of the damaged vehicles within themselves without notifying the Police or the FRSC. Another issue responsible for underreporting is that some victims who sustain broken bones or injuries due to Road Traffic Crashes prefer to use native healers for their injuries rather than going to the hospital for treatment. This leads to crash victims not captured in hospital records. In an effort to solve the issue of underreporting, the National Committee on Road Traffic Crash Information System (NACRIS) was inaugurated in April 2014, the committee was tasked with the responsibility of collating crash data and fatalities from different agencies (FRSC, National Bureau of Statistics, Police, Hospital, Vehicle Inspection Officers) in order to have a comprehensive account of the road crashes and fatalities that occur in Nigeria (IRTAD, 2018).

2.3 State of the art

Various studies have been conducted on traffic crashes in Nigeria. Ukoji, (2014), in his work showed the trend of Road Traffic Crashes and fatalities in Nigeria from 2006 to 2014. He reported that Nigeria recorded the highest number of fatalities in 2013 with 2061 traffic fatalities (estimated from Nigeria Watch database), and that within Nigeria, Abuja recorded the highest fatality rate per 100,000 population. Nigeria Watch, is a less – advanced online database compared to that of the FRSC, which focuses on violent deaths, including road fatalities resulting in at least one fatality.

Ihueze and Onwurah, (2018), developed a model that predicted Road Traffic Crashes in Anambra state. They reported that incorporating human, vehicle and environmental factors produces a more reliable model that can accurately predict the traffic crashes in Anambra state. Adeoye et al., (2014), in their study tried to understand how human, vehicle and environmental factors are responsible for road traffic crashes in Nigerian cities. They reported that young people are mostly affected by road traffic crashes and single vehicle crashes were predominant in Nigerian cities. Afolabi and Gbadamosi, (2017), investigated the causes and consequences of Road Traffic Crashes. They confirmed that human, mechanical and environmental factors are the causes of majority of Road Traffic Crashes in Nigeria.

Uzondu et al., (2019), investigated unsafe behaviours in traffic. In their study they used observational traffic methods to observe the traffic conflicts at three junctions in Owerri. They concluded that incorrect use of indicators and tailgating were the two unsafe behaviours that could likely result to traffic crashes at the junctions at Owerri. Most work done on traffic crashes in Nigeria have just tried to understand the causes and consequences from traffic crash data. Only Uzondu et al., (2018) and Uzondu et al., (2019), observed unsafe road user behaviours using an observational method in understanding the underlying causes of Road Traffic Crashes in Nigeria with the aid of a modified Swedish traffic conflict technique in Owerri, Nigeria. The severity of observed conflicts were not computed and they did not relate various traffic causes with interviews or questionnaire from road users.

2.3.1 Traffic Safety Evaluation (TSE)

The issue of Road Traffic Crashes and fatalities have been an issue for a long time, and various solutions have been proposed to solve the problem. The two major approaches to evaluate Road Traffic Crashes can be either through crash records based Traffic Safety Evaluation or through non – crash records based Traffic Safety Evaluation. Most researchers have tried to proffer solutions using a crash records based approach but have not been able to understand the underlying causes of Road Traffic Crashes. Crash record based approach, is when crashes and fatalities are understood by looking at historic data of Road Traffic Crashes and fatalities and solutions are proposed based on the understanding of the traffic situation. The limitation with crash record based approaches is that large historic data are required to fully understand the traffic situation and traffic crashes have to occur before the traffic situation can be understood. This limitation has made understanding the traffic situation in countries that do not have a well – established data collection and management system a problem. Other researchers have argued about the ethical morality of waiting for deaths to occur due to Road Traffic Crashes before the traffic situation can be understood and solutions can be proffered. This limitation has brought about the use of non – crash records based evaluation approaches to understand traffic crashes and fatalities and proffer solutions to the problem by observing traffic interactions preceding a crash and near misses with the possibility of resulting in a crash. Traffic Safety Evaluation (TSE) is further discussed in Chapter 3 (see section 3.2.1).

2.3.1.1 Crash records based Traffic Safety Evaluation

A number of crash record based Traffic Safety Evaluations have been conducted by researchers to try to understand Road Traffic Crashes and fatalities. Wang et al., (2011), conducted a study to understand how geometric design affects truck crashes at freeway divergence areas. They selected 391 freeway segments with different geometric designs at different locations in Florida and also collected crash data for the respective freeway. They found out that the exit configuration had no significant influence on the injury severity of truck related crashes at divergence areas. Lee et al., (2006), in their work showed that variable speed limit could reduce crash potential by 5 to 17%.

2.3.1.2 Non – crash records based Traffic Safety Evaluation

The non – crash records based traffic safety evaluation is a surrogate method that tries to understand the underlying causes of Road Traffic Crashes and fatalities without the use of historical data of traffic crashes or fatalities. The Swedish Traffic Conflicts Technique and the Dutch Objective Conflict Technique for Operation and Research are the two major non – crash based Traffic Safety Evaluation methods. A number of studies on non – crash record based Traffic Safety Evaluations have been conducted by researchers (Hydén 2016; Laureshyn et al., 2016; Laureshyn, 2010; Zheng et al., 2014), which are further highlighted in Chapter 3. This research however adopts the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) to understand the underlying causes of traffic crashes and fatalities in Abuja, Nigeria and also relates same to responses obtained from questionnaires about road user behaviours,. The choice of the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) is due to its ease of implementation and the successes recorded from the implementation in Bangladesh, which is also further discussed in Chapter 3.

2.4 Key findings

The messages drawn from the reviewed literature in this chapter and how it influences the adopted methodology in Chapter 3 are summarised below:

- Road Traffic Crashes and road safety remain critical in Low and Middle Income Countries (LMIC) which is home to 60% of the world's vehicles and accounts for 85% of the world's population. Concerted cost – effective and timely road safety efforts are therefore required in improving road transport safety in Low and Middle Income Countries.
- The Sustainable Development Goals (SDG) Goal 3, target 6 and the United Nations Decade of Action for Road Safety 2011 – 2020, aim at a 50% reduction in the number of global road traffic deaths and injuries by 2020 as well as stabilising and reducing the forecast levels of road traffic deaths by the end of 2020 respectively. However, most Low and Middle Income Countries (LMIC) are far from achieving the Decade of Action goal for reducing fatalities by half in 2020, as most Low and Middle Income Countries are showing increase in fatalities.
- The accuracy of Road Traffic Crash data in Low and Middle Income Countries (LMIC) is questionable, since road traffic crash data from traditional sources suffer from some form of underreporting.
- Road safety studies in Nigeria rely on Road Traffic Crash data from Nigeria's lead safety agency, the Federal Road Safety Corps (FRSC) as the main source of data. Data from the FRSC shows slight reductions followed by an increase in the number of road traffic fatalities, however, these figures are contradictory to the WHO estimates, which indicate steady increase, and casts doubts on the reliability of crash data from the FRSC, which is a

pointer to the underreporting of traffic crashes and traffic injuries in Nigeria. The limitations and biases of the FRSC data include; underreporting, lack of details of the few reported crashes and omission of information about the processes that resulted in the crash.

- Due to the limitations of the crash data from the FRSC and the fact that traffic crash data and fatalities have to be accumulated for a long time before safety issues can be understood and solutions proposed, an alternative non – crash based but safety – related evaluation of unsafe traffic interactions with the potential of resulting in a traffic crash is most appropriate. These challenges have led researchers to the use of non – crash based Traffic Safety Evaluation methods in understanding traffic interactions and proffering suggestions for the prevention and reduction of Road Traffic Crashes. Traffic Safety Evaluation (TSE) methods, are highlighted in Chapter 3.
- Traffic Conflicts Techniques (TCT) are surrogate methods of non – crash based but safety – related evaluation of critical traffic events. Traffic conflicts occur frequently and can be observed in shorter time compared to crashes, thereby making its analysis easier to perform. Popularly used Traffic Conflict Techniques are the Swedish Traffic Conflict Technique (Swedish TCT) and the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) which are further discussed in details in Chapter 3 (see sections 3.5.2 and 3.5.3).
- The Traffic Conflicts Techniques have been applied mostly in Europe and America, however, there is an existing successful application in Bangladesh, which is a developing country like Nigeria, with similar traffic safety challenges, including chaotic traffic situations, incomplete crash data, underreported traffic fatalities and inefficient crash data collection systems.
- The Traffic Conflicts Techniques (TCT) are useful in understanding traffic safety conditions and are suitable when there is a lack of quality in crash data. Traffic conflict

studies are therefore, best combined with other methods which include, interview and interaction with road users, and crash data analysis which this research adopts.

The full research methodology including the ethical approval granted by the ethical review committee is presented in details in the methodology chapter “Chapter 3”.

CHAPTER THREE
METHODOLOGY

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter broadly outlines and clearly describes the specific steps adopted to collect and analyse the data used in this doctoral research. The objectives of the research outlined in chapter one, and the literature review in chapter two, served as guides for the development of the research methodology. This chapter focuses on the methodological research processes as well as the justification and limitations of these adopted processes which are of relevance to road safety research in Nigeria.

The adopted research method has three key tasks done in coherence with each other. First, the crash projection task which aims at finding out for Nigeria's capital city of Abuja, how far – off, road traffic death levels are from the set targets of the United Nations Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goals (SDG): Goal 3, Target 6. This is further explained in section 3.3. Secondly, questionnaires were designed and administered to road users in Abuja, Nigeria, to evaluate the attitudes and behaviours of road users, and to also seek their opinions on the causes of high levels of road traffic crashes in Abuja. Interviews were also conducted with representatives of the Federal Ministry of Transportation and the Federal Road Safety Corps (FRSC), to serve a similar purpose as the questionnaires. The interviews also provided information on the roles of the Federal Ministry of Transportation and the FRSC with respect to checking the relatively high levels of road traffic crashes in Nigeria, as well as their knowledge of RTC in general. Third and finally, onsite traffic conflicts observations were carried out at selected junctions within Abuja, which is also further explained in section 3.6. Figure 3.1 is a flowchart summarising the adopted research methodology, and shows the various sequential steps involved in the research.

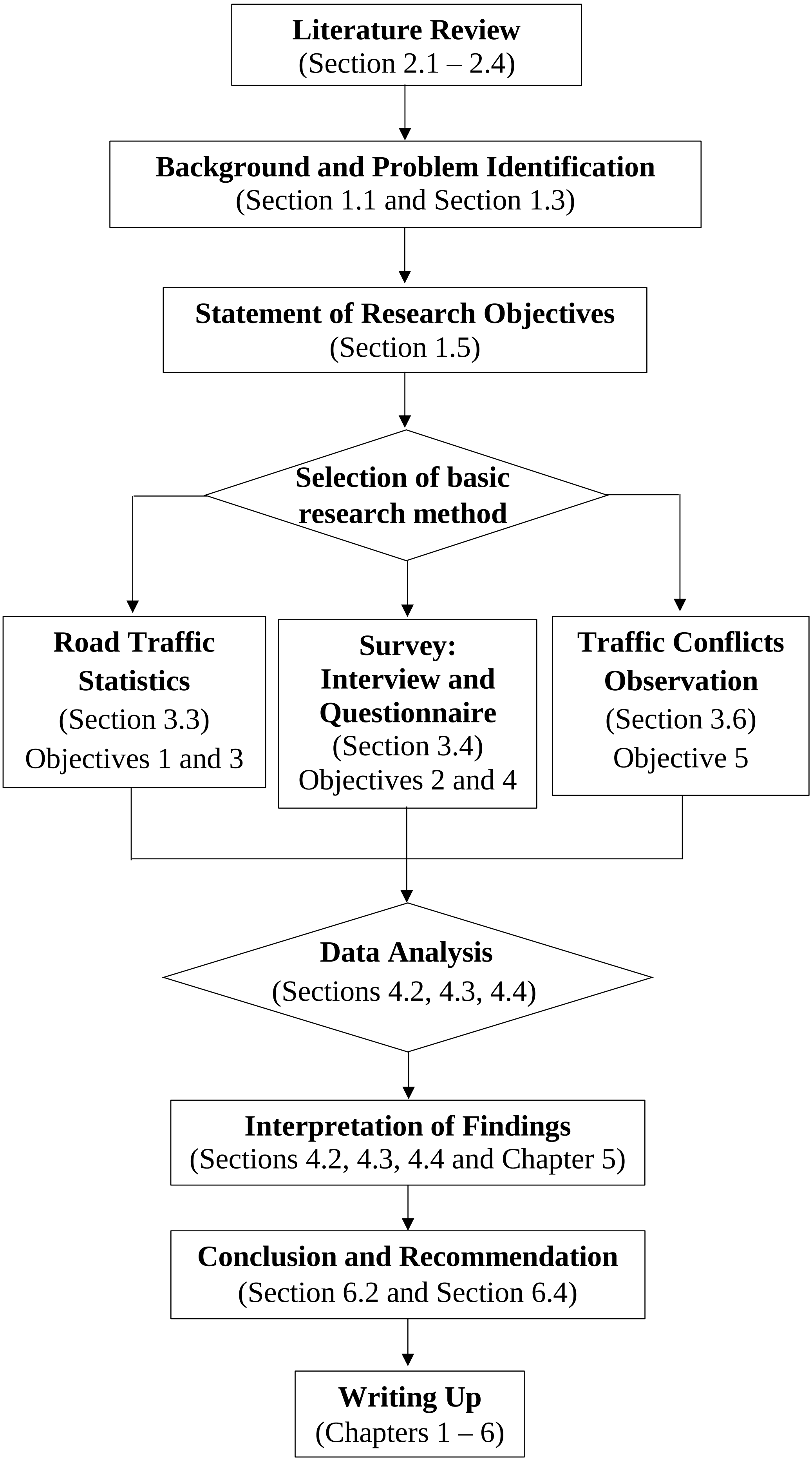


Figure 3.1: Flowchart of the research methodology.

3.2 Research ethics

Full ethical approval was granted, prior to adopting the research methodology explained in this chapter. In line with the University of Birmingham's code of practice for research, an application for ethical review for this PhD research was submitted to the University's ethical review committee. The ethical review application was reviewed by the Science, Technology, Engineering and Mathematics ethical review committee and full ethical approval was granted on the proviso that health and safety approval should be granted prior to the commencement of the field work. (See Appendix B for the ethical approval and the general health and safety risk assessment form).

The final research method which is presented and explained in this chapter was also assessed by the ethical review committee, with necessary corrections and adjustments to the adopted method effected, prior to the ethical review committee granting full ethical approval for the research. An overview of the adopted research method is presented in section 3.2.1, and is explained further in details in Sections 3.3, 3.4 and 3.6.

3.2.1 Overview of the research method

The logical thought process involved in the choice of research methodology is predicated on achieving the research aim and objectives, the researcher's understanding of the reviewed literature in chapter two, and a general objective of suggesting ways of improving the evaluation of road transportation safety in Nigeria.

Most often, the main and only data source used for Traffic Safety Evaluation (TSE) studies is the crash history (Laureshyn, 2010). According to Zajic, (2012), traditionally, road traffic safety is measured in terms of the number of Road Traffic Crashes (RTC) and/or the number of injured road users in traffic. According to Mahmud et al., (2018), Traffic Safety Evaluation could either be a traditional or a surrogate safety evaluation.

While the surrogate evaluation is based on traffic conflict observation, the traditional evaluation is based on crash data. Mahmud et al., (2018), summarises the different traditional Traffic Safety Evaluation (TSE) approaches in Table 3.1.

Table 3.1: Traditional Traffic Safety Evaluation (TSE) approaches.

Traffic Safety Evaluation (TSE) approaches	Related research
I. Before - after Observation	
• Naïve before - and - after study	Council, 2009; Ogden 1996
• Before - and - after study with yoked comparison	Griffin and Flowers, 1997; Harwood et al., 2003
• Before - and - after study with the empirical bayes approach	Namjune and Ihn, 2013; Elvik, 2008
II. Black Spot Identification Program	Roper and Turner, 2008; Hoque et al., 2006
III. Mainstream/ Statistical Modelling Approaches	
• Descriptive model	OECD, 1997; Archer, 2005
• Predictive or analytical model	Lord et al., 2007; Eenink et al., 2008
• Risk model	Williams et al., 1995; Brehmer, 1994
• Accident consequence model	Pham 2008; OECD, 1997
IV. Road safety audit (RSA)/ Inspection (RSI)	iRAP, 2012; Job, 2012
V. Safe system approach	Chen and Meuleners, 2011; Mooren et al., 2011

Adapted from: Mahmud et al., (2018).

The naive before and after study, although not recommended in practice, utilises crash records in the before period to predict expected crash rates, on the proviso that safety treatments were not applied. According to Council, (2009), the treatment effect refers to the changes in crash counts from the before condition to the after condition.

The before and after study with yoked comparison utilises a treatment site (treated facility) and a comparison site (untreated facility), which are expected to be similar, to aid a one – on – one correspondence between both sites. If the treatment site is an intersection, then the comparison site is expected to be a similar intersection including the area (urban, rural, commercial business district), the type of intersection (three or four – legged), the presence of traffic controls (signalised or two – way stop – controlled), the geometric design as well as the volume of traffic. The comparison site is not expected to have experienced any geometric or traffic improvement changes between the before and after studies. The assumption is that the factors affecting the comparison group would also affect the treatment group in the same manner. Thus, changes in the crash levels from the before period to the after period, without improvements in the treatment site would be of same proportion as observed in the matching comparison site. Based on this assumption, the crash frequency at the treatment site in the before period is multiplied by the ratio of the after – to – before crashes at the comparison site. This is done in order to predict the number of crashes in the after period at the treated site, without any improvements implemented.

The before and after study with the empirical bayes approach is a statistical approach that utilises safety performance functions to estimate crash frequencies, in a situation where safety measures are assumed to have not been implemented. It is used in determining the appropriate weighting assigned to the relevant factors in the estimation of crash outcomes for a treatment group.

Black spot identification is a reactive approach which utilises crash data from locations noted for high crash occurrence.

The descriptive model describes the traffic safety situation using exposure, risk and consequence of a crash. The predictive model on the other hand is a mathematical formula which relates safety levels (e.g. crashes and fatalities) on existing roads and other variables explaining these levels (e.g. road geometry, traffic volume). According to Mahmud et al., (2018), the risk model identifies and quantifies risk factors in predicting individual road – user behaviour, which in turn makes safety assessments from the risk reduction effects of various counter measures.

Road safety audit/inspection involves an accredited team of road safety professionals with sound knowledge on road safety and transportation engineering. It is an intensive method involving the production of an examiner's report on the safety performance and crash potential of the transport system (Mahmud et al., 2018).

On request, the Federal Road Safety Corps (FRSC) made available, Road Traffic Crash (RTC) data from 1990 – 2016. From the data of the entire country provided by the FRSC, road traffic data for Abuja was singled out. However, on inspection, the FRSC crash data (see appendix A) can be best described as defective due to underreporting of crashes, mainly minor crashes (crashes without serious damages, serious injuries, or resulting in loss of lives), thus making the identification of potential road safety hazards less accurate. This is consistent with the opinions of Iyanda, (2019) and Adeloye et al., (2016).

In developing countries (Nigeria inclusive), the availability of reliable crash data is rare, and in cases where they are available, these crashes are usually underreported, with little knowledge of the causative factors and time of occurrence recorded (Hoque and Mahmud, 2009). From a review of previous studies (Savolainen et al., 2011; Lord and Mannering, 2010), road safety researchers rely on road traffic crash data for safety evaluations (as seen in Table 3.1), however, these data have *"well – recognised availability and quality problems"* (Zheng et al., 2014). Zheng et al., (2014), further suggest that *"observing crashes to prevent crashes is a reactive approach that is often criticized by its poor timeliness from an ethical standpoint".*

A proactive approach here, would be any surrogate approach that evaluates traffic safety prior to a crash occurring. A good example is the Traffic Conflict Technique (TCT). According to Zajic, (2012), Traffic Safety Evaluation (TSE) approaches using crashes as direct indicators of safety are reactive and inhuman as they involve waiting for road traffic crashes to occur, followed by the collection of sufficient crash data over a long period of time (in most cases, several years), before safety evaluations can be carried out.

To also satisfy the other objectives of the research, the opinions of the residents of Nigeria's capital city "Abuja" on the reasons for the high crash rates had to be sought. Questionnaires were administered (see section 3.4) as opposed to just relying on the annual reports from the FRSC, because the annual reports had incomplete information required for the successful completion of the research.

In gaining a better understanding of these unsafe interactions/behaviours in traffic contributing to the occurrence and severity of these crashes, the researcher therefore sought an alternative (surrogate) evaluation of road safety. The choice of an alternative safety assessment is based on adopting a non – crash based but safety – related evaluation of traffic interactions. Traffic conflicts occur more frequently in traffic when compared to crashes, and can therefore be observed within shorter times. A description of traffic conflicts based on their severity is presented in Table 3.2. There are different traffic conflicts techniques, and these various methods are reviewed in section 3.5.

3.3 Road Traffic Crash projection

The UN global plan for the Decade of Action for Road Safety 2011 – 2020 has an overall goal to stabilise and then reduce the forecast levels of road traffic fatalities around the world by the year 2020 (WHO, 2015). The SDG goal 3 target 6 also aims at halving the number of global deaths and injuries from road traffic crashes by 2020 (WHO, 2018). If the decade of action and

SDG targets are achieved globally, millions of avoidable road traffic deaths can be potentially prevented from occurring. A Second Decade of Action for Road Safety 2021 – 2030 has been proclaimed by the United Nations General Assembly with a goal of reducing road traffic deaths and injuries by at least 50% from 2021 to 2030. Nigeria's Road Traffic Crash (RTC) statistics for 2018 – 2020 are yet to be made public by the FRSC, therefore, it is too early to conclude on the outcomes (successes or failures) of the First Decade of Action for Road Safety 2011 – 2020.

First, in projecting the road traffic fatalities in Abuja, Nigeria, based on existing road traffic crash records, the Federal Road Safety Corps (FRSC) was approached to provide the available road traffic data. The available road traffic crash data which is data from 1990 – 2016 was made available by the Federal Road Safety Corps (FRSC) and this was also authenticated by the National Bureau of Statistics (NBS), Nigeria (See Appendix A for the formal request letter for road traffic crash data, sent by the researcher to the FRSC). Some States in Nigeria were created by the Federal Military Government in 1991 and 1996, therefore, these states have zero crash records recorded by the FRSC from 1990 up to 1996 (See Appendix A). The most recently created Nigerian states in 1991 and 1996 were carved out from existing states, therefore, the previously existing states prior to 1991 and 1996, are expected to have fewer crashes after the creation of the new states than before.

Mbakwe et al., (2018), are of the opinion that Nigeria lacks a *"reliable and comprehensive database of traffic accidents and casualties".* It is also known that road traffic crash data are not readily available, and in very rare cases where they are available, they are "*incomplete and lack the necessary information needed to tackle road safety problems"* (Uzondu et al., 2019).

The data provided by the FRSC was purely aggregated numerical road traffic crash data without the causes of the crashes, details of the vehicles or class of road users involved (Uzondu et al., 2019), and this was the case for the 36 states in Nigeria and the FCT (Abuja). The data is only distributed on a state by state basis into number of fatal cases, serious cases, minor cases, persons killed and persons injured (see Appendix A). However, despite the data quality issues associated with the FRSC data, the analysis was done using this data, because the FRSC data is the official and authorised road safety data in Nigeria.

The FRSC indicates that in 2010 there were 11,385 total cases of road traffic crashes resulting in 35,691 injuries and about 6,052 deaths (FRSC, 2011). These figures experienced some increase in 2011 to 13,196 road traffic crashes where 6,054 persons were killed and 41,165 were injured or permanently disabled (FRSC, 2012). Although from the FRSC data 1990 – 2016, there has been a generally slight decline in traffic crashes and traffic deaths on Nigerian roads, these declining figures however, have shown the possibility of increasing in future, and are still far off from the UN and SDG targets (FRSC, 2016).

Vehicle registration data from the National Bureau of Statistics (NBS) and population data on a state by state basis from the National Population Commission (NPC) were also used in the analysis to estimate road traffic deaths per 100,000 population and fatalities per 10,000 registered vehicles in Nigeria. The data analysis is presented in chapter 4, section 4.2, using line graphs, bar charts and choropleth maps.

This aspect of the methodology focuses on showing that despite heavy underreporting from the FRSC, the official road fatality levels are still above the targets set by the United Nations Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goals (SDG) goal 3 target 6.

3.4 Questionnaires

Over 85% of road traffic crashes occur as a result of human behaviour and incapacitation (Adejugbagbe et al., 2015; WHO, 2009), and an estimated 22% of the resulting fatalities involve pedestrians (Wales, 2017). Therefore, in identifying the current road safety challenges in Abuja, road users (both drivers and pedestrians) took part in the survey, providing additional personal opinions on the causes and reasoning behind relatively high frequency of occurrence of road traffic crashes in Abuja.

Paper – based questionnaires were utilised in identifying the major issues affecting road traffic safety in Abuja, Nigeria and in obtaining information on the possible behaviours and attitudes of road users that are capable of causing road traffic crashes. A sample of the questionnaire used is attached in Appendix C. The road users were selected due to the unavailability of comprehensive road safety data in Nigeria, most especially data of individuals involved in road crashes, thus identifying crash survivors as respondents for the survey, was impossible. There was also no guarantee that these crash survivors would willingly partake in the research.

The methods adopted in selecting the sample size, administering questionnaires, and analysing the successfully completed questionnaires, are explained in detail in sections 3.4.1 and 3.4.2.

3.4.1 Sample size and administering of questionnaires

A major component in a research study design is the selection of an appropriate survey sample size. According to Al – Hammoudi, (2014), sample sizes are usually estimated to sufficiently have "*an acceptable chance of answering the research question*", albeit, not larger than necessary. A sample size calculator was used in estimating the sample size, by adopting a 95% confidence level and 5% margin of error. Factors that were considered in the estimation of the number of questionnaires to be administered also include the estimated population size of Abuja, the daily average road users in the city, as well as the cost of producing the questionnaires. 1,526 questionnaires were distributed face to face on a field trip to Abuja from November 2018 to February 2019. This is consistent with a similar study conducted by Al – Hammoudi, (2014), using the city of Abu Dhabi as case study, where 1200 questionnaires (600 for drivers, and 600 for pedestrians) were utilised. 321 questionnaires were successfully completed and returned, representing a response rate of about 21%. The response rate was satisfactory and sufficient for this study. Bryman, (2012), opines that questionnaire response rates depend on the type of study and also differ in various countries.

According to the 2016 population projection of Nigeria's National Bureau of Statistics (NBS), and the National Population Commission (NPC), the Federal Capital Territory (FCT) – Abuja has an estimated population of 3,564,126, with the Abuja Municipal Area Council (AMAC) having an estimated population of 1,967,500. According to Omidiji, (2010), Abuja experiences an average daily traffic inflow of 68,260 vehicles from the 4 major high density routes (Kubwa – Suleja – Kaduna; Gwagwalada – Lokoja; Gwagwa – Karimo; and Nyanya – Keffi routes) linking the city to neighbouring states. The average daily traffic inflow has however increased in recent years due to population growth, migration, and increased private vehicle ownership (Ashara et al., 2020).

Apart from the general road users approached on the roads, offices and businesses in the Central Business District (CBD) of Abuja were also approached to administer the surveys to their employees. The respondents were selected from road users (public and government workers, construction staff, business owners, students and other private office workers) in Abuja, who regularly commute to the city centre. The justification for the selection of the respondents is their consistency in daily commuting to and from the city thus experiencing daily traffic conditions and interactions. There was an equal chance of picking any road user in the city centre, thus eliminating issues of selection bias. This was ensured by approaching all businesses and offices in the CBD, and giving all the potential respondents an even chance of participating in the survey. The questionnaires were distributed in person (face to face) rather than via web link, email or telephone, and this was done in order to avoid any technological issues and unforeseen barriers which might affect the successful administration, interpretation and return of the questionnaires.

The respondents (based on their regular interaction with other road users) gave objective views on the issues of road traffic safety in Abuja. From the successfully completed and returned questionnaires, the respondents included a variety of individuals; employed, unemployed, graduates, university students amongst others. Employment status and level of education were not the only characteristics defining the Abuja population, other factors included; age, gender, and marital status.

In administering the questionnaires as well as assisting in the traffic conflicts observation (see section 3.6), two research assistants were utilised, one female and one male. It was important to have both genders of assistants, since some of the respondents were a bit more comfortable interacting with a female assistant and vice – versa. The assistants had excellent interpersonal and interviewing techniques, with prior experience of dealing with respondents. The assistants assisted in the distribution, administration, and collection of the completed questionnaires as well as in the clarification of any questions or points raised by the respondents.

3.4.2 Questionnaire analysis

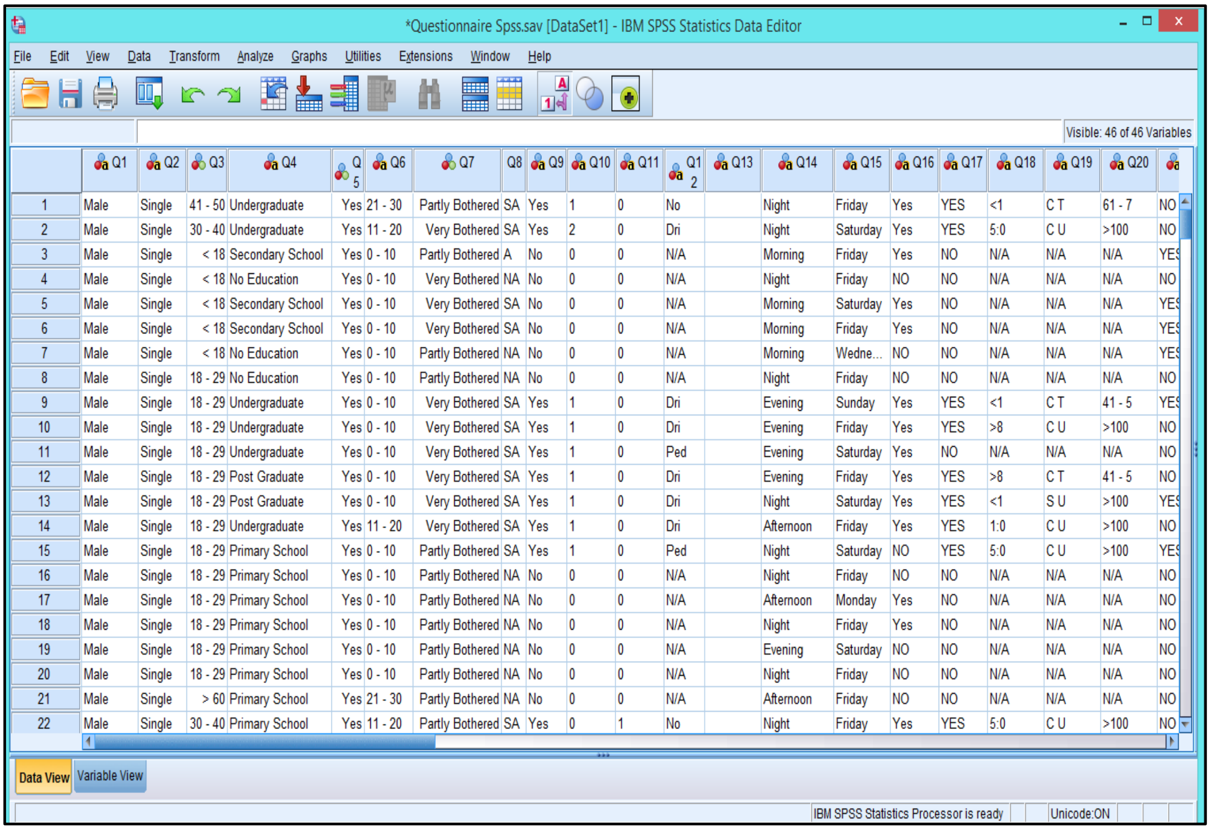
The completed questionnaires were analysed using contingency tables (or cross tabulations) and the use of Chi – square test to determine if two variables were dependent on each other.

3.4.2.1 Contingency table/cross tabulation

Contingency table/cross tabulation (two way frequency table) is a table that consists of frequency counts of categorical data corresponding to two different variables. Questions regarding driver behaviours (over speeding, use of seatbelts etc.) were analysed against the demographic criteria (age, gender, marital status, highest education received and the years of driving) to understand road user behaviours in Abuja.

The frequency counts were done for particular questions tackling certain road user behaviours (e.g. do respondents use their seatbelts when driving) and the results were tabulated against the demographic criteria, after which inference was drawn about the certain road user behaviour. The analysis was carried out using the statistical software SPSS

The output of the crosstabs shows the frequency count of a particular question against the demographic criteria. To determine if there is a relationship between the certain questions and the demographic criteria, a Chi – square test is performed.



	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	
1	Male	Single	41 - 50	Undergraduate	Yes	21 - 30	Partly Bothered	SA	Yes	1	0	No		Night	Friday	Yes	YES	<1	C T	61 - 7	NO
2	Male	Single	30 - 40	Undergraduate	Yes	11 - 20	Very Bothered	SA	Yes	2	0	Dri		Night	Saturday	Yes	YES	5:0	C U	>100	NO
3	Male	Single	< 18	Secondary School	Yes	0 - 10	Partly Bothered	A	No	0	0	N/A		Morning	Friday	Yes	NO	N/A	N/A	N/A	YES
4	Male	Single	< 18	No Education	Yes	0 - 10	Very Bothered	NA	No	0	0	N/A		Night	Friday	NO	NO	N/A	N/A	N/A	NO
5	Male	Single	< 18	Secondary School	Yes	0 - 10	Very Bothered	SA	No	0	0	N/A		Morning	Saturday	Yes	NO	N/A	N/A	N/A	YES
6	Male	Single	< 18	Secondary School	Yes	0 - 10	Very Bothered	SA	No	0	0	N/A		Morning	Friday	Yes	NO	N/A	N/A	N/A	YES
7	Male	Single	< 18	No Education	Yes	0 - 10	Partly Bothered	NA	No	0	0	N/A		Morning	Wedne...	NO	NO	N/A	N/A	N/A	YES
8	Male	Single	18 - 29	No Education	Yes	0 - 10	Partly Bothered	NA	No	0	0	N/A		Night	Friday	NO	NO	N/A	N/A	N/A	NO
9	Male	Single	18 - 29	Undergraduate	Yes	0 - 10	Very Bothered	SA	Yes	1	0	Dri		Evening	Sunday	Yes	YES	<1	C T	41 - 5	YES
10	Male	Single	18 - 29	Undergraduate	Yes	0 - 10	Very Bothered	SA	Yes	1	0	Dri		Evening	Friday	Yes	YES	>8	C U	>100	NO
11	Male	Single	18 - 29	Undergraduate	Yes	0 - 10	Very Bothered	SA	Yes	1	0	Ped		Evening	Saturday	Yes	NO	N/A	N/A	N/A	NO
12	Male	Single	18 - 29	Post Graduate	Yes	0 - 10	Very Bothered	SA	Yes	1	0	Dri		Evening	Friday	Yes	YES	>8	C T	41 - 5	NO
13	Male	Single	18 - 29	Post Graduate	Yes	0 - 10	Very Bothered	SA	Yes	1	0	Dri		Night	Saturday	Yes	YES	<1	S U	>100	YES
14	Male	Single	18 - 29	Undergraduate	Yes	11 - 20	Very Bothered	SA	Yes	1	0	Dri		Afternoon	Friday	Yes	YES	1:0	C U	>100	NO
15	Male	Single	18 - 29	Primary School	Yes	0 - 10	Partly Bothered	SA	Yes	1	0	Ped		Night	Saturday	NO	YES	5:0	C U	>100	YES
16	Male	Single	18 - 29	Primary School	Yes	0 - 10	Partly Bothered	NA	No	0	0	N/A		Night	Friday	NO	NO	N/A	N/A	N/A	NO
17	Male	Single	18 - 29	Primary School	Yes	0 - 10	Partly Bothered	NA	No	0	0	N/A		Afternoon	Monday	Yes	NO	N/A	N/A	N/A	NO
18	Male	Single	18 - 29	Primary School	Yes	0 - 10	Partly Bothered	NA	No	0	0	N/A		Night	Friday	Yes	NO	N/A	N/A	N/A	NO
19	Male	Single	18 - 29	Primary School	Yes	0 - 10	Partly Bothered	NA	No	0	0	N/A		Evening	Saturday	NO	NO	N/A	N/A	N/A	NO
20	Male	Single	18 - 29	Primary School	Yes	0 - 10	Partly Bothered	NA	No	0	0	N/A		Night	Friday	NO	NO	N/A	N/A	N/A	NO
21	Male	Single	> 60	Primary School	Yes	21 - 30	Partly Bothered	NA	No	0	0	N/A		Afternoon	Friday	NO	NO	N/A	N/A	N/A	NO
22	Male	Single	30 - 40	Primary School	Yes	11 - 20	Partly Bothered	SA	Yes	0	1	No		Night	Friday	Yes	YES	5:0	C U	>100	NO

Figure 3.2: Example of questionnaire responses keyed in into SPSS.

3.4.2.2 Chi – square test

The Chi – square test is used to check for independence. The test verifies if there is a relationship between the two categorical variables used in the contingency table or if the relationship is just by chance. The Chi – square is a goodness of fit test that is used to test the hypothesis that an observed frequency distribution fits some claimed distribution. The Chi –

square test rejects or fails to reject the null hypothesis which states that the row and column variables are independent or the alternative hypothesis states that the row and column variables are dependent.

$$\chi^2 = \sum_{i=1}^{n} \frac{(O-E)^2}{E} \tag{3.1}$$

Where O = Observed frequency.

E = Expected frequency of the response categories.

n = Total number of observations

The observed frequency is the frequency count in the cell in the contingency table/cross tabulation while the expected frequency is computed using Equation (3.2).

$$E = \frac{(row\ total)(column\ total)}{grand\ total} \tag{3.2}$$

The computed test statistic is then compared to the critical value obtained in standard text book to verify if there is a significant difference or not. Two decision rules are used to pass judgement if one should reject or fail to reject the null hypothesis.

The two decision rules are:

I. If the test statistic is greater than the critical value, then one rejects the null hypothesis that the two variables are independent but if the test statistic is less than the critical value, then one fails to reject the null hypothesis.

II. If the p – value is less that the level of significance α, one rejects the null hypothesis but if the p – value is greater than the level of significance α, one fails to reject the null hypothesis.

The Chi – square test was analysed using the statistical software SPSS, the software computed the critical value, test statistics and p – value.

The following assumptions had to be satisfied to verify the reliability of the results obtained. The assumptions include:

1) The sample data are randomly selected.

2) The sample data are represented as frequency counts in a two – way table.

3) For every cell in the contingency table, the expected frequency E is at least 5. (There is no requirement that every observed frequency must be at least 5. Also, there is no requirement that the population must have a normal distribution or any other specific distribution).

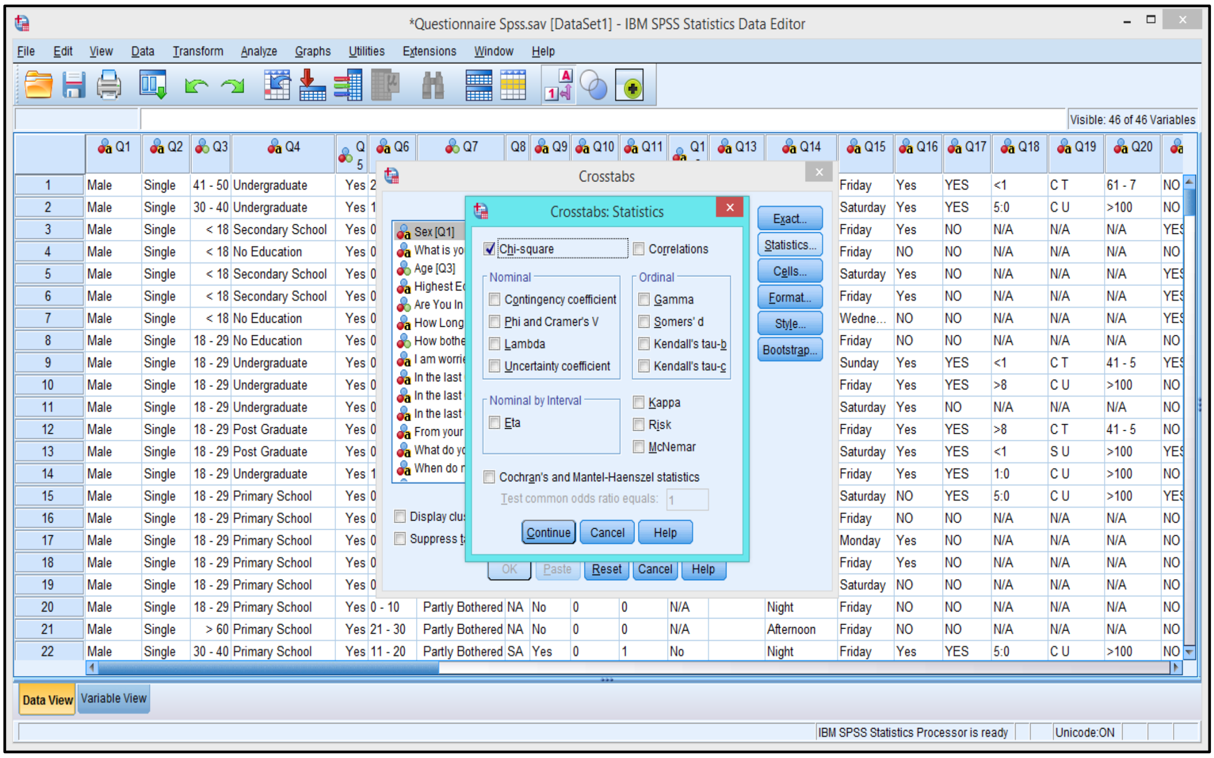


Figure 3.3: Example of Chi – square test for questionnaires.

3.4.3 Interviews

The researcher successfully sought the audience of Nigeria's Minister of Transportation and the Corps Marshal of the Federal Road Safety Corps (FRSC) for recorded interviews. However, due to their very busy schedules, they opted to provide written responses to the interview questions against the initial request for a recorded interview. The recorded interviews would have afforded the researcher the opportunity to ask questions at several levels, which are aimed at getting the most information from the FRSC and the Ministry of Transportation. However, the written responses to the interview questions did not impact negatively on the outcome, rather the anonymity of the written responses, provided the Ministry and the FRSC representatives the opportunity to freely express their personal opinions on the issues of road safety in Nigeria. The responses to the interview questions for both the Transport Ministry (2 Administrators) and the FRSC (4 Marshals) were typed and also written on their official letter headed papers (see appendix C). The responses to the interview questions (see appendix C), were analysed and presented in Section 4.3.9. Their responses to the interview questions were from personal experiences (as key players involved in Nigeria's road transportation safety), however, these opinions were backed with data from the FRSC annual reports.

The findings, contributions and recommendations of this research are proposed to be discussed with the relevant stakeholders in the Ministry of Transportation, the Nigerian Police Force (NPF) and the Federal Road Safety Corps (FRSC). The recommendations focus on behavioural and attitudinal reorientation of road users to lead to step changes in crash levels, as well as general reductions in traffic conflicts and unsafe road interactions. The feasibility of these suggestions are to be recommended for further discussion with road transport policy makers of the Federal Capital Territory Administration (FCTA)**.**

3.5 Surrogate traffic safety indicators

Surrogate safety indicators are indirect means of measuring road traffic safety. They serve as supplements to crash records based safety analysis. According to Laureshyn et al., (2017), "*The primary assumption is that there is a form of continuity in the severity of the events taking place in traffic and are also interrelated to their occurrence*". The surrogate safety indicators are therefore used in studying critical traffic events which occur frequently, thereby making the analysis of these incidents easy to perform (Laureshyn et al., 2017). Road traffic crashes are the most severe of these road traffic events. Their (Road Traffic Crashes) occurrences are very rare in developed countries, while the normal traffic interactions are not severe and occur more frequently. The traffic events having severity levels above "normal", and occurring frequently enough to be observed in sufficient amounts within some reasonable amount of time, indicate the potential safety problems that lead to road traffic crashes (see section 3.5.1 for further details).

According to Uzondu et al., (2019), in a city with many vehicles, road users lacking knowledge of road safety and commuting on poorly designed roads, it is expected that unusual traffic behaviours seemingly different from what is obtainable in the developed world will be the norm. These conflicts can be estimated from real traffic situations or simulated ones. Although there is a growing interest in the simulation approach, differences still exist between the observed and simulated conflicts, and this research opted for the real traffic observation technique. Once there is an unusually high occurrence of road traffic crashes at a particular road location, it is assumed, that the road design or the traffic operations are unsafe. Therefore, crash data is used in determining: The most unsafe locations, the types of dangers available and whether changes in road designs or traffic operations are effective.

However, as explained earlier (see section 3.3), there are many issues associated with Road Traffic Crash data collection in Nigeria. Crash data are mostly underreported. Underreported road traffic crash data makes the identification of road hazards less accurate. Crashes do not occur frequently, therefore, a long time is needed to collect enough useful data. Also, data errors and incomplete information are sometimes found in crash records. Additionally, the crash records sometimes are not helpful in identifying specific road hazards. For these reasons, other safety indicators are useful. The Traffic Conflict Technique is an important way of measuring the crash potential of highway intersections and junctions without having to wait for crashes to happen. Traffic conflicts are good surrogates for road traffic crashes, meaning that traffic conflicts data may be used as a substitute for crash data.

Different surrogate indicators and techniques exist (Gettman and Head, 2003; Laureshyn et al., 2010), however, the validity of these techniques have often been questioned. Many of these techniques are either in their conceptual stages or have been tested on very limited datasets. The potential risk is that different techniques might produce different and possibly contradicting results, which might undermine their credibility.

Popularly used surrogate techniques include: The Swedish Traffic Conflict Technique (Swedish TCT), the Dutch Objective Conflict Technique for Operation and Research (DOCTOR), and the Canadian Probabilistic Surrogate Measures of Safety (PSMS) technique (Hydén 2016; Laureshyn et al., 2016; Laureshyn, 2010; Zheng et al., 2014; Saunier et al., 2010; Van der Horst and Kraay, 1986).

3.5.1 The Probabilistic Surrogate Measures of Safety (PSMS) technique

In determining the severity of a conflict, the Canadian probabilistic surrogate measures of safety (PSMS) technique utilises the minimum Time to Collision (TTC min) and the risk of collision (ROC). The Time – to – collision is defined as the time taken by two vehicles to collide if they maintain their current speeds and remain on same path (Laureshyn et al., 2010). The minimum TTC (TTC min) and ROC are ranked using three severity levels, with the final severity of the event being the sum of both the TTC and ROC. *"The ROC levels are low, moderate and high, and the minimum TTC levels are less than 2 seconds, less than 1.6 seconds and less than 1 second, respectively"* (Johnsson et al., 2018).

3.5.2 The Swedish Traffic Conflict Technique (Swedish TCT)

The Swedish traffic conflict technique (Swedish TCT) was developed in the 1970s/1980s at Lund University (Hydén, 1987). This technique distinguishes between non – serious and serious conflicts. Serious conflicts are believed to have a strong correlation with the number of reported crashes.

The Swedish traffic conflict technique (Swedish TCT) is easily applied and does not require any complex equipment. After a week's training, conflict observers are expected to seamlessly carry out the field work without much challenges. As stated earlier, the Swedish TCT is simple to use, thus making it appropriate to be used in less – developed countries where technical equipment is often lacking. This technique is best applied in combination with other methods, like crash analyses, behavioural studies, interactions, and interviews with road users.

According to the Swedish TCT, a collision course is a necessary condition for a conflict. This happens at a certain moment when two road users were on their way to collide, and they would have collided if one or both of them had not taken an evasive action.

The conflict severity ranking is based on two indicators: time – to – accident (TA) which is time remaining to a collision when an evasive action is taken by a road user and Conflicting Speed (CS), the speed of the road user when they take the evasive action (Hydén and Linderholm, 1984; Laureshyn and Varhelyi, 2018; Muhlard, 1993; Archer and Kosonen, 2000). The TCT method is often criticised due to the differences between the individual observers in evaluating the severity of an evasive manoeuvre (Laureshyn et al., 2010).

The possibility of using the Swedish TCT for the conflicts observation due to the ease of its application and no requirement of complex equipment had earlier been explored, however, the uncertainties surrounding the Swedish TCT training conducted by Lund University, informed the researcher's decision to opt for a similar TCT in "DOCTOR". DOCTOR is similar to the Swedish TCT and was the next most appropriate TCT (based on the research objectives), when compared to other available TCT.

The Dutch Objective Conflict Technique for Operation and Research (DOCTOR) is further discussed in section 3.5.3.

3.5.3 The Dutch Objective Conflict Technique for Operation and Research (DOCTOR)

This conflict observation technique was jointly developed by the Institute for Road Safety Research (SWOV) and the Institute for Perception TNO (IZF-TNO) in the Netherlands. DOCTOR's development involved adopting knowledge from behavioural observations and video – aided analyses by IZF – TNO (van der Horst and Kraay, 1986), and the international calibration study at Malmo (Grayson, 1984). Here, the severity of conflicts are graded on a scale of 1 to 5. With 1 representing a slight conflict and 5, a severe one or collision. Table 3.2 classifies conflict severity according to DOCTOR.

Table 3.2: Classification of conflict severity by DOCTOR.

Conflict severity	Class	Definition
Slight	1	Precautionary braking or changing lanes or other anticipatory braking or changing lanes with a low probability of a collision.
	2	Controlled braking or changing lanes to avoid a collision with little manoeuvring time.
Serious	3	Strong braking, rapid changing lanes or stopping to avoid a collision, resulting in a near-crash (No time left for a controlled manoeuvre).
	4	Emergency braking or strong swerving resulting in a near – crash or slight collision.
	5	Near miss which could have potentially resulted in a crash with severe consequences.

Source: Modified after Kraay et al., (2013).

The severity of conflicts take into account the probability of a collision occurring and the implications if a collision actually occurs. According to DOCTOR, the risk of a collision occurring is estimated by the minimum Time to Collision (TTC min) (below 1.5 secs is critical) and/or Post Encroachment Time (PET) values (less than 1 sec is critical). The Post Encroachment Time (PET) is "*the time between the moment that the first road-user leaves the path of the second and the moment that the second reaches the path of the first*" (Kraay et al., 2013). An illustration of the Post Encroachment Time (PET) is shown in Figure 3.4.

This technique contains a subjective component, as the observer is always expected to take into account the road user's behaviour and the consequences of a collision occurring (Laureshyn et al., 2016). DOCTOR's criteria for initial selection is events with imminent collision courses and the possibility of injuries or other forms of losses, especially if there are no changes in speed and the collision courses (Johnsson et al., 2018).

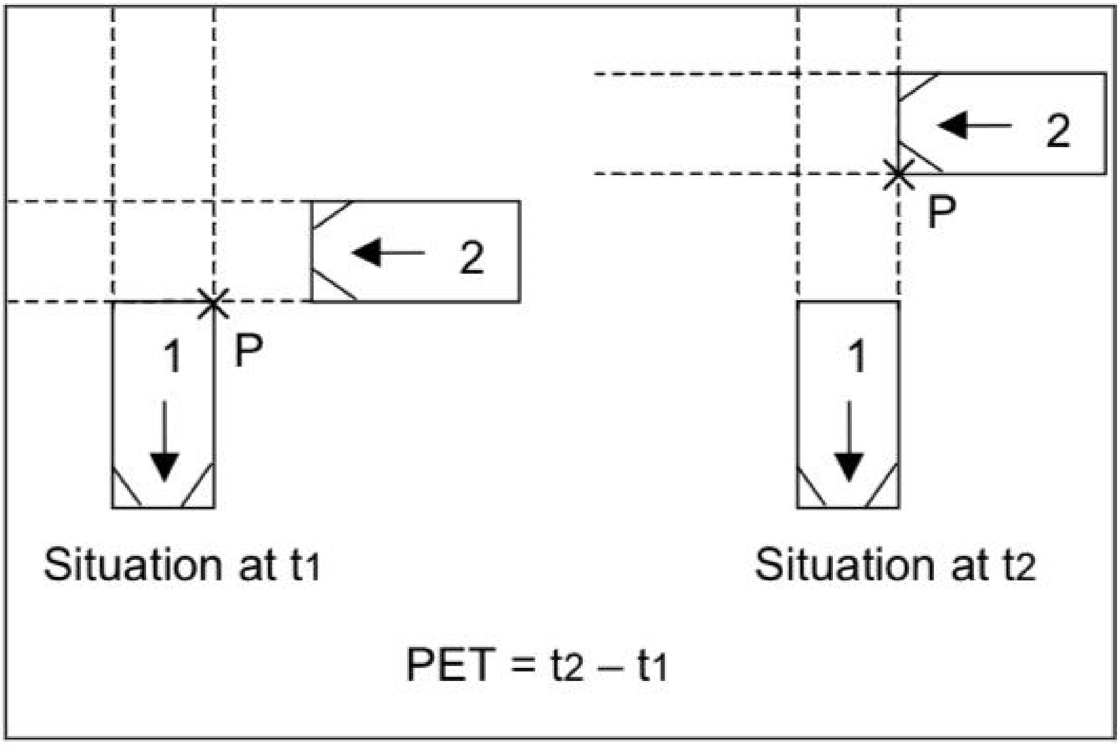


Figure 3.4: Illustration of Post Encroachment Time (PET) (source: Kraay et al., 2013).

The Dutch Objective Conflict Technique for Operation and Research (DOCTOR) has been mostly applied in Europe (van der Horst et al., 2014; Ángel – Domenech et al., 2014). However, a record of successful application in Low and Middle Income Countries (LMICs), is the study by (van der Horst et al., 2017) in Bangladesh, which based on the conditions in Bangladesh, could be successfully replicated in Nigeria.

According to the World Health Organisation (WHO), in 2015, Bangladesh had an estimated road traffic death rate (per 100,000 population) of 13.6, with 21,316 deaths estimated as the actual number of road traffic deaths. However, the Bangladesh official government reports, show 3,196 road traffic deaths (van der Horst et al., 2017). Similarly, in Nigeria, according to the WHO the estimated road traffic death rate (per 100,000 population) was 21.4, with 35,641 deaths recorded for the same year. Just as in Bangladesh, the Nigerian government data for road traffic deaths and road crash related injuries, shows very much underreported figures, when compared to other international sources like the World Health Organization (WHO). The official government figures from the Federal Road Safety Corps (FRSC) in 2016 was just 5,053 deaths, approximately 7 times under reported. Like most Low and Middle Income Countries (LMICs), Nigeria and Bangladesh share similar challenges associated with successfully conducting road traffic safety evaluation studies. These challenges include but are not limited to chaotic traffic situations, biased and incomplete crash data and underreporting of road traffic deaths, thus causing an underrepresentation of the actual scale of road traffic crashes.

The study in Bangladesh by van der Horst et al., (2017) *"an evaluation of speed management measures in Bangladesh based upon alternative accident recording, speed measurements, and DOCTOR traffic conflict observations"* was successful. The study was conducted at the instance of the Bangladesh government. The Bangladesh government granted permission for a before and after study involving the design and implementation of an integrated speed management program. According to DOCTOR *"a conflict is a critical traffic situation in which two (or more) road users approach each other in such a manner that a collision is imminent and a realistic probability of personal injury or material damage is present if their course and speed remain unchanged*". DOCTOR also defines a critical situation as one which occurs when the available space for a manoeuvre is less than the space required for a normal reaction (van der Horst and Kraay, 1986).

From the study by van der Horst et al., (2017), prior to the implementation of these interventions in Bangladesh, the locations adopted for the study had a combined annual average of 200 injuries, 100 serious crashes and 10 deaths. However, after the implementation of the traffic interventions from April 2015 to January 2016, the number of serious crashes dropped by 66%, injured people by 73% and deaths by 67%. Serious DOCTOR traffic conflicts (conflicts on scale 3, 4 and 5), also dropped from *"64 serious conflicts per location in a 4.5 hours period before, to 29 serious conflicts in the after period, on average, or a 55% reduction in relative terms"* (van der Horst et al., 2017).

Furthermore, the experiences of van der Horst et al., (2017), especially the ease of implementation and the successes recorded from the implementation of DOCTOR in Bangladesh therefore informed the application of this Traffic Conflict Technique (TCT) "DOCTOR" in Abuja, Nigeria, with the believe that the successes achieved in Bangladesh can be replicable in Nigeria. Table 3.3 summarises the possible methods of traffic conflicts data collection. In addition to the approaches summarised in Table 3.3 by Zheng et al., (2014), scoring of conflicts from recorded videos can also be applied, as seen in the study *"an evaluation of speed management measures in Bangladesh based upon alternative accident recording, speed measurements, and DOCTOR traffic conflict observations"* by van der Horst et al., (2017).

It is also important to note that when crash data is unavailable or lacking in quality, conflict data is very helpful in understanding traffic safety conditions. According to Laureshyn, (2010), traffic conflict observations are suitable in cases of limited or poor quality crash data.

From Table 3.3, the field observation method of traffic conflict data collection was adopted, due to the simplicity of its application and the ability to observe more sensory and contextual information (Zheng et al., 2014).

Table 3.3: Summary of traffic conflict data collection methods using DOCTOR.

Conflict Data Collection Method	Advantages	Disadvantages	References
Field Observation	• Ease of application. • More valid than many objective measures.	• Intra- and inter-observer variability. • High cost. • Labour intensive.	Hauer, (1978); Glauz and Migletz, (1980); Nel, (1989); Parker and Zegeer, (1989); Almqvist and Ekman, (2001).
Computer Vision Technique	• Automatically detects traffic conflicts. • Cost - effective. • Reliable and efficient.	• High video quality requirement. • Still under development.	Wakabayashi and Renge, (2002); Saunier and Sayed, (2007); Saunier and Sayed, (2008); Ismail et al., (2009); Oh et al., (2009); Ismail et al., (2010); Oh et al., (2010); Saunier et al., (2010); Ismail et al., (2011); Autey et al., (2012);Sayed et al., (2012); Sayed et al., (2013).
Naturalistic driving	• Allows to study rare safety situations as conflicts and crash situations.	• Limited data size. • Data is protectedand not fully available forresearch community. • Event screening is time - consuming.	Dingus et al., (2006a); Dingus et al., (2006b); McLaughlin et al., (2008); Guo et al., (2010); Uchida et al., (2010); Dozza and González, (2012); Wu and Jovanis, (2012); Bagdadi, (2013a); Bagdadi, (2013b); Habibovic et al., (2013); Dozza and González, (2013); Jonasson and Rootzén, (2014); Valero-Mora et al., (2013).

Source: Zheng et al., (2014)

3.6 Onsite traffic conflict observation

From a list of potential locations in the Abuja Municipal Area Council (AMAC), 1 roundabout and 5 junctions with similar traffic conditions were selected after site visits. The junctions were adjudged to be relatively unsafe, based on recommendations from the FRSC, personal experience of the researcher and the study by Omidiji, (2010).This provided the researcher an opportunity to compare between the relatively safe and unsafe junctions and to identify the causative traffic conflicts increasing the unsafety of these junctions.

The conflict observation locations presented in chapter 4 (see Figure 4.31), were selected based on previous observational studies of road traffic engineering measures on Federal Capital Territory roads in Abuja, Nigeria, by Omidiji (2010). These junctions were selected within Abuja, from areas with junctions of close proximity, however, with contrasting reported road traffic crashes. That is, the different junctions experience traffic crash rates ranging from very bad to average. The junctions share similar road conditions but have different safety issues, as the former experiences more road traffic crashes when compared to the latter.

Figure 3.5 is a map of the Federal Capital Territory (FCT), showing the location of the Abuja Municipal Area council (AMAC) and other area councils.

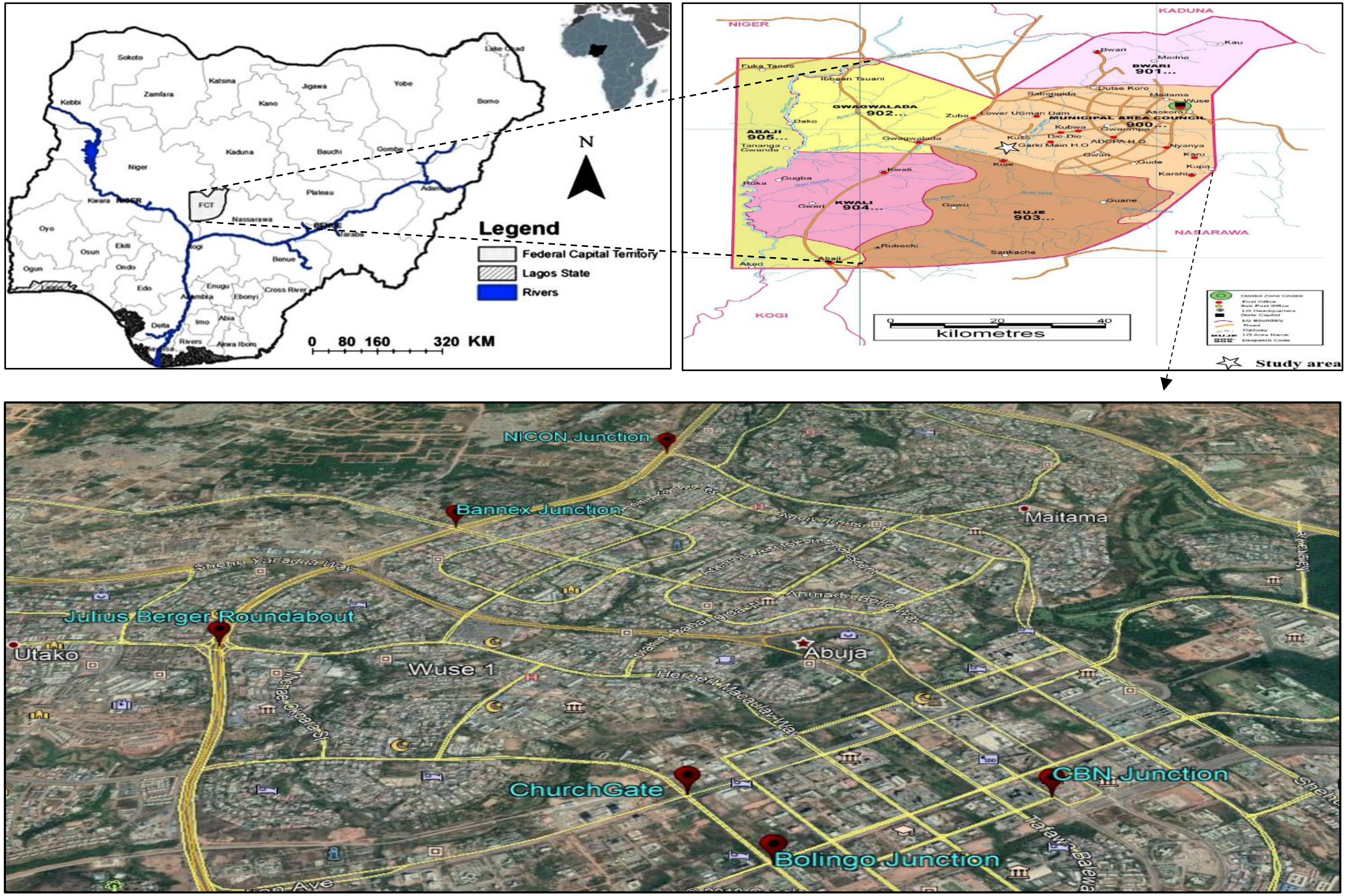


Figure 3.5: Map of Abuja, showing the city centre (adapted from Ismaila, 2014 and Ofobruku et al., 2017).

The choice of the study sites is mainly exploratory, emphasising on conflicts/unsafe traffic interactions occurring between "vehicle and vehicle", "vehicle and tricycle", and "vehicle and pedestrian". Tricycles, also known as "Keke NAPEP", "Keke Maruwa" or "Keke Marwa" to most Nigerians (see Figure 3.6), are used as a means of public transportation. The criteria for selection also included traffic flow during peak periods, presence of pedestrians, chaotic vehicular traffic, variety in usage, etc. These junctions, as explained earlier were chosen based on their location on the key routes linking the business and administrative centres of the FCT, which are usually characterized by very high vehicular movement, as well as an associated average pedestrian demand during peak traffic hours. The characteristics of these junctions indicate the existence of potential conflicts. These unfavourable traffic conditions have caused a lot of conflicts not only for vehicles but also for pedestrians alike.

These locations were not only used for the traffic conflicts observation, but were also ideal in administering questionnaires to road users, ensuring the respondents had experienced sufficient interactions with other road users. This was necessary as the respondents were expected to give objective views on road traffic safety issues as well as regularly occurring traffic conflicts in Abuja. The traffic conflict observation was to be earlier done using video observations, however, approval was not obtained from the authorities of the FRSC and the FCTA, therefore the observation was done manually. The position of the observers were chosen carefully in order to get a very good view of the junctions. To ensure utmost accuracy of the conflict observations, the activities of the observers did not in any way influence the road users' behaviour. In an ideal condition, the observer and equipment are expected to be invisible to the road users to ensure observations are done without obstructions and distractions (Uzondu et al., 2019). The best practice is to low – key blend into the natural background to become inconspicuous, so as to prevent influencing the behaviour of road users. The observers therefore did not wear any reflective vests.

Figure 3.6: Tricycles used for public transportation in Abuja.

The six roads selected for the conflicts observations had minimal distractions and obstructions. They include: Bannex Junction, NICON Junction, CBN Junction, Churchgate Junction, Bolingo Junction and Julius Berger roundabout. The selected sites for the traffic conflicts observation are presented in chapter 4 (see section 4.4).

The observation recording sheet (Appendix D) contains a record of the weather conditions, the date and time of the observation. It also records the identity of the observer, location under investigation, type and time of the conflicts as well as road surface conditions. The estimated speed and distance at the time of conflict, the evasive action, sketch of study location and the class of road users (drivers/pedestrians) involved in the particular conflict were also recorded. The distances were estimated using the relative position of signposts, electric poles, street lights and other available road furniture as reference points.

The conflicts were scored from observation of traffic conflicts mainly between "vehicle and vehicle", "vehicle and tricycle", and "vehicle and pedestrian" at the six different junctions. The observation periods were constant (same length of time) for all the junctions.

The observations (3 observations per day), took place at the various junctions for 4.5 hours daily (1.5 hours per observation period) and a total of 31.5 hours over seven days. 7 days (1 week) were devoted to each of the junctions. The time periods were: peak (7:00 – 8:30 and 16:30 – 18:00), off-peak (11:00 – 12:30) daily for the entire week. According to Laureshyn and Várhelyi, (2018) this length of time for conflicts observation is justified as "*observations are usually done in periods of 1 – 2 hours with breaks in between for the observer to recover*". Hydén and Várhelyi, (2000) also suggests that about 30 hours of conflicts observation at a conflicts observation site is sufficient to observe serious conflicts and allow for a safety analysis of the site. Laureshyn and Várhelyi, (2018) also opine that shorter periods of traffic conflicts observations can be adopted in countries with major road safety issues since the number of traffic conflicts observed over a short time is still relatively high. This is evident in the studies by Uzondu et al., (2019), van der Horst et al., (2017) and Abdul Manan and Várhelyi, (2015).

The conflict observation was limited to between the hours of 7am to 7pm daily, because the sun sets a few minutes before 7pm, thus leading to decreased visibility, as can be seen in Figure 3.7. Also, since the street lights were barely functional the researcher had to make his personal safety a priority. The conflict observations ended by 6pm, however, the time left before 7pm was utilised for the purpose of collating the conflict observation sheets and discussing the challenges experienced by the study assistants while observing conflicts.

The traffic observation (just like the administering of questionnaires) was performed during a field trip to Abuja from November 2018 to February 2019.

3.6.1 Unsafety according to DOCTOR

According to DOCTOR, traffic conflicts are classified on a scale of 1 to 5. Conflicts with severity of 1 and 2 are classified as slight conflicts, while observed conflicts scored with a severity of 3, 4 and 5 are classified as serious conflicts. Definition of these conflicts and their severity levels, have been earlier summarised in Table 3.2.

Figure 3.7: A road Junction in Abuja.

3.6.2 Inter – observer reliability

As earlier explained earlier in section 3.4.1, two assistants and the researcher served as conflict observers. Due to the unavailability of funds and time constraint, the assistants were trained by the researcher on conflict observation and recording for only three days. The training involved the scoring and discussion of a number of conflict situations which was compared with that of the researcher. This was done in order to assess and ascertain the inter observer reliability. The observers also acquired some practical experience by working through the DOCTOR instruction and training tape provided by Dr. Richard van der Horst via email (van der Horst, 2018). The videotapes were provided in digital form. Although the quality was not that great, the video was adequate enough and the main idea of DOCTOR was understood by the observers. Once the training had been completed, a test conflict observation was conducted and the reliability of the observers were estimated. From the test conflict observation, the two observers had similar recordings. Uzondu et al., (2019) defines reliability rate, as the percentage of correctly recorded conflicts, when compared with all possible conflicts and non – conflicts recorded. The effective reliability rate of the observers was estimated to be 88% when compared with the training tapes.

The observed differences in the conflict recording of both assistants was because the observers were relatively new to traffic conflicts and suffered a slight loss of concentration once there is an increase in traffic flow and the roads are busy. Observers were trained to measure speed by comparing their estimates with measurements by a radar gun as a control instrument. The serious conflicts relevant to the research as defined by DOCTOR in Table 3.2, were reviewed, analysed and categorized by the researcher and are presented in chapter four (see section 4.4). The categorised slight and severe conflicts are a function of the minimum Time – to – Collision (TTC min) value estimated from vehicle speed and distance of the road users before their trajectories cross (see Appendix D for estimation of TTC).

Traffic counts were also undertaken, to get more insight into the conflicts as well as the volume of traffic on the roads. The traffic counts were done for all types of vehicles. The traffic count was achieved with the assistance of Etteh Aro and Partners. "Etteh Aro and Partners Consulting Engineers" is an indigenous Civil Engineering consultancy with an office in Abuja, Nigeria.

The final analysis therefore involves the explanation of the identified conflicts in group, and the description of the conflicts based on the observed traffic interactions at the junctions.

3.6.3 Traffic count

The traffic count involved both manual and automatic counting. The manual counting was used mainly for pedestrians and in areas where the automatic traffic counting equipment could not be set up. The automatic traffic count was conducted with the assistance of Etteh Aro and Partners. This involved the continuous counting and classifying of vehicles for seven (7) continuous days using an automatic traffic counting/classifying equipment, followed by an extraction of the relevant data for the duration of the traffic conflicts observation. The equipment used was MetroCount 5600 Automatic vehicle counter/classifier (Figure 3.8).

Figure 3.8: MetroCount 5600 Automatic vehicle counter. (Etteh Aro and Partner, 2018).

The equipment uses a pair of pneumatic tubes laid across the road and connected to a logger, as shown in Figure 3.8 above. The logger has a pair of air sensors which is activated by every hit on the tubes. It works on a time stamped principle, implying that the hits on the tube are recorded and stored in the memory of the road side unit at the time of the hit. After the specified traffic count days, the data is downloaded unto a laptop and interpreted using a specialized software (MetroCount Traffic Executive). This software using certain algorithms is able to interpret the hits registered on the equipment and convert them to vehicles. The advantage of this is that different reports can be generated from the same data registered, also the record of each vehicle that crosses the tube is taken including the volume, class of vehicle, number of axles, distance between the axles and speed. Results of the traffic volume count relevant to the study are presented in section 4.4.2.

3.7 Summary

This chapter has described the adopted research methodology. With respect to the limitations of road safety data collection in Nigeria, and the underreporting of secondary Road Traffic Crash (RTC) data from the Federal Road Safety Corps (FRSC), an alternative proactive surrogate means of obtaining data on unsafe road user behaviours using the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) was adopted. The Dutch Objective Conflict Technique for Operation and Research (DOCTOR) which was combined with the analysis of FRSC data, administering of questionnaires on road users and interviews with the Federal Road Safety Corps (FRSC) and ministry of transportation, to understand road user behaviours has also been presented in this chapter. The justifications for adopting DOCTOR as a TCT for this study has also been presented in this chapter.

CHAPTER FOUR
RESULTS

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter highlights the research findings. The collected data was analysed in order to describe the transport safety situation in Abuja, Nigeria, as well as identify and explore the causes of road traffic crashes. The research findings are presented in three key sections. Section 4.2 describes the road transport safety situation in Nigeria and discusses Abuja's performance with respect to the United Nations Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goals (SDG) Goal 3, target 6. Section 4.3 presents the results of the questionnaires administered to road users and the results from the interviews of the representatives from the Ministry of Transportation and the Federal Road Safety Corps (FRSC). Section 4.4 focuses on the analysis of data gotten from the traffic conflicts observation. The research findings are however discussed in the next chapter (chapter 5).

4.2 Road crash data projection

Comprehensive and robust data are critical components necessary for the actualisation of future targets. The targets here are the United Nations Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goals (SDG) Goal 3, target 6, which both seek to stabilise and reduce road traffic deaths by 50% by the year 2020. To this end, the road traffic crash data from 1990 – 2016 and vehicle registration data provided by the Federal Road Safety Corps (FRSC) and the National Bureau of Statistics (NBS) respectively are presented in this section.

4.2.1 Trend analysis of crash fatalities in Nigeria

Figure 4.1 shows the time series graph of road traffic deaths in Nigeria from 1990 – 2016. It can be observed that there were large fluctuations in the number of deaths from 1990 to 2001, which normalised during later years. These major changes in road deaths can be attributed to the country's return to democracy in 1999 after military rule, which saw more funding and new drives by the FRSC towards improving road traffic data collection. The highest recorded road traffic deaths of 9,946 people occurred in 2001 while the lowest recorded road traffic deaths of 4,519 people occurred in 2005. Generally, data smoothing is done to remove random variations from a data set in order to clearly capture the important patterns in the data, as well as show the seasonal and cyclic components. If a data set (for example, the FRSC data) does not have a definite or well established trend due to evident spikes and dips over the years, as noticed in the FRSC data, taking average is the simplest way to smooth the data. For this study, a moving average was used for smoothing. The moving average was used because it gives an overall picture of the trends in a data set and is useful in the forecasting of long – term trends. The moving average was applied to the road traffic data for Nigeria and Abuja and are presented in Figure 4.1 and Figure 4.3 respectively.

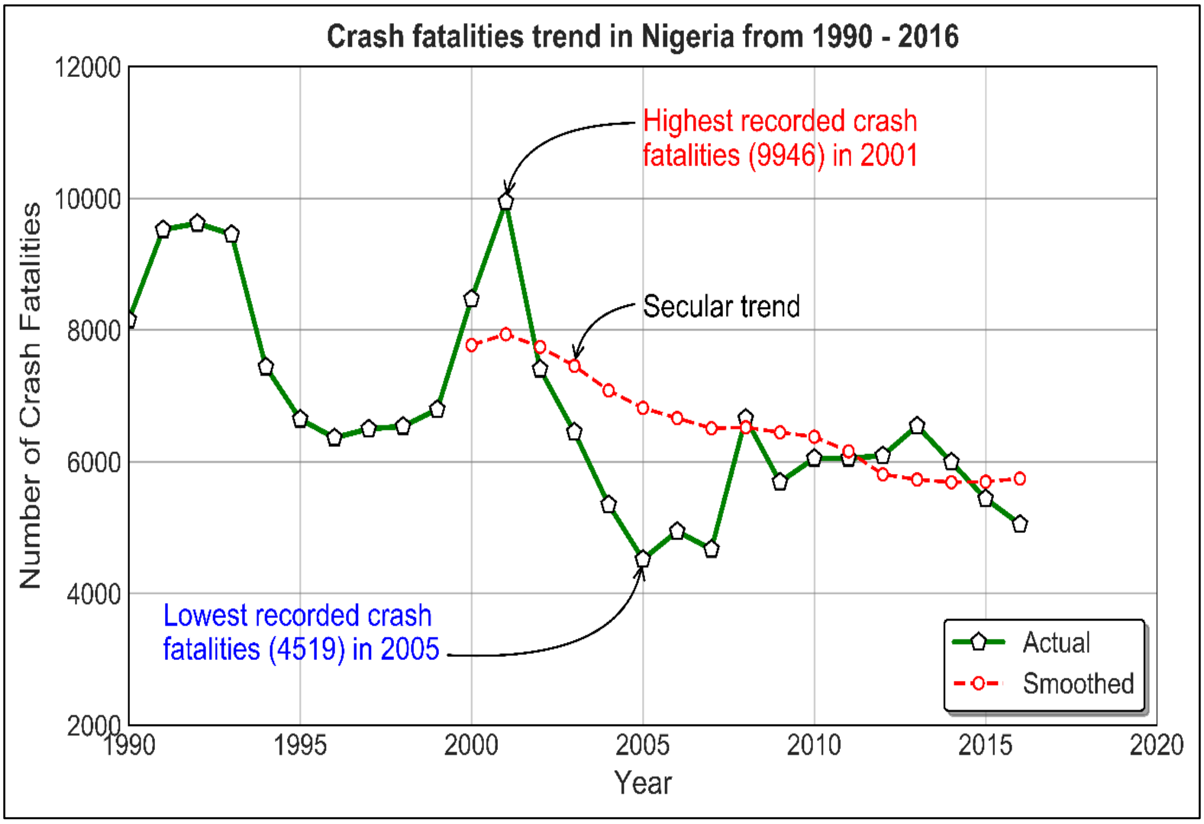


Figure 4.1: Crash fatalities trend in Nigeria, 1990 – 2016 (Source: FRSC, 2016).

The secular trend shows that the general trend of road traffic deaths for the duration of 1990 – 2016 has been on the decline, with signs of increasing slightly post – 2016. It can also be observed that based on the data from the Federal Road Safety Corps (FRSC), the number of road traffic deaths was on the increase from 2007 – 2008 and 2009 – 2013, this is consistent with the findings of the 2015 Global Status Report On Road Safety (WHO, 2015). The actual recorded road traffic deaths have however been on the decline for the period of 2013 – 2016, this is in contrast to the slight increase experienced from 2011 – 2013, this shows that based on the decrease associated with the FRSC data, actions are currently being taken towards achieving the UN Decade of Action for road safety 2011 – 2020. However, the rather large fluctuations in Figure 4.1 are likely due to differences in annual data collection systems.

4.2.2 Trend analysis of crash fatalities for the 36 states in Nigeria

Figure 4.2 shows the trend for the number of road traffic deaths for the period of 2006 – 2016 on a State by State basis. The trend analysis for the Federal Capital Territory (FCT) – Abuja is presented in section 4.2.3. From Figure 4.2, it can be observed that Abia, Anambra, Bauchi, Ebonyi, Gombe, Ondo, Oyo, Sokoto, Yobe and Zamfara states all had an upward trend for the period under consideration. Generally, since 2011 (the start of the implementation of the UN decade of action) all the states except Bayelsa state have experienced heavy fluctuations (without any signs of stabilising) in the number of fatalities. At least 28% of the states have the number of road traffic deaths on the rise since 2011. Very few States have shown very good indications in trying to achieve the UN Decade of Action goal. Akwa – Ibom, Bayelsa, Imo, Lagos and Ogun States have shown continuous decline in the number of road traffic deaths, while the rest of the States have shown general fluctuating figures in the number of road traffic crashes and fatalities. There is no known explanation for the decline in crash fatalities experienced in states showing continuous decline, however, a possible reason is the literacy levels in the North and South, which is further discussed in chapter 5 (see section 5.2).

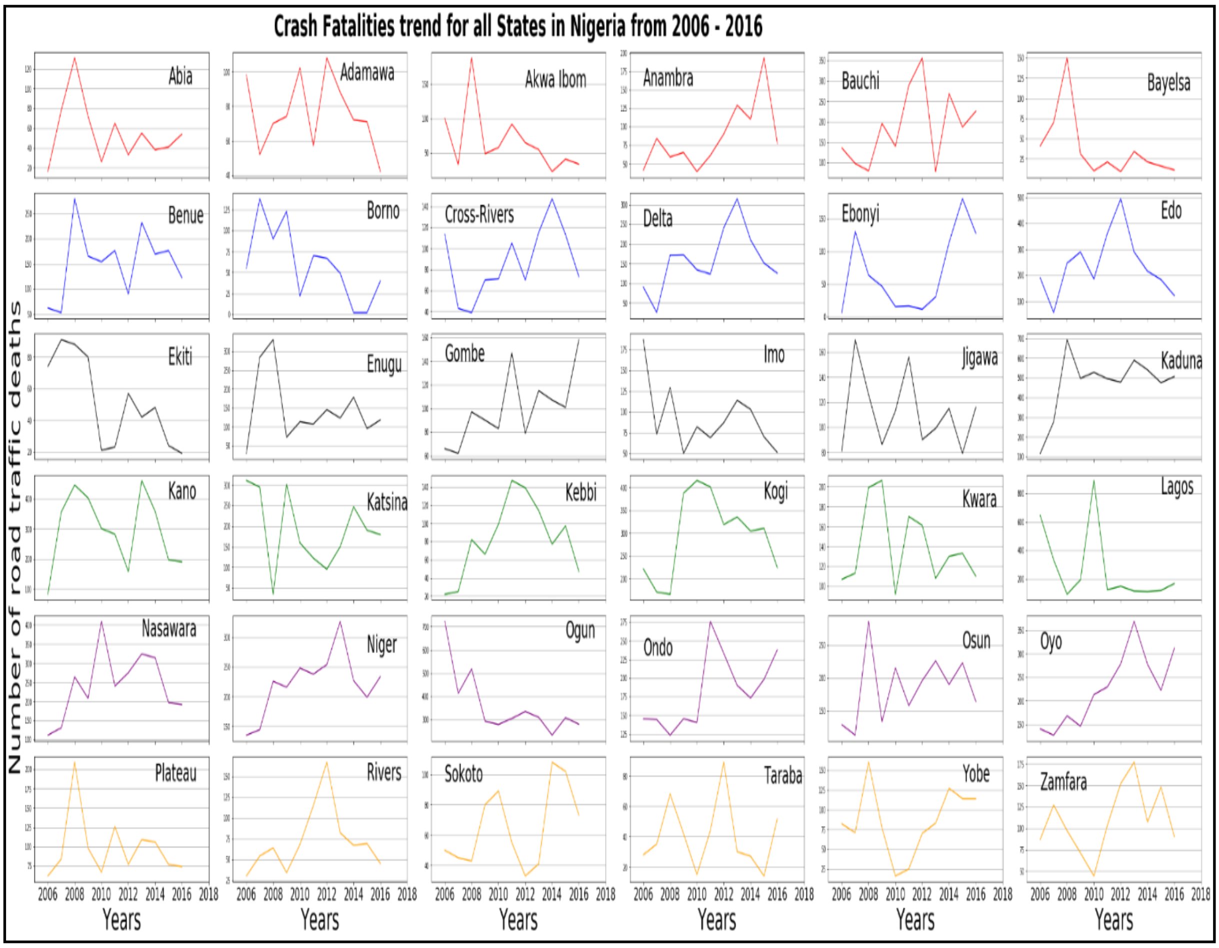


Figure 4.2: Crash fatalities trend for the 36 States in Nigeria (Source: FRSC, 2016).

4.2.3 Trend analysis of crash fatalities in Abuja

Figure 4.3 shows the trend analysis for crash fatalities in Abuja for 1990 – 2016. It can be observed that the road traffic deaths keep fluctuating from high to low throughout the period under consideration. This depicts a typical cyclic trend. A cyclic pattern exists when a data set experiences spikes and dips that are not for a fixed period of time. The highest number of road traffic deaths recorded was 465 in 2011 and the lowest number of deaths recorded was 5 in 2001, which deviates largely from other recorded road traffic deaths in the city. There is no known reason or explanation for the sharp drop in 2001 and 2007, as there were very low road traffic deaths recorded followed by a rapid increase in 2002 and 2008. This therefore typifies the data quality and credibility issues associated with the FRSC data, characterised by fluctuations due to the non – systematic collection and recording of traffic data in Nigeria.

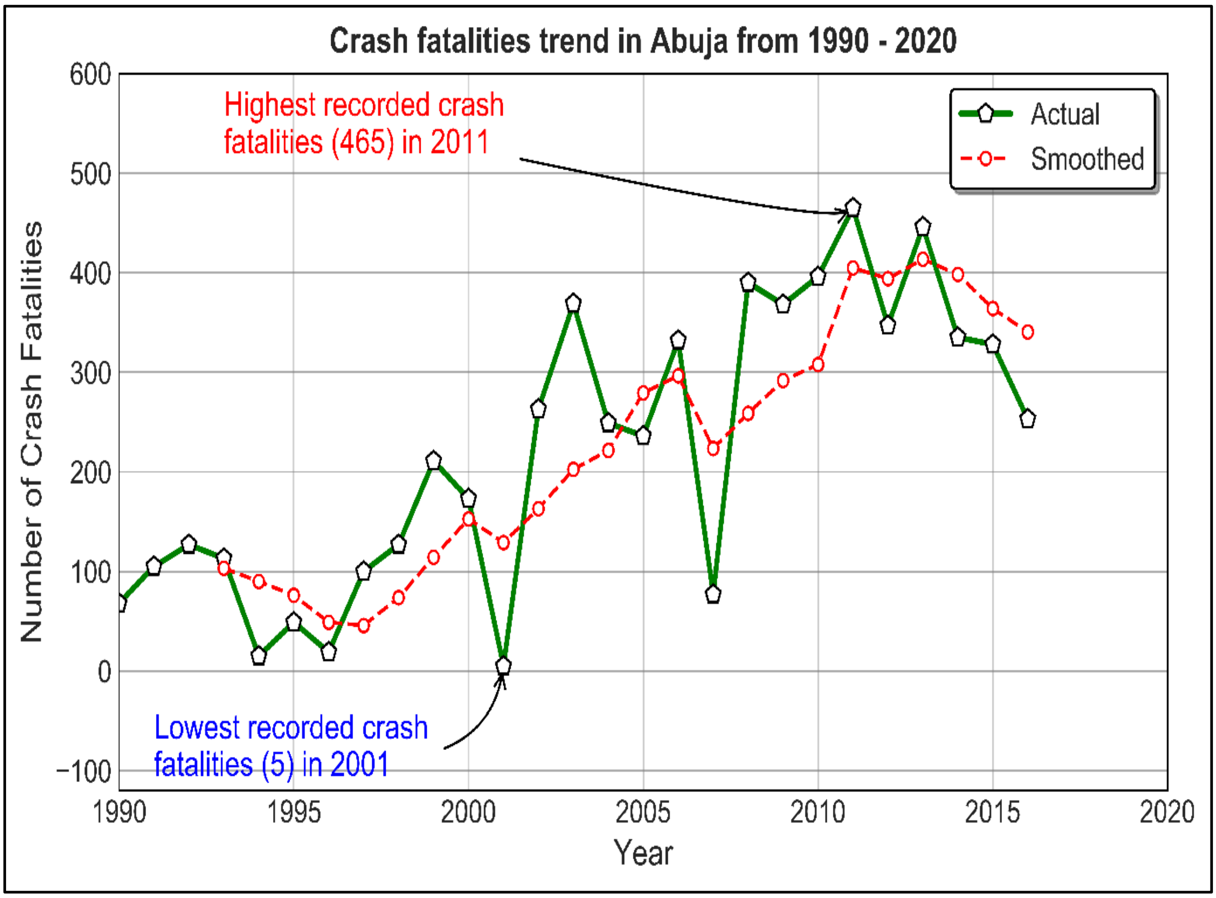


Figure 4.3: Crash fatalities trend in Abuja (Source: FRSC, 2016).

The secular trend shows a general increase in the number of road traffic deaths since 1990. Figure 4.3 however shows that a decrease in road traffic deaths commenced at the start of the Decade of Action for road safety. This indicates that since the launch of the Decade of Action, the city has made some progress towards achieving the goals of the UN Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goals (SDG) Goal 3, target 6.

4.2.4 Road traffic deaths

Figures 4.4 and 4.5 show the number of road traffic deaths for all the states in Nigeria for 2016, and their geographical distribution respectively. From Figure 4.4 it can be observed that Bayelsa State recorded the lowest number of road traffic deaths (11) in 2016 while Kaduna recorded the highest number of deaths (505). Abuja recorded the fourth highest number of road traffic deaths (253). Fifteen states in the country recorded road traffic deaths less than 100, while fourteen States recorded road traffic deaths that were between 100 and 200. The remaining seven States including the Federal Capital Territory (Abuja) were in excess of 200 road traffic deaths. The high living cost in Nigeria's capital city, Abuja, has seen most government workers migrating to more affordable neighbouring States (Kaduna, Nassarawa, Kogi and Niger), from where they commute very long distances to work daily, thus contributing to road traffic deaths on the highways linking these States to Abuja. This is a similar case in Lagos State (the former capital city of Nigeria), which has seen heavy migration to Ogun, Oyo, and Ondo States, thus contributing to the road traffic deaths in those States.

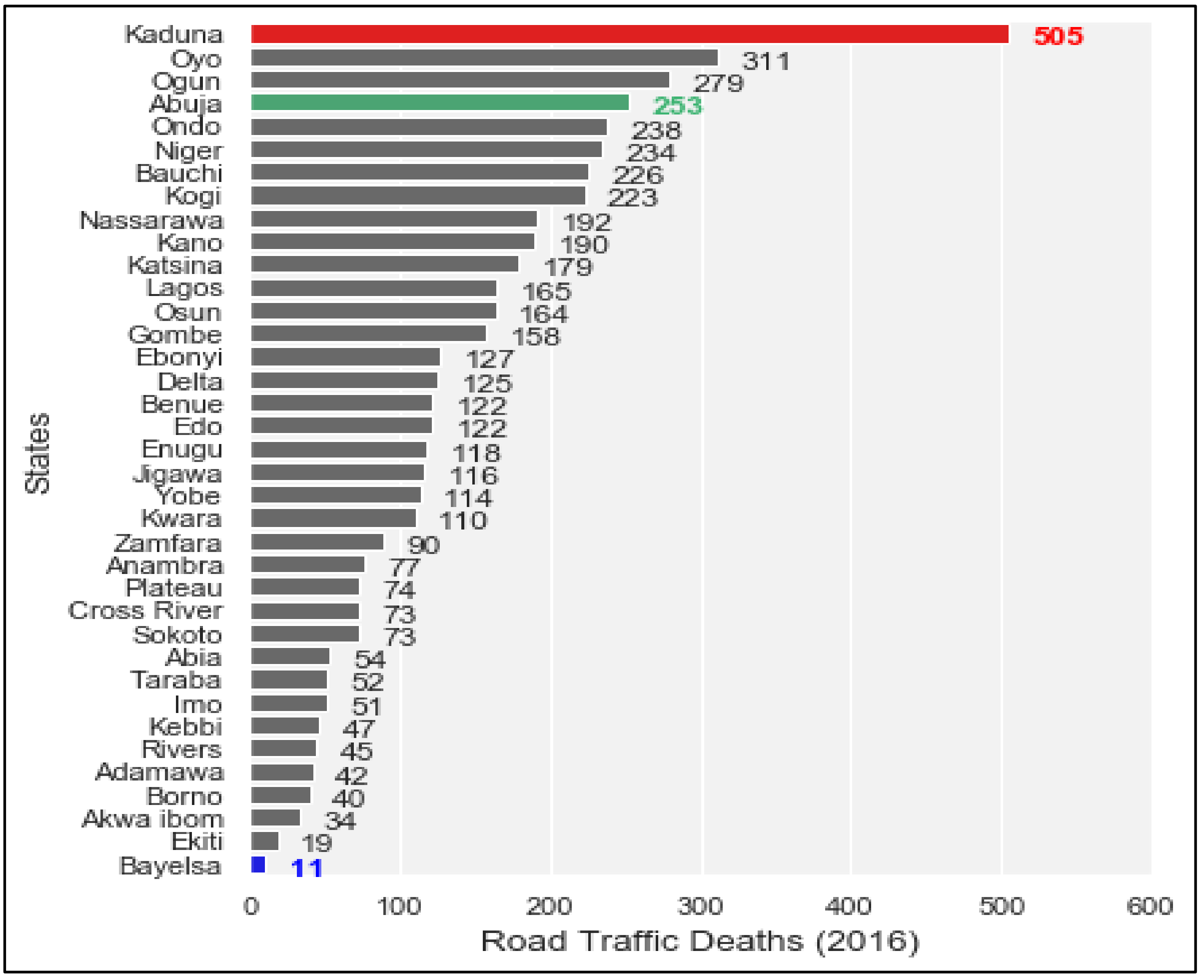
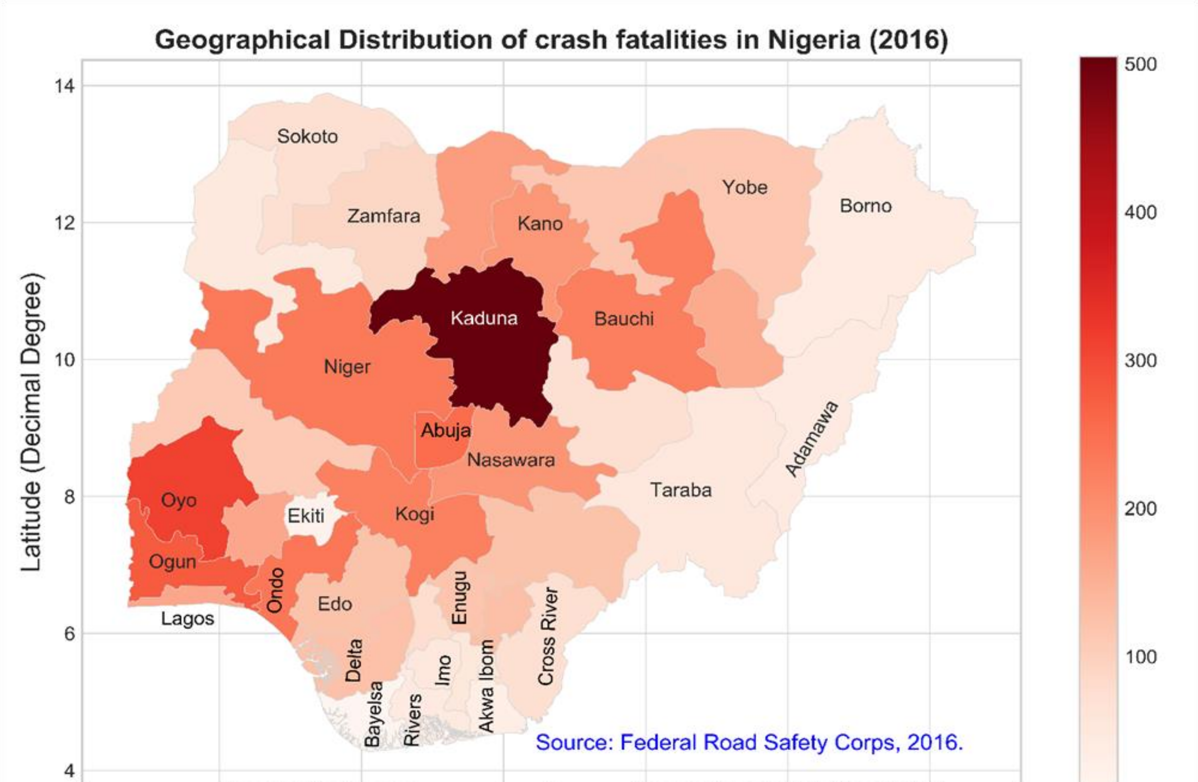


Figure 4.4: Number of road traffic deaths in Nigeria, 2016 (Source: FRSC).



	Geo-Political Zones	Average Crash Fatalities (2016)
1	North Central	173
2	North East	106
3	North West	172
4	South West	196
5	South South	69
6	South East	86

Figure 4.5: Geographical distribution of crash fatalities in Nigeria, 2016 (Source: FRSC, 2016).

Comparing the 2016 road traffic deaths (Figures 4.4 and 4.5) with the average road traffic deaths in Nigeria from 2006 – 2016, shown in Figures 4.6 and 4.7, it can be observed that in 2016, Bayelsa State had only 11 fatalities, which is lower than the average number of deaths 38 (the lowest for all States from 2006 – 2016). This indicates that the number of road traffic crashes in Bayelsa State is on the decline and can be confirmed in Figure 4.2. Kaduna State which recorded the highest number of traffic deaths in 2016 when compared with the average road traffic deaths from 2006 – 2016 shows that very little difference exists between the two, which indicates a partly constant trend in the number of road traffic deaths.

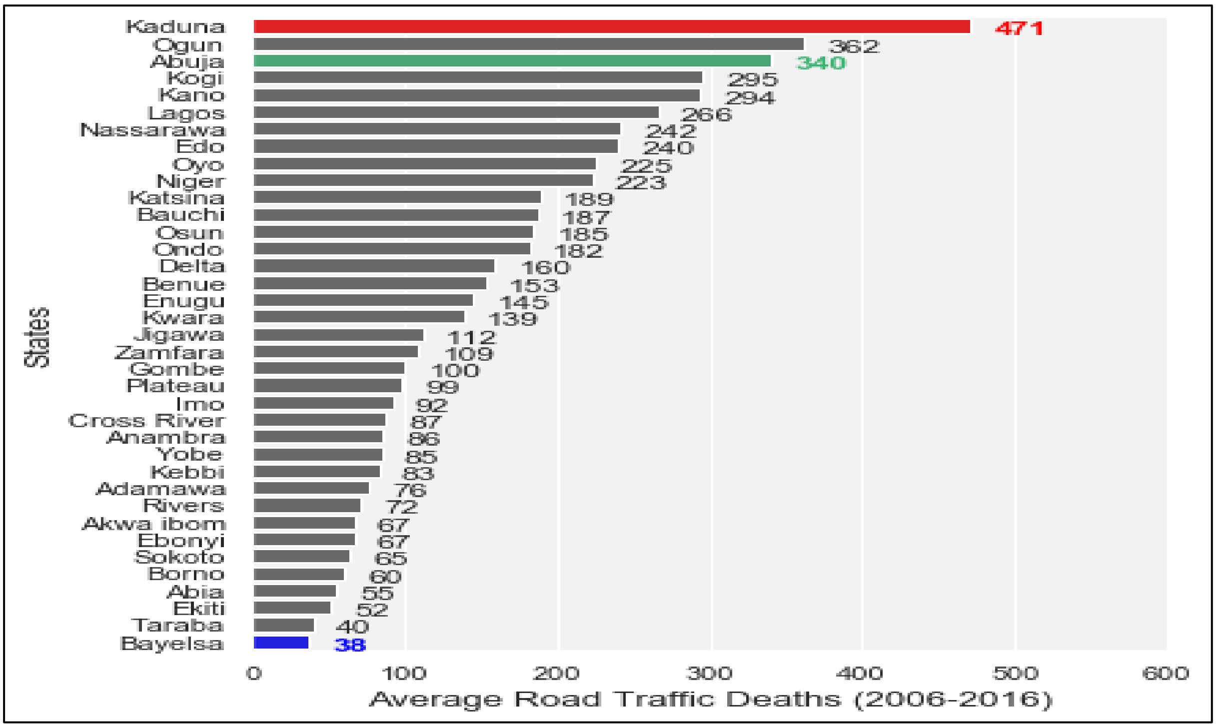
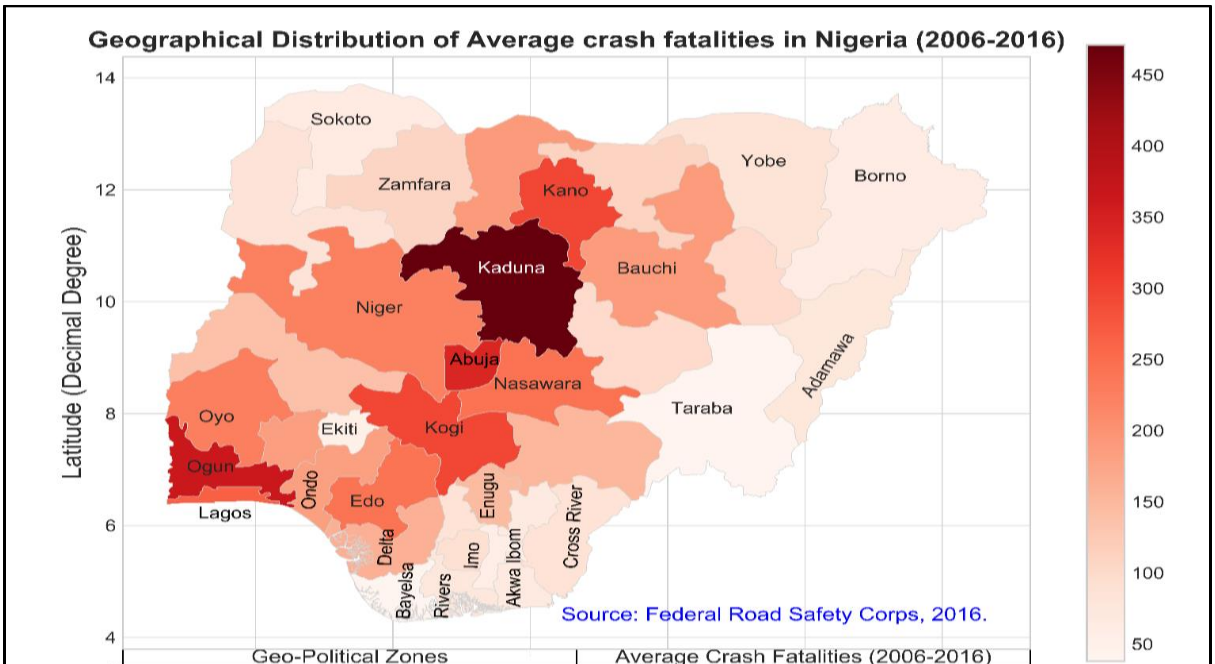


Figure 4.6: Average yearly number of road traffic deaths, for States in Nigeria (2006 – 2016) (Source: FRSC, 2016).



	Geo-Political Zones	Average Crash Fatalities (2006-2016)
1	North Central	213
2	North East	92
3	North West	189
4	South West	212
5	South South	111
6	South East	89

Figure 4.7: Geographical distribution of crash fatalities in Nigeria (2006 – 2016) (Source: FRSC, 2016).

Abuja which also recorded 253 road traffic deaths in 2016 experienced a relatively higher average road traffic deaths from 2006 – 2016 (340), this indicates that the road traffic deaths are on the decrease in recent years, as previously confirmed in Figure 4.3.

4.2.5 Road traffic deaths per 100,000 population

The road traffic deaths per 100,000 population is a good indicator of the severity of road traffic crashes in a country, as it takes into account the number of road traffic crashes with respect to the population of the country. From Figures 4.8 and 4.9, it can be observed that Abuja had the highest cases of road traffic deaths per 100,000 population in 2016. The number of road deaths per 100,000 population was 13.13, which signifies that out of every 100,000 people in Abuja approximately 13 people died in 2016 due to road traffic crashes.

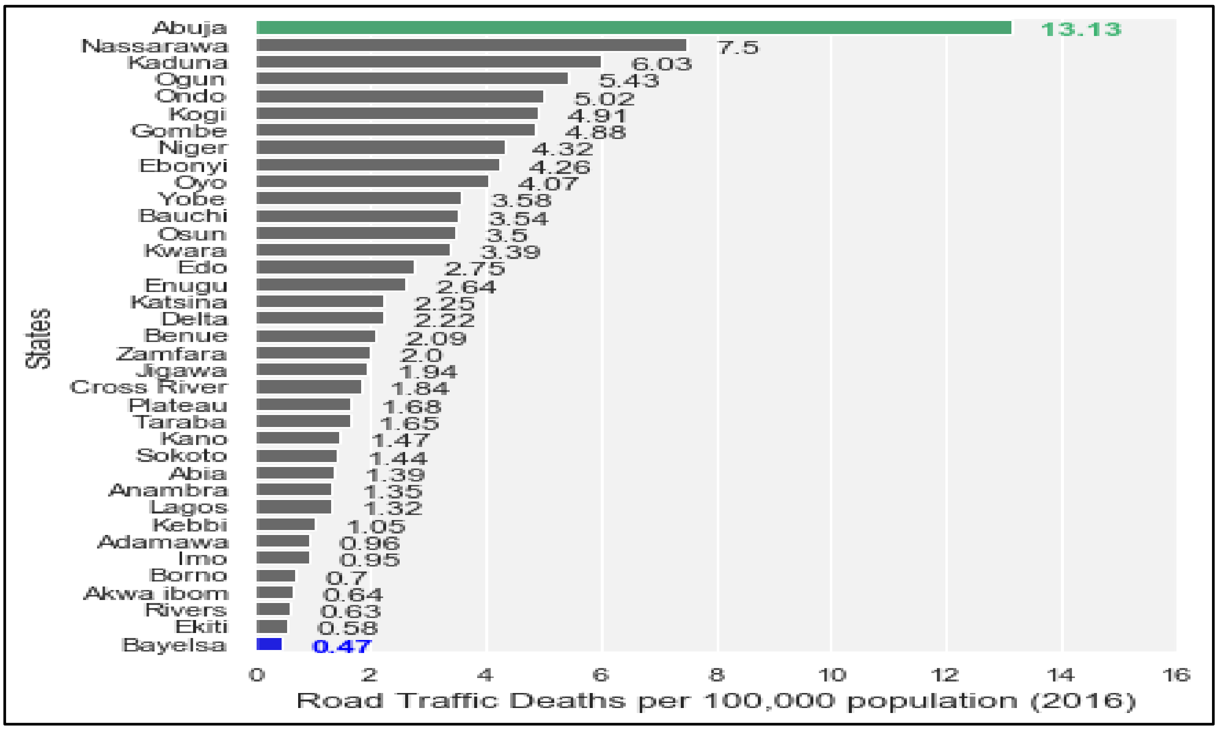
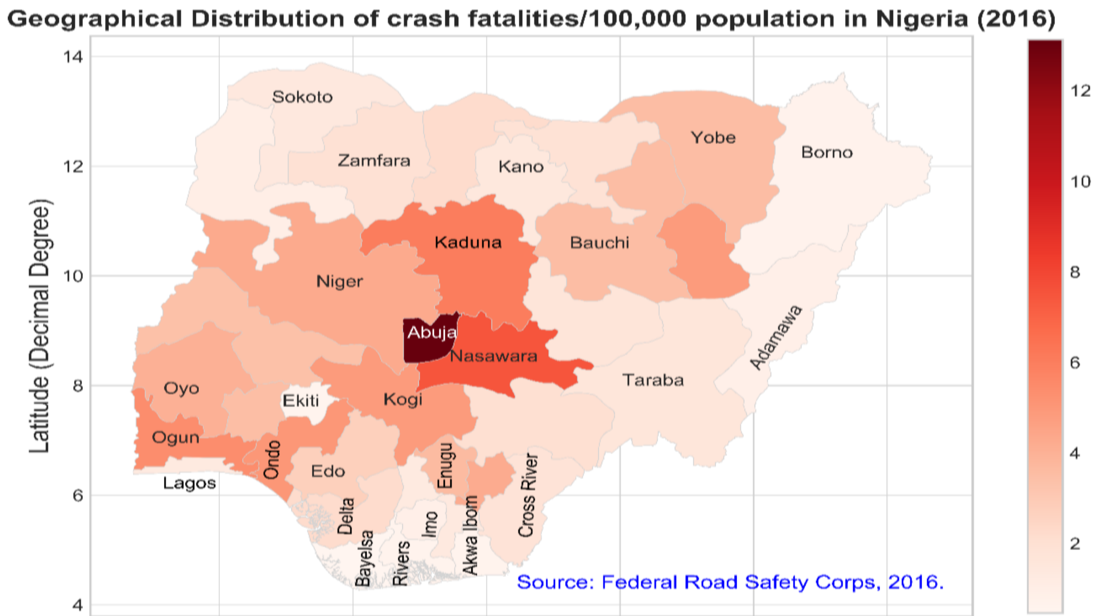


Figure 4.8: Road traffic deaths per 100,000 population for all states in Nigeria for year 2016 (Source: FRSC, 2016).

Though Kaduna recorded the highest number of road traffic deaths in Nigeria in 2016, the risk of dying as a result of road traffic crashes is higher in Abuja than in Kaduna. Kaduna had the third highest road traffic deaths per 100,000 population, which resulted in approximately 6 deaths out of every 100,000 people living in Kaduna in 2016. The lowest road traffic deaths per 100,000 people occurred in Bayelsa State, resulting in less than a single death out of every 100,000 people that lived in Bayelsa in 2016. Figures 4.8 and 4.9 show that in 2016, Bayelsa was the safest state in terms of the risk of dying from road traffic crashes and the chance of dying as a result of a road traffic crashes is more likely in Abuja than in any other state.



	Geo-Political Zones	Average Fatalities/100, 000 population
1	North Central	5.29
2	North East	2.55
3	North West	2.31
4	South West	3.32
5	South South	1.43
6	South East	2.32

Figure 4.9: Geographical distribution of crash fatalities per 100,000 population in Nigeria (2016) (Source: FRSC, 2016).

Figures 4.10 and 4.11 show the average road traffic deaths per 100,000 population from the year 2006 – 2016. From the total road traffic deaths per 100,000 population recorded, the risk of dying as a result of road traffic crashes in the Federal Capital Territory (FCT) – Abuja, was 20.54 per 100,000 population for 2006 – 2016. This is also despite the fact that the crash data from the Federal Road Safety Corps (FRSC) is highly underreported (Ogazi and Edison, 2012; WHO, 2018).

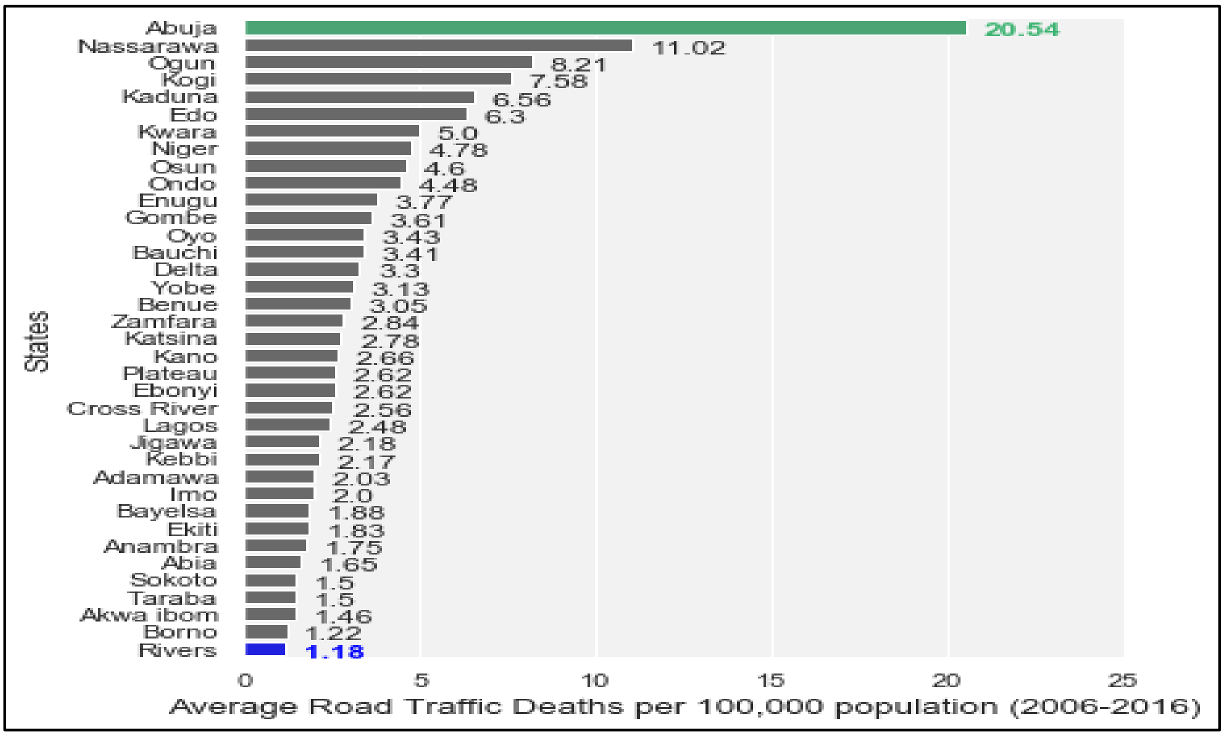
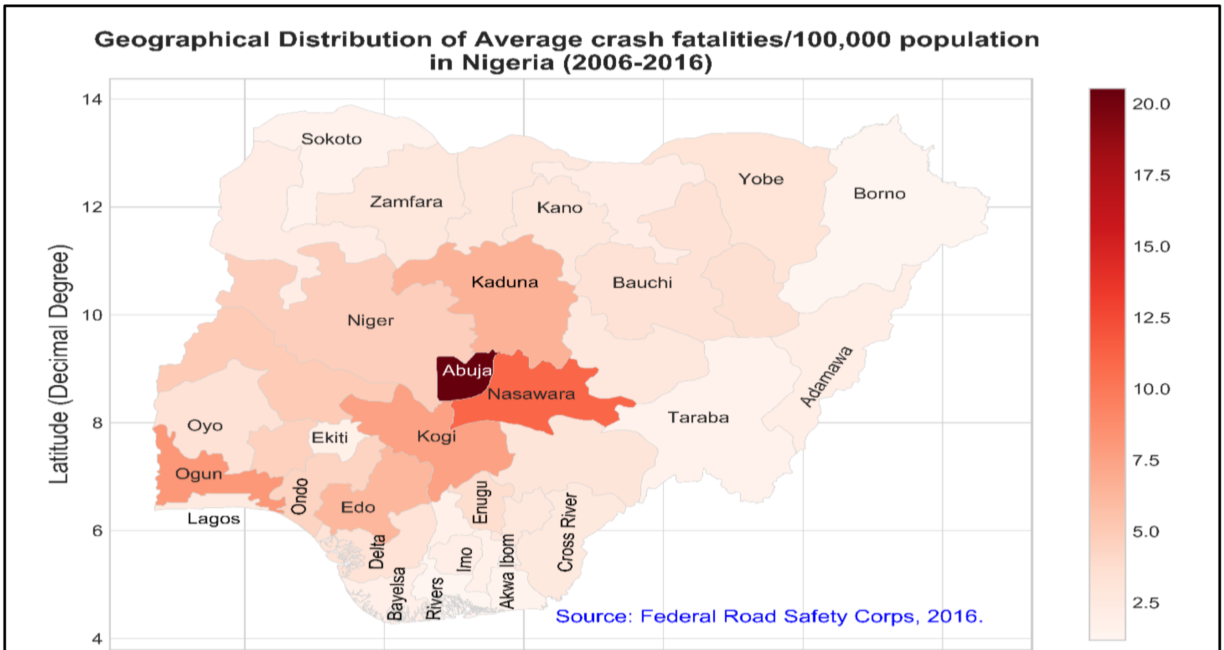


Figure 4.10: Average Road traffic deaths per 100,000 population for all states in Nigeria for year 2006 – 2016 (Source: FRSC, 2016).



	Geo-Political Zones	Average Fatalities/100, 000 population
1	North Central	7.8
2	North East	2.48
3	North West	2.96
4	South West	4.17
5	South South	2.78
6	South East	2.36

Figure 4.11: Geographical distribution of average crash fatalities per 100,000 population in Nigeria, 2006 – 2016 (Source: FRSC, 2016).

This is alarming as it still exceeds the global rate for road traffic deaths, which was only 17.4 within same period. This shows that drastic actions are needed if the rate of deaths per 100,000 population is to be reduced in Abuja. The state showing the least risk (safest) for that time frame (2006 – 2016) was Rivers state, with an approximate average death of just 1 person out of every 100,000 population (see Figure 4.10).

4.2.6 Registered vehicles in Nigeria

As at 2018, the National Bureau of Statistics (NBS) estimates that there are a total of 11.7 million registered vehicles in Nigeria. Of the 11,760,871 registered vehicles, 6,785,956 (57.7%) are commercial vehicles, 4,819,251 (41%) are private vehicles, 149,470 (1.3%) are Government vehicles, while 6,194 (0.1%) are Diplomatic vehicles (NBS, 2018a). Lagos State has continuously had the highest number of registered vehicles in Nigeria. From Figure 4.12, Lagos recorded the highest average number of registered vehicles from 2013 – 2016 due to its very large population.

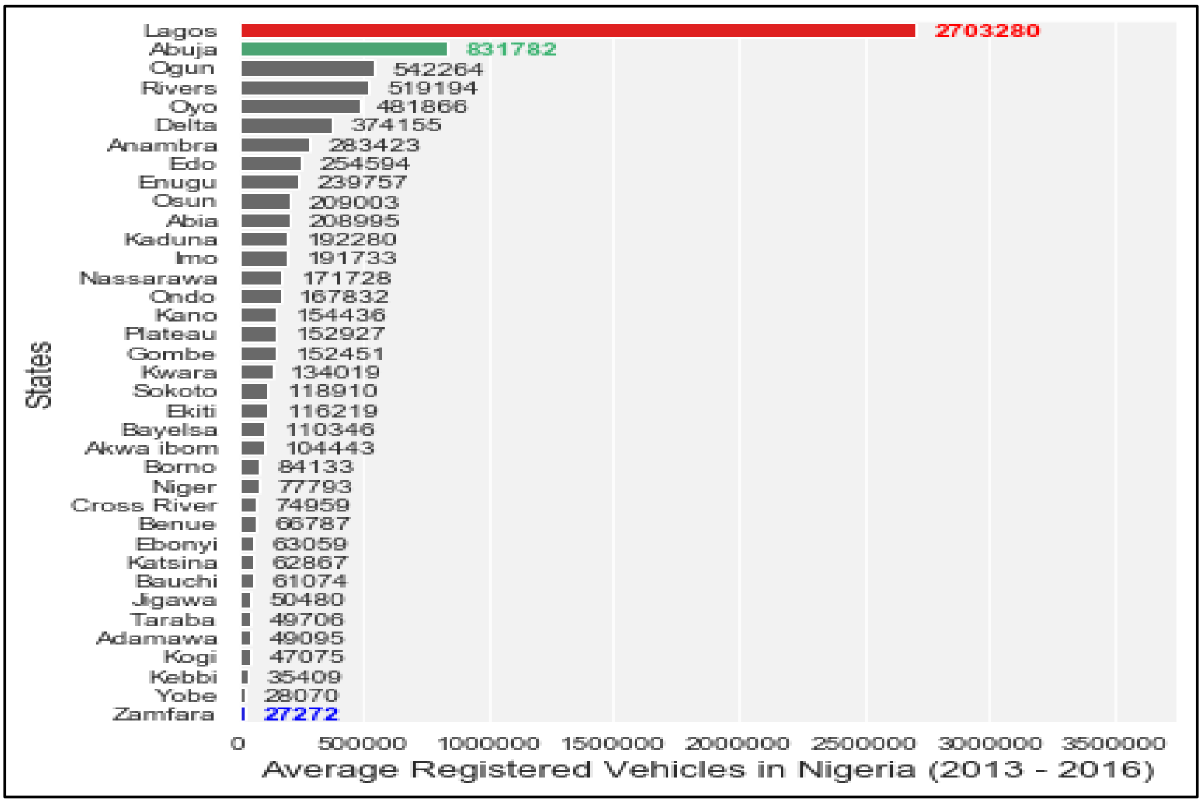


Figure 4.12: Average registered vehicles in Nigeria, 2013 – 2016 (Source: NBS).

Also, a contributory factor is its status as the unofficial commercial capital of the country, and home to one of the major functioning and Nigeria's largest and busiest sea port (Port of Lagos), thus making foreign used (second hand) vehicles readily available at relatively cheaper rates than in most Nigerian States. The average registered vehicles in Lagos for years 2013 – 2016 was three times the number of registered vehicles in Abuja. Abuja recorded the second highest average registered vehicles for 2013 – 2016, this can be attributed to its status as Nigeria's capital city and the fact that it is more economically stable than most States in the country. Zamfara State however recorded the lowest number of average registered vehicles for the period under consideration, with just 27,272 registered vehicles.

Records in 2016 as shown in Figure 4.13 show that Lagos still has the highest number of registered vehicles with 3,074,019 vehicles while Abuja had a total of 950,202 registered vehicles. This shows that the number of newly registered vehicles have been relatively consistent in recent years in Lagos and Abuja while States like Rivers, Edo and Delta have experienced slight increases in the number of registered vehicles.

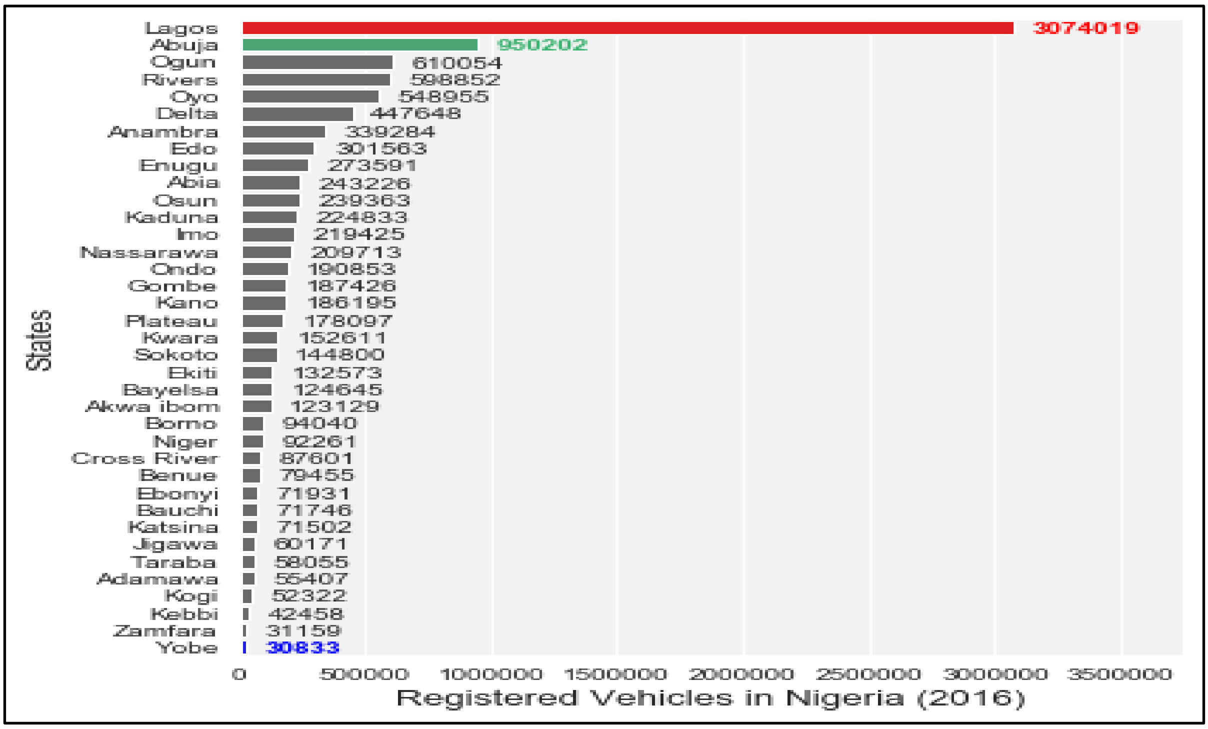


Figure 4.13: Registered vehicles in Nigeria, 2016 (Source: NBS).

It can be observed that the South – West geopolitical zone (mainly Lagos, Ogun, Oyo) have more registered vehicles than other geopolitical zones in Nigeria, which might be due to the relatively cheap cost of vehicles in Lagos State, thus, neighbouring States tend to benefit from the low prices of vehicles. The South – South geopolitical zone (mainly Rivers, Edo, Delta, Bayelsa) have the second highest number of registered vehicles in Nigeria, and this might also be attributed to Rivers State having a functioning sea port (Onne Sea port) and the region being relatively economically stable since the region is Nigeria's Oil producing region and home to all her oil and gas resources. As seen in Figure 4.14, people who work in Abuja but cannot afford the high cost of housing in Abuja live in neighbouring states and commute to work daily using their vehicles which also contributes to the high number of registered vehicles in the North Central geopolitical zone. The North – East (mainly Yobe, Adamawa, Taraba) has the lowest number of registered cars in the country due to insecurity and the volatile nature of the economy of the States in the region.

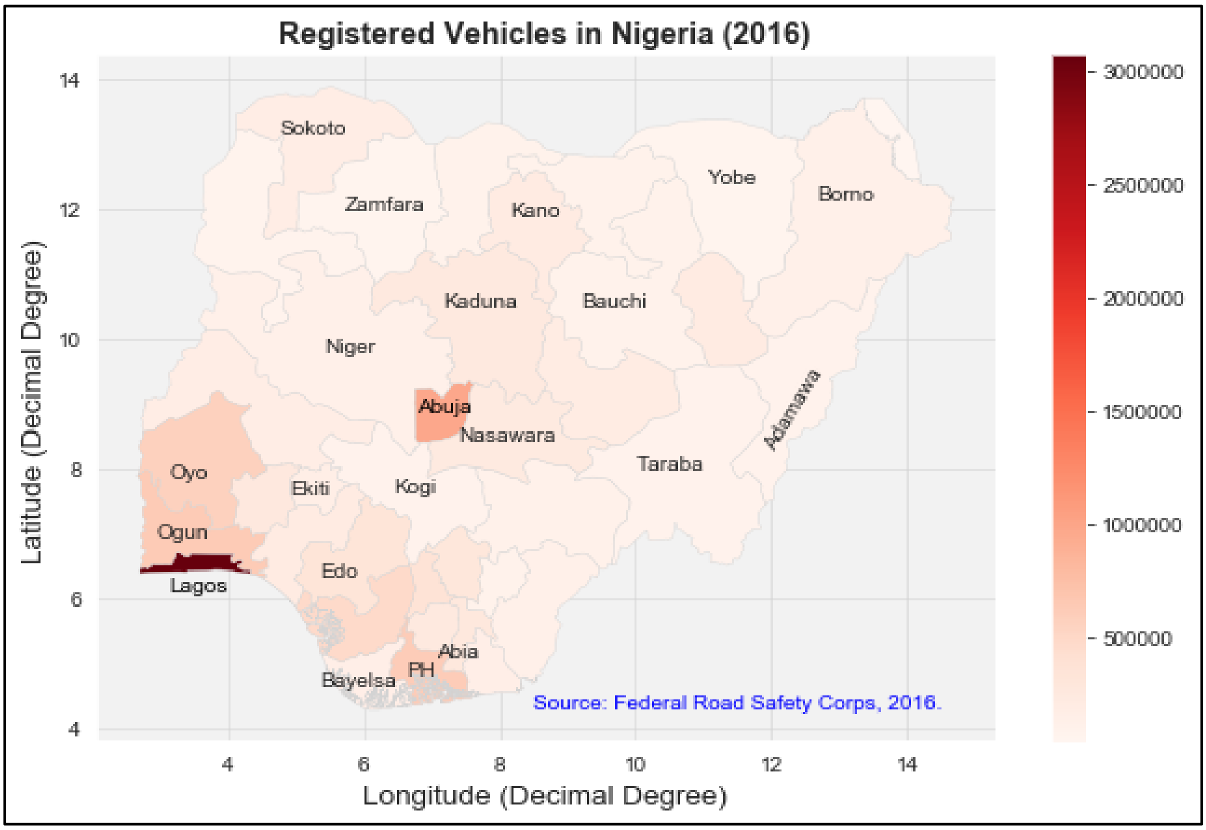


Figure 4.14: Map of registered vehicles in Nigeria in 2016 (Source: NBS)

4.2.7 Road traffic deaths per 10,000 registered vehicles

The number of fatalities per 10,000 vehicles indicates the number of road traffic deaths for every 10,000 registered vehicles involved in road traffic crashes. From Figure 4.15, Abuja had 2.66 fatalities per 10,000 registered vehicles in 2016. Kogi had the highest fatalities per 10,000 registered vehicles while Lagos state had the lowest fatalities per 10,000 registered vehicles. Lagos accounts for about 30% of Nigeria's vehicular movement. The low fatalities in Lagos might be due to the traffic congestion regularly experienced on Lagos roads.

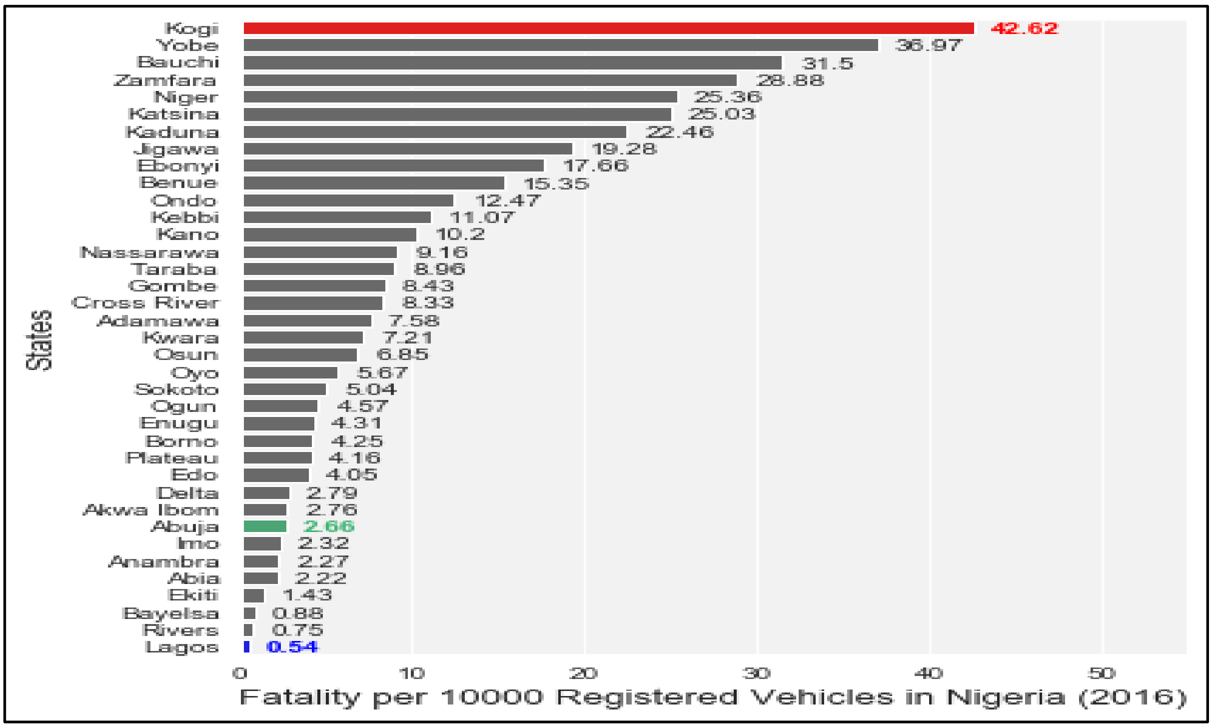


Figure 4.15: Fatalities per 10,000 registered vehicles in Nigeria, 2016 (Source: NBS).

Kogi which had one of the lowest numbers of registered vehicles in Nigeria (see Figure 4.13), had 42.62 fatalities per 10,000 registered vehicles, which might be due to the location of the state as the major link between Northern and Southern Nigeria, thus contributing to heavy vehicular flow passing through the State as well as associated road traffic crashes and deaths due to the poor state of the roads. Kogi is the only State in Nigeria bordered by 10 different States. Most road transport journeys originating to and from Southern Nigeria to Northern Nigeria, pass through Lokoja, (the capital) or Okenne both in Kogi State.

From Figure 4.16, it can be observed that Northern Nigeria had higher fatalities per 10,000 registered vehicles when compared to the South. This indicates that as the number of registered vehicles continue to increase in Nigeria, without adequate road safety measures, fatalities would also increase in the North.

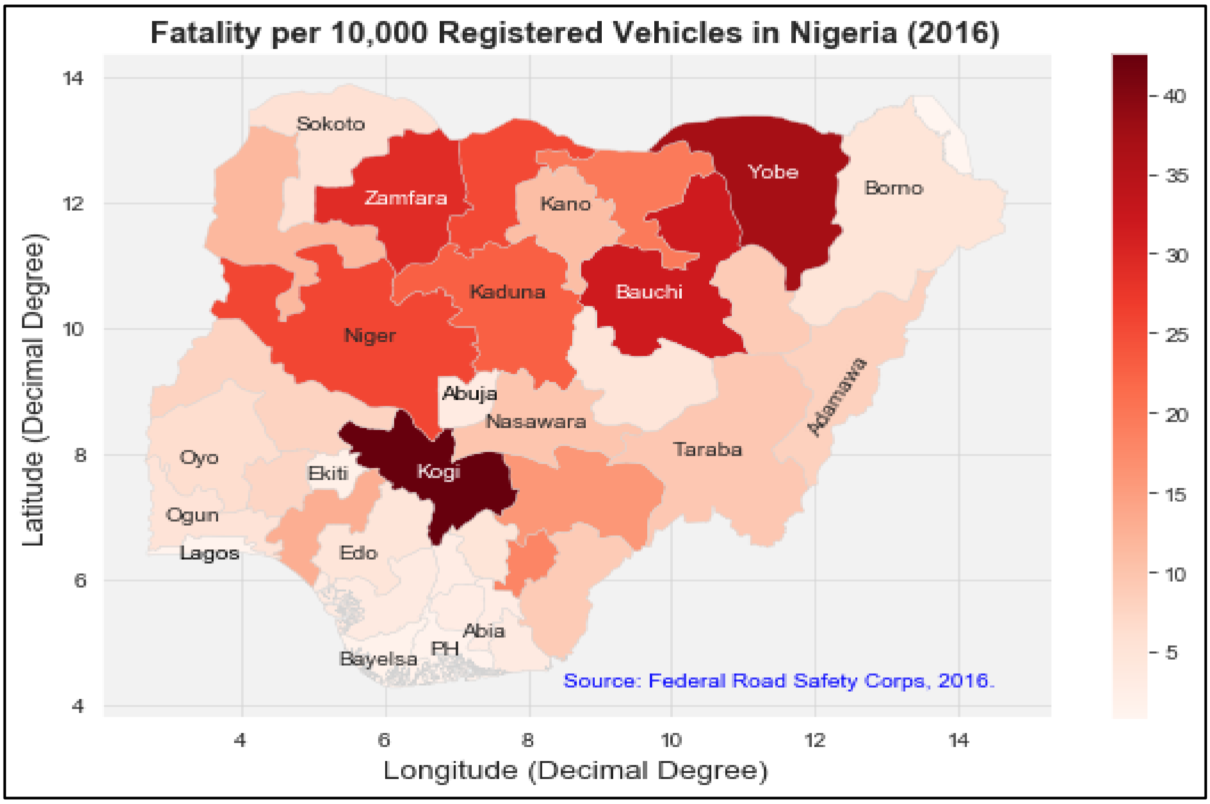


Figure 4.16: Map of fatality per 10,000 registered vehicles in Nigeria, 2016 (Source: NBS)

From the general overview of road transport safety in Abuja and Nigeria by extension, it can be observed that the number of road traffic deaths have continuously exceeded the set targets of the United Nations Decade of Action for Road Safety 2011 – 2020 and that of the Sustainable Development Goals (SDG) Goal 3 target 6. Going by the current trend, the United Nations Decade of Action goal and the SDG target of stabilising and halving deaths from road traffic crashes will not be actualised in Abuja and also by extension Nigeria by the end of 2020.

From foregoing, the choice of Abuja for this study is a no – brainer, which is justified by the existing traffic safety issues, as the city currently experiences one of the highest number of yearly road crashes and injuries in Nigeria (FRSC, 2016). In 2016, Abuja had the highest number of road traffic deaths per 100,000 population in Nigeria, which is also consistent with the average yearly number of road traffic deaths per 100,000 population from 2006 – 2016. The level of education, security ease of collecting road safety data, as well as its status as Nigeria's capital city, makes it an ideal choice for traffic safety policy reforms, and an excellent study area. To this end, the behaviour and attitude of road users in Abuja as well as the opinion of the residents of Abuja was sought with the use of questionnaires, in understanding the behavioural risk factors contributing to the rather high levels of Road Traffic Crashes in the City. The analysis of these findings are presented in the next section (section 4.3).

4.3 Questionnaire Analysis

The questionnaires administered to road users in Abuja in order to understand their attitudes and behaviours, as well as identify the factors responsible for Road Traffic Crashes (RTC) are analysed in this section. A total of 1,526 questionnaires were successfully distributed by hand on a field trip to Abuja, Nigeria. 321 questionnaires were successfully completed and returned, representing a response rate of about 21%.

Univariate analysis was done on the questionnaires to summarise as well as describe the responses of the respondents, after which bivariate analysis was also carried out on the questionnaires to understand the relationship between categorical variables. Inferential statistics were also performed in order to pass judgement on various constructs the questionnaire intended to measure. The findings of this study are discussed in Chapter 5.

4.3.1 Demography of road users

The demography of the respondents is shown in Figure 4.17. From Figure 4.17, it can be seen that out of 321 respondents, 212 were male which accounts for approximately 66% of the respondents, while 109 were females, accounting for approximately 34% of the respondents that took part in the survey. The marital status of the respondents showed that a majority of the respondents were married which accounted for 57.9% of the respondents while the respondents who indicated that they were divorced accounted for 1.6% of the survey. The single respondents who took part in the survey accounted for 28.7% of the respondents while the separated accounted for 3.4%. The demography in terms of age showed that majority of the road users who participated in the survey were within the ages of 41 – 50, which accounted for 37.9% of the respondents. Nigeria does not yet have any available demographic data of road users or exposure of road users in Abuja, however, Kumar and Srinivasan, (2013) in a study of the socio – demographic profile of Road Traffic Crash victims noted that males drive automobiles than females and have the propensity to experience road traffic conflicts than females. This demography is similar to what is obtainable in Abuja, therefore, the study sample is an actual representation of the road users in Abuja.

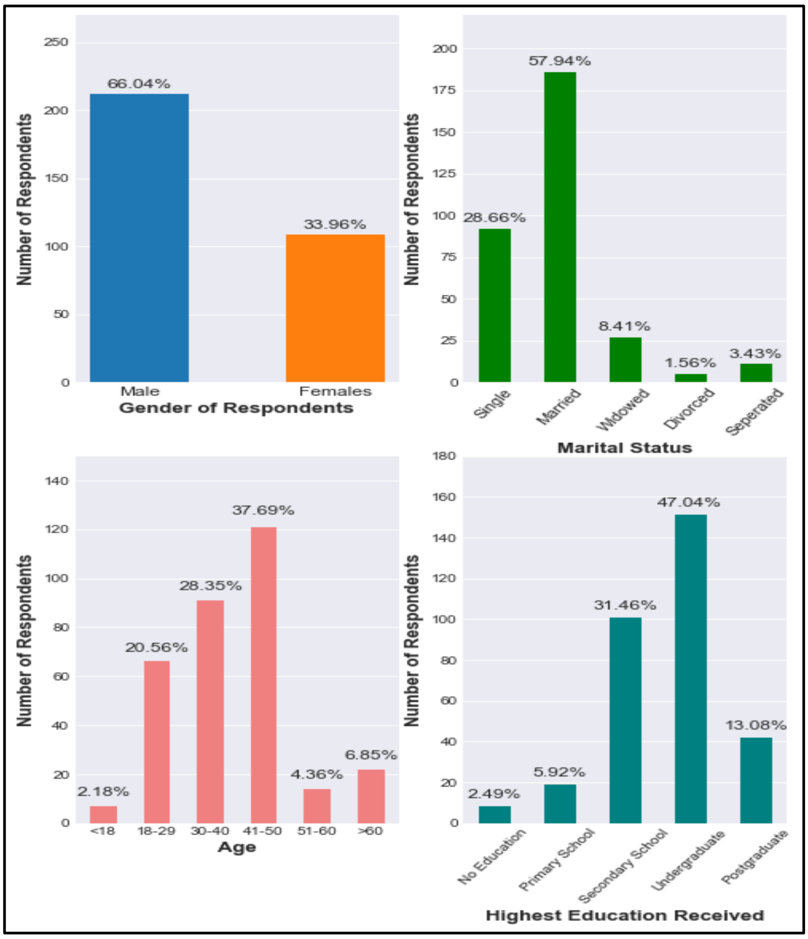


Figure 4.17: Demography of the respondents.

Figure 4.17 shows that respondents below the age of 18 accounted for about 2.2%, and this was due to the fact that in Nigeria, most people below the age of 18 are yet to own private vehicles and a majority of the respondents below 18 who participated in the survey were mostly pedestrians or driven by an older adult. Respondents above the age of 60 accounted for 6.9% of the survey, while 20.6% of the respondents were between the ages of 18 – 29. 51.1% of the respondents were below the age of 40. Given the preponderance of this age group in the population, per head of population, this group is not underrepresented in the sample, because the population of Abuja is dominated by politicians and civil servants who mostly fall outside this age group.

With respect to the highest level of education received by the respondents, it can be observed that majority of the respondents had acquired undergraduate degrees and understood the need for the survey. The respondents who were educated to undergraduate level accounted for 47% of the survey, while those with postgraduate degrees accounted for 13.1% of the survey. Respondents who did not have any formal education that took part in the survey were only 2.5%. It was also observed that the respondents whose highest level of education received was just primary education accounted for just 5.9% of the survey. The respondents who received secondary education as their highest level of education, accounted for 31.5% of the survey. Majority of the respondents that had received minimum education above primary school level accounted for 91.6%, therefore, a majority of the respondents had the minimum required understanding of why the survey was carried out and must have previously gained awareness about road traffic crashes.

4.3.2 How bothered are road users about Road Traffic Crashes

From the questionnaires it can be noted that all the respondents were bothered to some extent about Road Traffic Crashes (RTC) in Abuja. 273 respondents indicated that they were very bothered about Road Traffic Crashes (RTC) in the capital city, and this accounts for 85% of the respondents, while the remaining 15% of the respondents were partly bothered. None of the respondents indicated they were not bothered about Road Traffic Crashes (RTC), (see Appendix C, Q7). This indicates that road users in Abuja are aware of the dangers of Road Traffic Crashes and express concerns over it.

4.3.2.1 Gender

The cross tabulation for gender of respondents and how bothered these respondents are about road traffic crashes is shown in Table 4.1 and Figure 4.18. There is no available data on the exposure of male and female drivers in Nigeria. From Figure 4.18, it can be observed that the male respondents were more bothered than the female respondents. Figure 4.18 shows that 90.6% of the male respondents were very bothered, compared to 74.3% of female respondents. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 14.96,\ df = 1,\ p = 0.000$) (see Appendix E1), which provides strong evidence that there is a relationship between the gender of respondents and how bothered respondents are about road traffic crashes in Abuja.

Table 4.1: Cross tabulation of gender and how bothered road users are about road traffic crashes.

Gender * How bothered are road users about road traffic crashes Cross tabulation					
			How bothered are you about road traffic crashes		Total
			Partly Bothered	Very Bothered	
Gender	Male	Count	20	192	212
		% within Gender	9.4%	90.6%	100.0%
	Female	Count	28	81	109
		% within Gender	25.7%	74.3%	100.0%
Total		Count	**48**	**273**	**321**
		% within Gender	15.0%	85.0%	100.0%

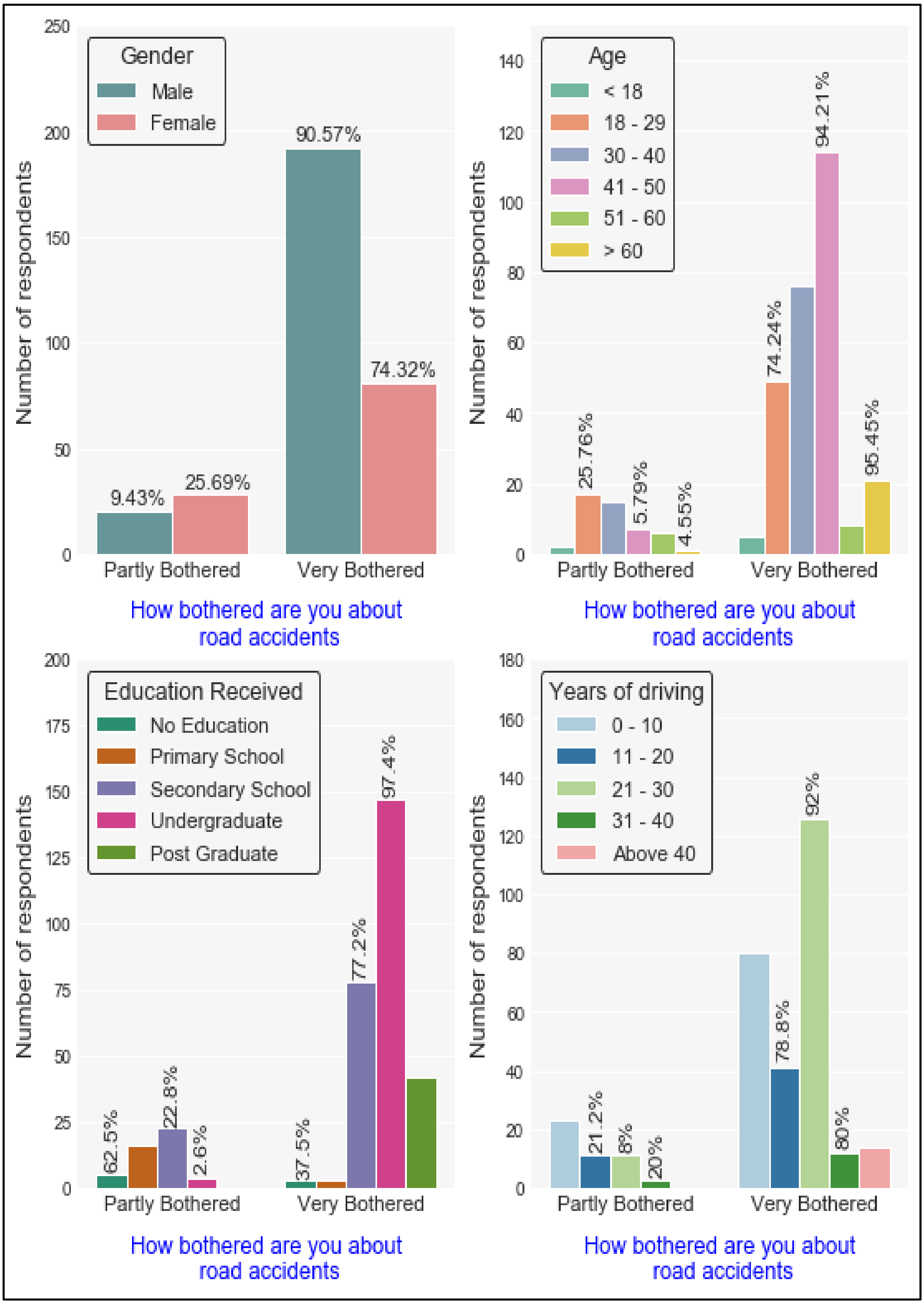


Figure 4.18: Relationship between gender, age, highest education received and years of driving and how bothered respondents are on the occurrence of road traffic crashes.

4.3.2.2 Marital Status

The cross tabulation relating the marital status and how bothered the respondents are about road traffic crashes is presented in Table 4.2. From Table 4.2, it can be observed that most of the married respondents were very bothered about road traffic crashes compared to single respondents. From the survey, 94.1% of the married respondents were very bothered about road traffic crashes while 62% of respondents that were single were also very bothered about road traffic crashes. The study shows that marital status affects how bothered people who live in Abuja are about road traffic crashes. Even if the difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 54.19,\ df = 4,\ p = 0.000$) (see Appendix E2), the assumption for minimum expected value of 5 was violated, therefore, there is no relationship between the marital status of respondents and how bothered respondents are about road traffic crashes.

Table 4.2: Cross tabulation of marital status and how bothered road users are about road traffic crashes.

Marital Status * How bothered are road users about road traffic crashes Cross tabulation					
			How bothered are you about road traffic crashes		Total
			Partly Bothered	Very Bothered	
Marital Status	Single	Count	35	57	92
		% within Marital Status	38.0%	62.0%	100.0%
	Married	Count	11	175	186
		% within Marital Status	5.9%	94.1%	100.0%
	Widowed	Count	1	26	27
		% within Marital Status	3.7%	96.3%	100.0%
	Divorced	Count	0	1	1
		% within Marital Status	0.0%	100.0%	100.0%
	Separated	Count	1	14	15
		% within Marital Status	6.7%	93.3%	100.0%
Total		Count	**48**	**273**	**321**
		% within Marital Status	15.0%	85.0%	100.0%

4.3.2.3 Age

The cross tabulation relating age groups and how bothered the respondents are about road traffic crashes is shown in Table 4.3. The result of the cross tabulation in Table 4.3 is also represented in Figure 4.18. From Figure 4.18, all age groups expressed serious concerns to a very high degree about road traffic crashes in Abuja. Respondents above the age of 60 and between the ages of 41 – 50 were the most bothered and 57.1% of respondents between the ages of 51 – 60 expressed that they were very bothered. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 25.690,\ df = 5,\ p = 0.000$) (see Appendix E3), which provides strong evidence that there is a relationship between the age group of respondents and how bothered respondents are about road traffic crashes.

Table 4.3: Cross tabulation of age group and how bothered road users are about road traffic crashes.

Age Group * How bothered are road users about road traffic crashes Cross tabulation					
			How bothered are you about road traffic crashes		Total
			Partly Bothered	Very Bothered	
Age Group	<18	Count	2	5	7
		% within Age Group	28.6%	71.4%	100.0%
	18 - 29	Count	17	49	66
		% within Age Group	25.8%	74.2%	100.0%
	30 - 40	Count	15	76	91
		% within Age Group	16.5%	83.5%	100.0%
	41 - 50	Count	7	114	121
		% within Age Group	5.8%	94.2%	100.0%
	51 - 60	Count	6	8	14
		% within Age Group	42.9%	57.1%	100.0%
	>60	Count	1	21	22
		% within Age Group	4.5%	95.5%	100.0%
Total		Count	**48**	**273**	**321**
		% within Age Group	15.0%	85.0%	100.0%

4.3.2.4 Education received

The cross tabulation relating the level of education received and how bothered the respondents are about road traffic crashes is shown in Table 4.4. The result of the cross tabulation in Table 4.4 is also presented in Figure 4.18. The survey shows that respondents whose highest education received were undergraduate and post graduate were the most bothered while respondents who had not received any form of education were the least bothered. The study reveals that 97.4% of respondents who had undergraduate level education were very bothered about road traffic crashes while 100% of respondents who had a post graduate degree were very bothered.

Table 4.4: Cross tabulation of highest education received and how bothered road users are about road traffic crashes.

Highest Education Received * How bothered are road users about road traffic crashes Cross tabulation					
			How bothered are you about road traffic crashes		Total
			Partly Bothered	Very Bothered	
Highest Education Received	No Education	Count	5	3	8
		% within Highest Education Received	62.5%	37.5%	100.0%
	Primary School	Count	16	3	19
		% within Highest Education Received	84.2%	15.8%	100.0%
	Secondary School	Count	23	78	101
		% within Highest Education Received	22.8%	77.2%	100.0%
	Undergraduate	Count	4	147	151
		% within Highest Education Received	2.6%	97.4%	100.0%
	Postgraduate	Count	0	42	42
		% within Highest Education Received	0.0%	100.0%	100.0%
Total		Count	48	273	321
		% within Highest Education Received	15.0%	85.0%	100.0%

The study shows that 37.5% of respondents who had not received any form of education were very bothered. This also shows that there is a positive correlation between the highest education received and how bothered respondents are about road traffic crashes. The result shows that the level of education received has an influence on understanding the challenges associated with road safety. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 116.1,\ df = 4,\ p = 0.000$) (see Appendix E4), which provides strong evidence that there is a relationship between the highest education received by respondents and how bothered respondents are about road traffic crashes.

4.3.2.5 Driving experience

Results showing the relationship between the driving experience of the respondents and how bothered respondents say they are about road traffic crashes are presented in Table 4.5 and Figure 4.18. 92% of the respondents with driving experience between 21 – 30 years were very bothered about road traffic crashes while 77.7% of the respondents who had between 0 – 10 years driving experience were very bothered.

The result shows that the number of driving years that a respondent has, enables them to show more concerns about the issues of road traffic crashes in Abuja. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 13.9,\ df = 4,\ p = 0.008$) (See Appendix E5), which provides strong evidence that there is a relationship between the driving experience and how bothered the respondents are about road traffic crashes.

Table 4.5: Cross tabulation of driving experience and how bothered road users are about road traffic crashes.

How Long Have You Been A Driver * How bothered are road users about road traffic crashes Cross tabulation					
			How bothered are you about road traffic crashes		Total
			Partly Bothered	Very Bothered	
How Long Have You Been A Driver	0 - 10	Count	23	80	103
		% within How Long Have You Been A Driver	22.3%	77.7%	100.0%
	11 - 20	Count	11	41	52
		% within How Long Have You Been A Driver	21.2%	78.8%	100.0%
	21 - 30	Count	11	126	137
		% within How Long Have You Been A Driver	8.0%	92.0%	100.0%
	31 - 40	Count	3	12	15
		% within How Long Have You Been A Driver	20.0%	80.0%	100.0%
	Above 40	Count	0	14	14
		% within How Long Have You Been A Driver	0.0%	100.0%	100.0%
Total		Count	48	273	321
		% within How Long Have You Been A Driver	15.0%	85.0%	100.0%

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4.3.3 Involvement in road traffic crashes in the last 6 months

Results from the survey (Appendix C, Q9), revealed that in the last 6 months, 29.6% of the respondents have been involved in road traffic crashes, while 70.4% of the respondents have not been involved in any crash. The result of the bivariate analysis is shown in Appendices E6 – E10 and the result is also presented in Figure 4.19.

From Figure 4.19, it can be seen that in the last 6 months, married respondents have been involved in more road traffic crashes than single respondents. One third of the respondents who are married have been involved in road traffic crashes in the last 6 months while 29.3% of respondents who are single have been involved in road traffic crashes. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 19.1,\ df = 4,\ p = 0.001$) (see Appendix E11), which provides strong evidence that there is a relationship between the marital status of respondents and if the respondents have been involved in road traffic crashes in the last 6 months.

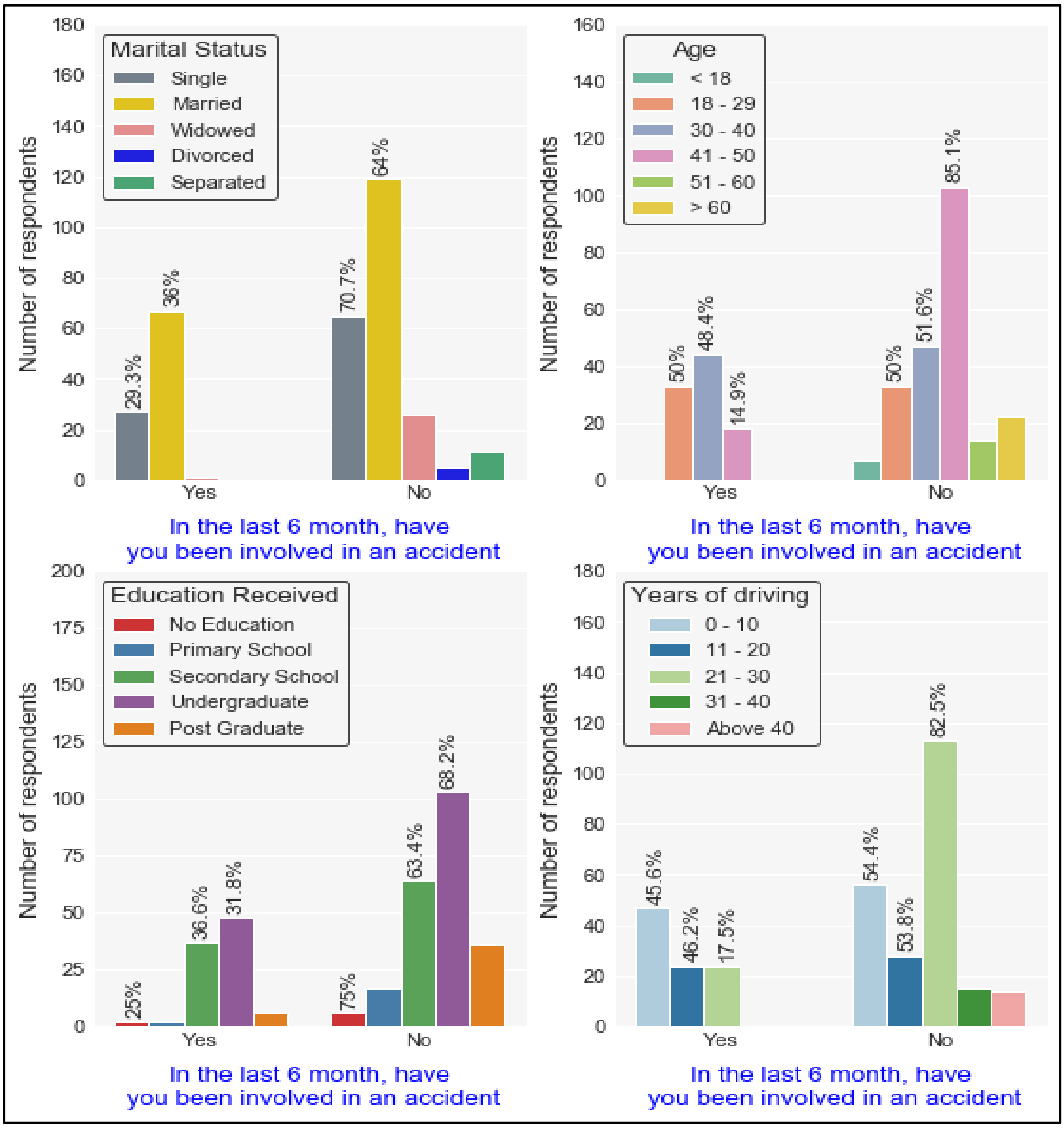

Figure 4.19: Relationship between marital status, age, highest education received and years of driving, and if respondents have been involved in road crashes in the last 6 months.

The results of the study also showed that respondents above the age of 51 indicated that they had not been in a road traffic crash in the last 6 months while other age groups agree to have been involved in road traffic crashes in the last 6 months. Respondents between the ages of 18 – 29 were the group most involved in road traffic crashes in the last 6 months while 14.9% of respondents between the ages of 41 – 50 have been involved in road traffic crashes in the last 6 months as seen in Figure 4.19. The result shows that the elderly have been less involved in road traffic crashes in the last 6 months compared to the younger respondents. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 59.21,\ df = 5,\ p = 0.000$) (see Appendix E12), which provides strong evidence that there is a relationship between the age group of respondents and if the respondents have been involved in road traffic crashes in the last 6 months.

For the relationship between the highest education received and if respondents have been involved in road traffic crashes in the last 6 months, the results from the study showed that respondents whose highest education received was secondary education had the most road traffic crashes in the last 6 months. The study showed that a quarter of the respondents who have not received any form of education were involved in road traffic crashes in the last 6 months. 36.6% of respondents who have received secondary school education were involved in road traffic crashes in the last 6 months while 31.8% who have received undergraduate education were involved in road traffic crashes in the last 6 months. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 10.87,\ df = 4,\ p = 0.028$) (See Appendix E13), which provides strong evidence that there is a relationship between the highest education received by respondents and if the respondents had been involved in a road crash in the last 6 months.

The result for the relationship between how long respondents have been driving and if respondents have been involved in road traffic crashes in the last 6 months showed that respondents that have been driving for 11 – 20 years have been involved in more crashes in the last six months compared to those with 0 – 10 years driving experience, and those with driving experiences of 21 years and above. From Figure 4.19, it can be seen that 45.6% of respondents who have been driving for less than 10 years, 46.2% of respondents who have been driving for 11 – 20 years and 17.5% of the respondents who have been driving for 21 – 30 years have been involved in road traffic crashes in the last 6 months. Respondents who have over 31 years driving experience were not involved in road traffic crashes in the last 6 months. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 41.34,\ df = 4,\ p = 0.000$) (see Appendix E14), which also provides strong evidence that there is a relationship between how long respondents have been driving and if the respondents have been involved in a road traffic crash in the last 6 months.

There is no relationship between gender and if respondents have been involved in a road traffic crashes in the last 6 month due to the fact that the difference between the expected and observed count was not statistically significant ($\chi^2 = 2.61,\ df = 1,\ p = 0.106$) (see Appendix E15). The findings of this study are further discussed in the next chapter (see section 5.3).

4.3.4 Road traffic crashes with injuries in the last 6 months

The result of the bivariate analysis is shown in Appendices E16 – E20 and the results are represented in Figure 4.20. The survey showed that 86.3% of the respondents have not been involved in any road traffic crash that resulted in injuries while 13.7% admitted to have been involved in crashes that resulted in injuries. From the study, more males have been involved in road traffic crashes that resulted in injuries than females. 16.5% of male respondents were involved in traffic crashes that resulted in injuries while 8.3% of female respondents were involved in traffic crashes that resulted in injuries. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 4.15,\ df = 1,\ p = 0.042$) (see Appendix E21), which provides strong evidence that there is a relationship between gender of respondents and if respondents have been involved in a road crash in the last 6 months that resulted in injuries.

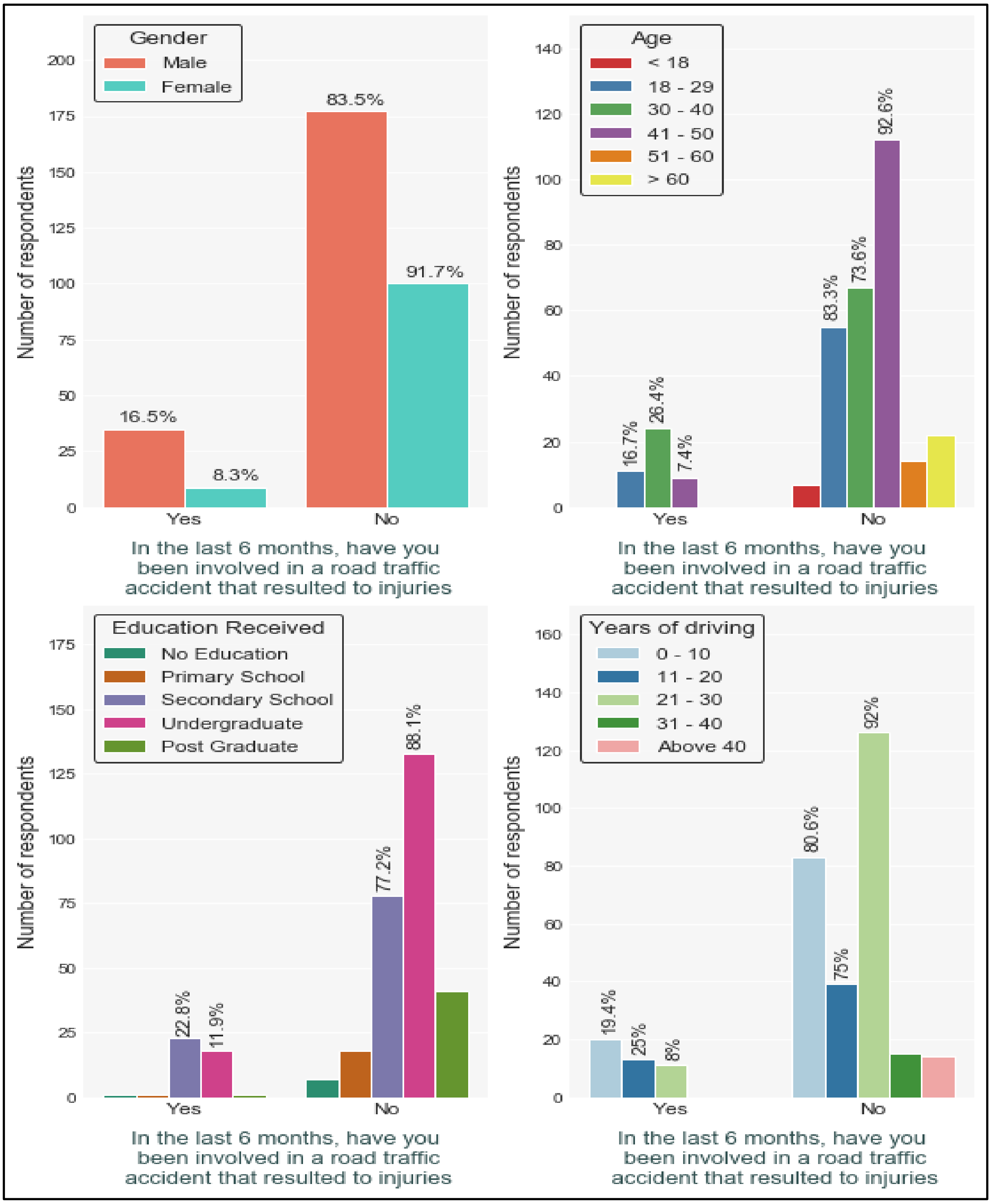

Figure 4.20: Relationship between gender, age, highest education received and years of driving, and if respondents have been involved in a road traffic crash in the last 6 month that resulted in injuries.

For the relationship between the age of respondents and if they have been involved in road traffic crashes that resulted in injuries, the study shows that respondents between the ages of 30 – 40 were more involved in road traffic crashes that resulted in injuries. The result also showed that respondents above the age of 50 and below the age of 18 have not been involved in road traffic crashes with injuries in the last 6 months. 26.4% of the respondents between the ages of 30 – 40 were involved in road traffic crashes that resulted in injuries while 16.7% of the respondents were involved in road traffic crashes that resulted in injuries. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 23.68,\ df = 5,\ p = 0.000$) (see Appendix E22), which provides strong evidence that there is a relationship between age group and if respondents have been involved in a crash in the last 6 months that resulted in injuries.

The bivariate analysis shows that respondents who received secondary school education were involved in more road traffic crashes that resulted in injuries. 22.8% of respondents who received secondary school education have been involved in road traffic crashes that resulted in injuries while 11.9% of respondents who had undergraduate level education were involved in road traffic crashes that resulted in injuries. The difference was statistically significant at level of significance of 0.05 ($\chi^2 = 13.14,\ df = 4,\ p = 0.011$) (see Appendix E23), which also provides strong evidence that there is a relationship between highest education received and if respondents have been involved in road traffic crashes in the last 6 months that resulted in injuries.

For the relationship between years of driving and if respondents have been involved in road traffic crashes that resulted in injuries in the last 6 months, results from the analysis showed that respondents with fewer years of driving were involved more in crashes that resulted in injuries compared to those with longer years of driving. 19.4% of respondents who have been driving for 0 – 10 years were involved in road traffic crashes that resulted in injuries, while

25% of respondents that have been driving for 11 – 20 years were involved in road traffic crashes that resulted in injuries. Respondents that had more than 31 years of driving experience were not involved in road traffic crashes in the last 6 months. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 16.786,\ df = 4,\ p = 0.002$) (see Appendix E24), which provides strong evidence that there is a relationship between how long respondents have been driving and if respondents have been involved in road traffic crashes in the last 6 months that resulted in injuries.

There was no statistical significance between the marital status of the respondents and if respondents had been involved in road traffic crashes that resulted in injuries in the last 6 months (see Appendix E25).

4.3.5 When do most Road Traffic Crashes happen in Abuja?

The results from the bivariate analysis are presented in Appendices E26 – E30 and presented in Figure 4.21. Figure 4.21 shows that 52.6% of the total respondents indicated that road traffic crashes occur mainly at night in Abuja, this might be attributed to poor visibility as a result of inadequate street lights on the road and the lack of electricity to power the street lights. The relationship between the gender of respondents and when most traffic crashes happen in Abuja showed that 60.4% of male respondents agreed that road traffic crashes happen in the night at Abuja while 37.6% of the female respondents agreed that road traffic crashes happen at night in Abuja. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 39.48,\ df = 3,\ p = 0.000$) (see Appendix E31), which provides strong evidence that there is a relationship between gender of respondents and the response to when most traffic crashes happen in Abuja.

From Figure 4.21, more than half of the respondents who are single were of the opinion that most traffic crashes occur at night in Abuja. 54.3% of the single respondents believe that most traffic crashes occur at night while 49.5% of respondents who are married opine that most road traffic crashes occur at night in Abuja. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 24.642,\ df = 9,\ p = 0.000$) (see Appendix E32), which provides strong evidence that there is a relationship between marital status of the respondents and the response to when most road traffic crashes happen in Abuja.

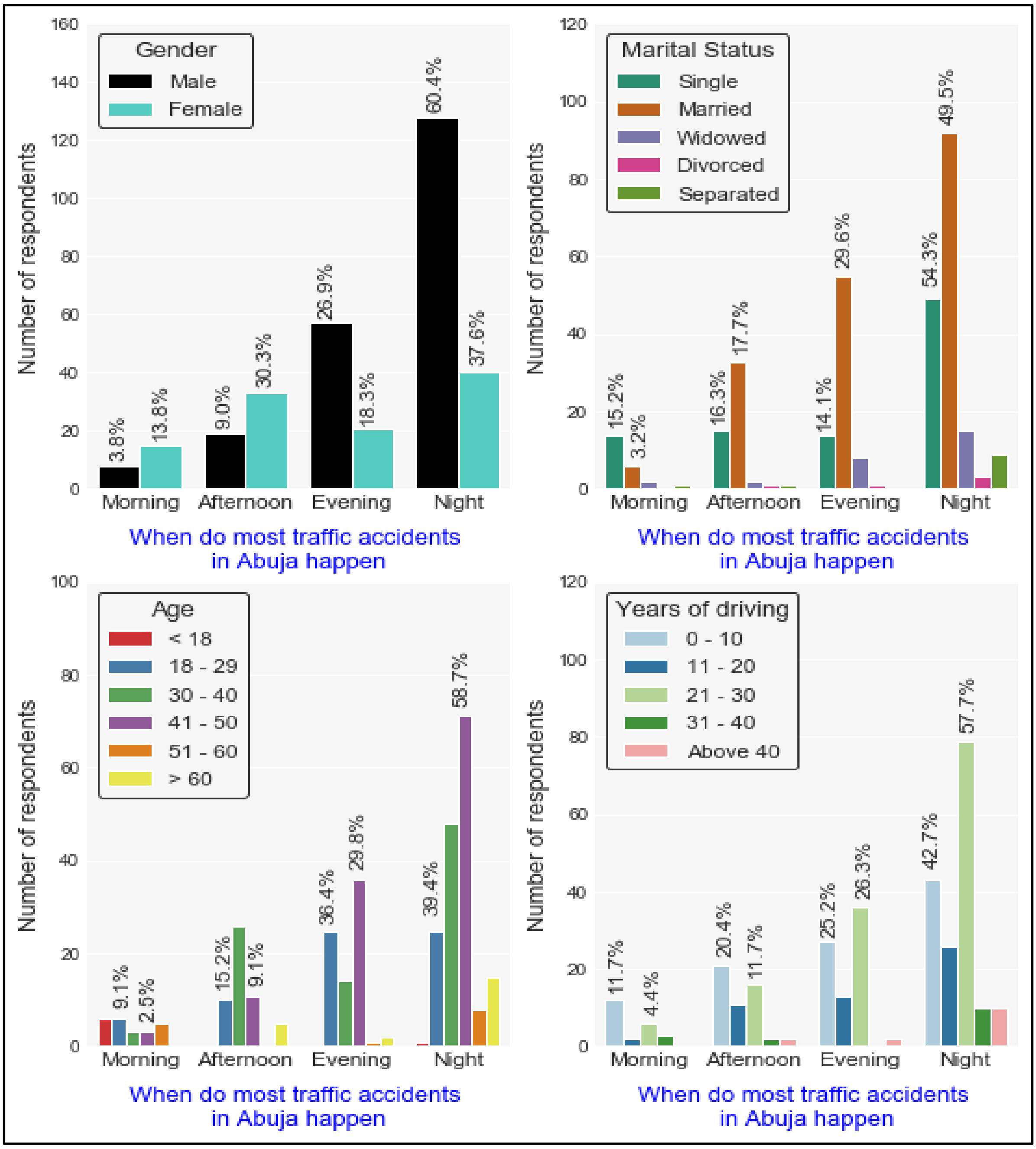

Figure 4.21: Relationship between gender, age, marital status and years of driving, and when most road traffic crashes happen in Abuja.

For the relationship between age and when most traffic crashes happen in Abuja, 58.7% of the respondents believe that most of the road traffic crashes occur at night. Even if the difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 120.25,\ df = 15,\ p = 0.000$) (see Appendix E33), the assumption for minimum expected value of 5 was violated, therefore,, there is no relationship between the age of respondents and the response to when most traffic crashes happen in Abuja.

For the relationship between years of driving and when most traffic crashes happen in Abuja, 57.7% of the respondents who have been driving for 21 – 30 years believe that majority of road traffic crashes occur at night while 42.7% of respondents who have been driving for 0 – 10 years believe that most traffic crashes occur at night. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 22.05,\ df = 12,\ p = 0.037$) (see Appendix E34), which provides strong evidence that there is a relationship between years of driving, and the response to when most traffic crashes happen in Abuja.

There was no statistical significance between the highest levels of education received by the respondents and when most traffic crashes happen in Abuja (see Appendix E35), therefore a relationship does not exist between the two variables.

Based on this survey, Road Traffic Crashes on Fridays account for 58.6% of the total crashes that occur during the week, followed by Saturday which accounts for 24.6% of crashes. Majority of crashes occur on Fridays than any other week days, and this is consistent with the findings of Haworth et al., (1997) and Ukoji, (2014). The findings of this study reaffirm the general notion that more Road Traffic Crashes (RTC) happen during weekends than during weekdays. A reason for this is probably because in Abuja, night parties, shows, night clubs and other social events hold mostly on Friday and Saturday nights. An ensuing effect of these social gatherings is drink driving by young drivers which has the potential of causing fatal Road Traffic Crashes.

For the relationship between what day of the week Road Traffic Crashes occur and the demography of respondents, there was no statistical difference between the occurrence of road traffic crashes and any of the demographic criteria (age, sex, education received, marital status and driving experience). This signifies that based on this survey, there is no strong evidence that the demographic criteria has a relationship with the days of the week most traffic crashes occur.

4.3.6 Behavioural risk factors

Majority of road traffic deaths can be attributed to poor road user behaviours. The road user behaviours namely excessive speeding, drink driving, not using seatbelts and child restraint which the questionnaires tried to gain insight from road users in Abuja are summarised in the following subsections.

4.3.6.1 Use of seatbelts

From the survey, 64.2% of the respondents admitted to not using their seatbelts regularly, while 35.8% reported that they regularly use their seatbelts. The bivariate analysis showing the relationship between the gender, marital status, age, highest education received and driving experience of respondents and if they regularly use their seatbelts, is presented in Appendices E36 – E40 and also presented in Figure 4.22. From Figure 4.22., it can be observed that more single respondents tend not to wear seatbelts than married respondents. 71.7% of single respondents agreed that they do not use seatbelts while 66.7% of married respondents agreed they do not wear seatbelts. Respondents whose marital status indicated separated tend to wear their seatbelts more than the single and married respondents, as about 72.7% of the respondents who are separated tend to wear their seatbelts while driving. The difference was statistically significant at level of significance of 0.05 ($\chi^2 = 17.994,\ df = 4,\ p = 0.001$) (see Appendix E41), which provides evidence that there is a relationship between marital status and if respondents regularly wear their seatbelts while driving.

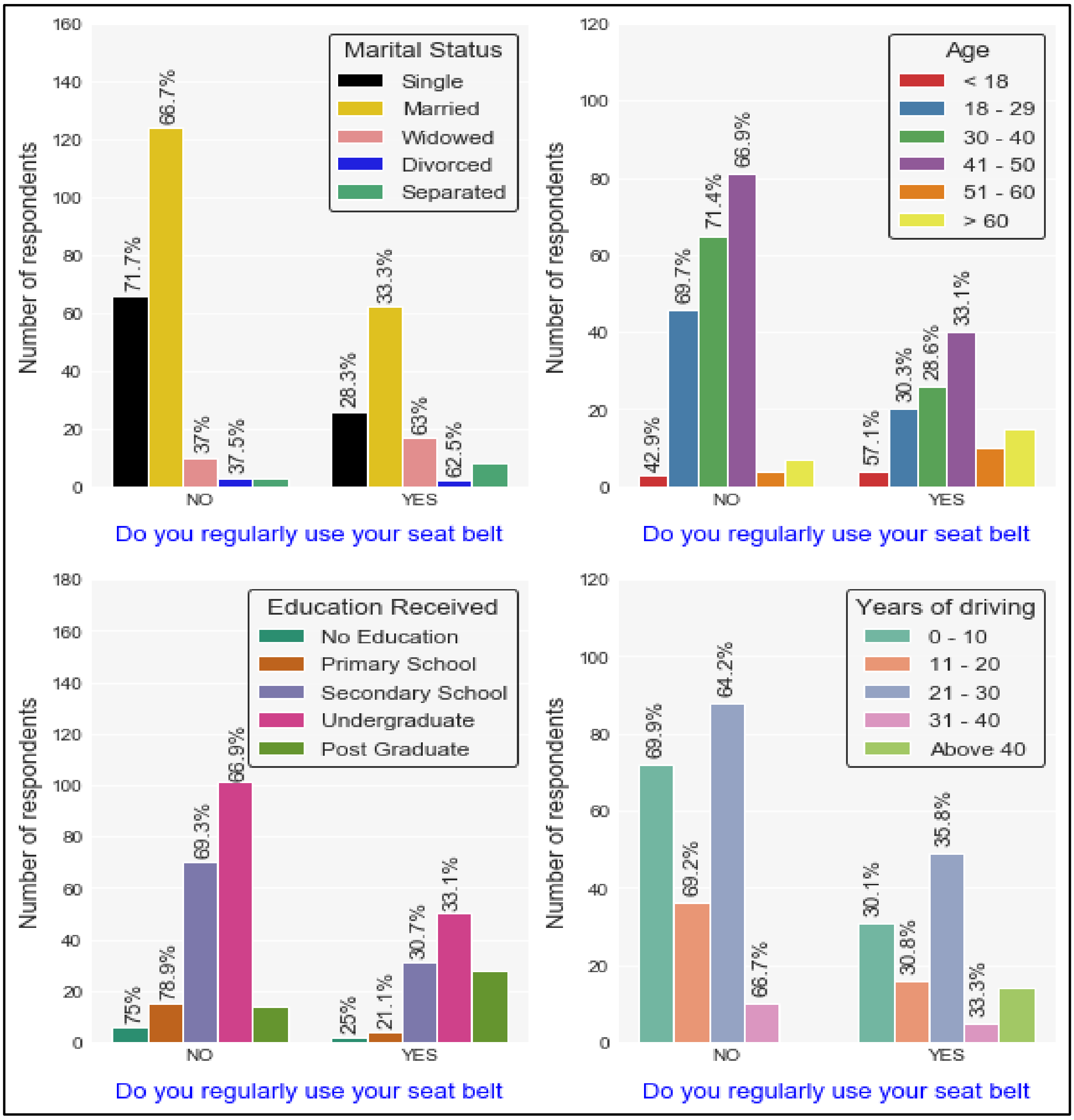

Figure 4.22: The relationship between marital status, age, highest education received and years of driving, and if respondents use seatbelts.

The relationship between age and if respondents wear their seatbelts showed that majority of the respondents between the ages of 30 – 40 tend not to wear their seatbelts while respondents older than 50 years tend to always wear their seatbelts. 71.4% of the respondents between the ages of 30 – 40 tend not to wear their seatbelts, similarly, 69.7% of respondents between the ages of 18 – 29 also tend not to wear their seatbelts. 42.9% of respondents below the age of 18 agreed to not wearing seatbelts. 71.4% of respondents between the ages of 51 – 60 wore their seatbelts. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 22.48,\ df = 5,\ p = 0.000$) (see Appendix E42), which provides strong evidence that there is a relationship between age and if the respondents regularly wear their seatbelts.

The relationship between the highest education received and if respondents wore their seatbelts showed that respondents whose highest education received was primary school tend not to wear seatbelts while respondents who have received post graduate education tend to wear their seatbelts regularly. 78.9% of respondents who received only primary education agreed to not wearing a seatbelt while 75.0% of respondents who received no education admitted to not wearing a seatbelt. 66.7% of respondents who had received a post graduate degree agreed to wearing their seatbelts. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 21.23,\ df = 4,\ p = 0.000$) (see Appendix E43), which provides strong evidence that there is a relationship between highest education received and if respondents regularly wear their seatbelts.

The relationship between how long respondents have been driving and if they wear their seatbelts while driving showed that respondents with fewer years of driving experience tend not to wear their seatbelts than respondents with more years of driving experience. 69.9% of respondents with just 0 – 10 years of driving experience admitted to not wearing their seatbelts while 69.2% of respondents with 11 – 20 years of driving experience agreed to not wearing their seatbelts. All respondents with over 40 years of driving experience agreed that they always wear their seatbelts. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 27.17,\ df = 4,\ p = 0.000$) (see Appendix E44), which also provides strong evidence that there is a relationship between years of driving and if respondents regularly wear their seatbelts. Since no assumption was violated, the relationship exists not solely due to the group of respondents with above 40 years of driving experience.

There was no significant relationship between the gender of the respondents and if the respondents regularly wear their seatbelts (see Appendix E45).

This survey showed that the road users in Abuja have a bad habit with respect to the use of seatbelts. Studies have shown that wearing of seatbelts reduces the risk of death of a driver and the occupant of the front seat by 50% as well as serious injuries by 25% for rear seat occupants (Ma et al., 2012; WHO, 2019). If the number of road traffic deaths are to stabilise and reduce by half in line with the goals of the United Nations Decade of Action for Road Safety 2011 – 2020, and the Sustainable Development Goal (SDG) Goal 3 target 6, by 2020, then strict enforcement of traffic laws have to be made that penalises any road user caught driving without the use of seatbelts.

4.3.6.2 Drink driving

From the questionnaire (see Appendix C, Q30) 37.4% of the respondents licensed to drive have been involved in drink driving at least once in the last month, while 62.6% did not engage in drink driving within the same period. The bivariate analysis with respect to if respondents engaged in drink driving in the last month, is presented in Appendices E46 – E49, and also presented in Figure 4.23. From Figure 4.23, it can be observed that the percentage of single respondents (34.7%) that engaged in drink driving just once in the last month were more than the married respondents (13.0%). It was also observed that overall, more married respondents engaged in drink driving. This is evident in the percentage of married drivers that engaged in drink driving twice in the last month, which was greater than the percentage of single drivers that engaged in drink driving.

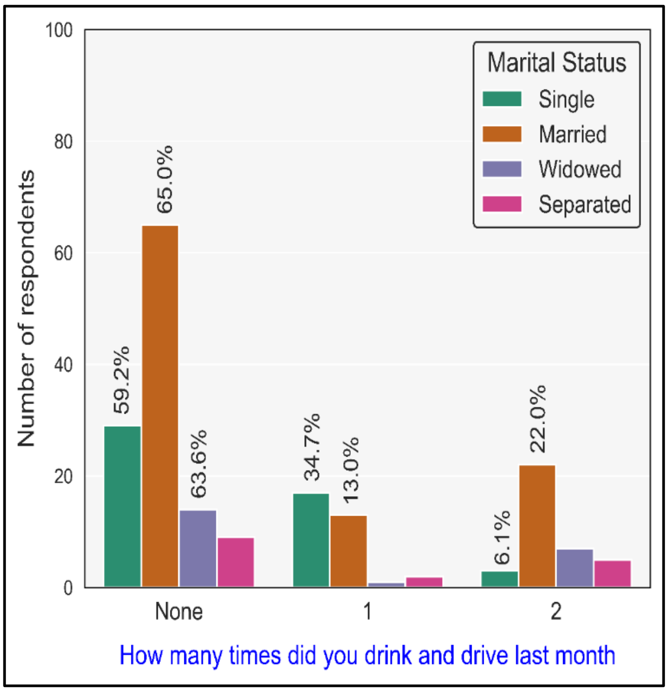

Figure 4.23: Relationship between marital status, and if respondents engaged in drink driving in the last month.

The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 19.507$, $df = 6,\ p = 0.003$) (see Appendix E50), which provides strong evidence that a relationship exists between marital status and if respondents engaged in drink driving in the last month. Other demographic criteria (like age, education, gender) were not statistically significant (see Appendices E51 – E54), therefore, no relationship exists between them and if respondents engaged in drink driving in the last month.

4.3.6.3 Child restraint

According to Nigeria's Highway Code, when travelling with children, child seats and restraints are necessary to reduce the possibility of injury or death, in the event of a crash. The FRSC prohibits children under 7 years from riding in the front seat of a vehicle (WHO, 2018). Nigeria's Highway Code also prohibits children between the ages of 0 – 12 months, from riding in the front seat of vehicles, however, when carried by adults, they are mandated to face the rear with the help of a child restraint. For children within the ages of 1 – 7, a child seat strapped properly to the back seat, and facing the front of the car is needed. Children above 7 years are expected to ride facing the front of a vehicle but restrained with safety belts. The FRSC has no specified child restraint standard and enforcement is low at level 3, on a scale of 10 (WHO, 2018).

A majority of the respondents who owned cars and are licensed to drive claimed they did not have toddlers or babies, and therefore, they did not drive with children in their cars. This accounts for 72.2% of the driving respondents. 27.8% of the driving respondents however indicated that they drive their children in their cars and had need for child restraints. The bivariate analysis of the demographic criteria and if respondents drive with a child in their cars is shown in Appendices E55 – E59 and presented in Figure 4.24. Figure 4.24 shows that more female respondents drive with their children in the car than male respondents. 58.5% of the female respondents agreed that they drive with their children in their cars, while 15.7% of the male respondents admitted to driving with their children in their cars. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 34.69,\ df = 1,\ p = 0.000$) (see Appendix E60), which provides strong evidence that there is a relationship between the gender of the respondent and if respondents drive their children in their cars.

The bivariate analysis between marital status and if respondents drive their children in their cars revealed that the married respondents who owned cars and were licensed to drive, admitted to driving their children in their cars, more than any other group. 39.0% of respondents who were married agreed that they drive their children in their cars while 61.0% of the married respondents admitted to not driving with children in their cars. 22.4% of the single respondents admitted to driving children in their cars while 18.2% of separated respondents agreed that they drive children in their cars. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 17.85,\ df = 4,\ p = 0.001$) (see Appendix E61), which provides strong evidence that there is a relationship between marital status and if respondents drive their children in their cars.

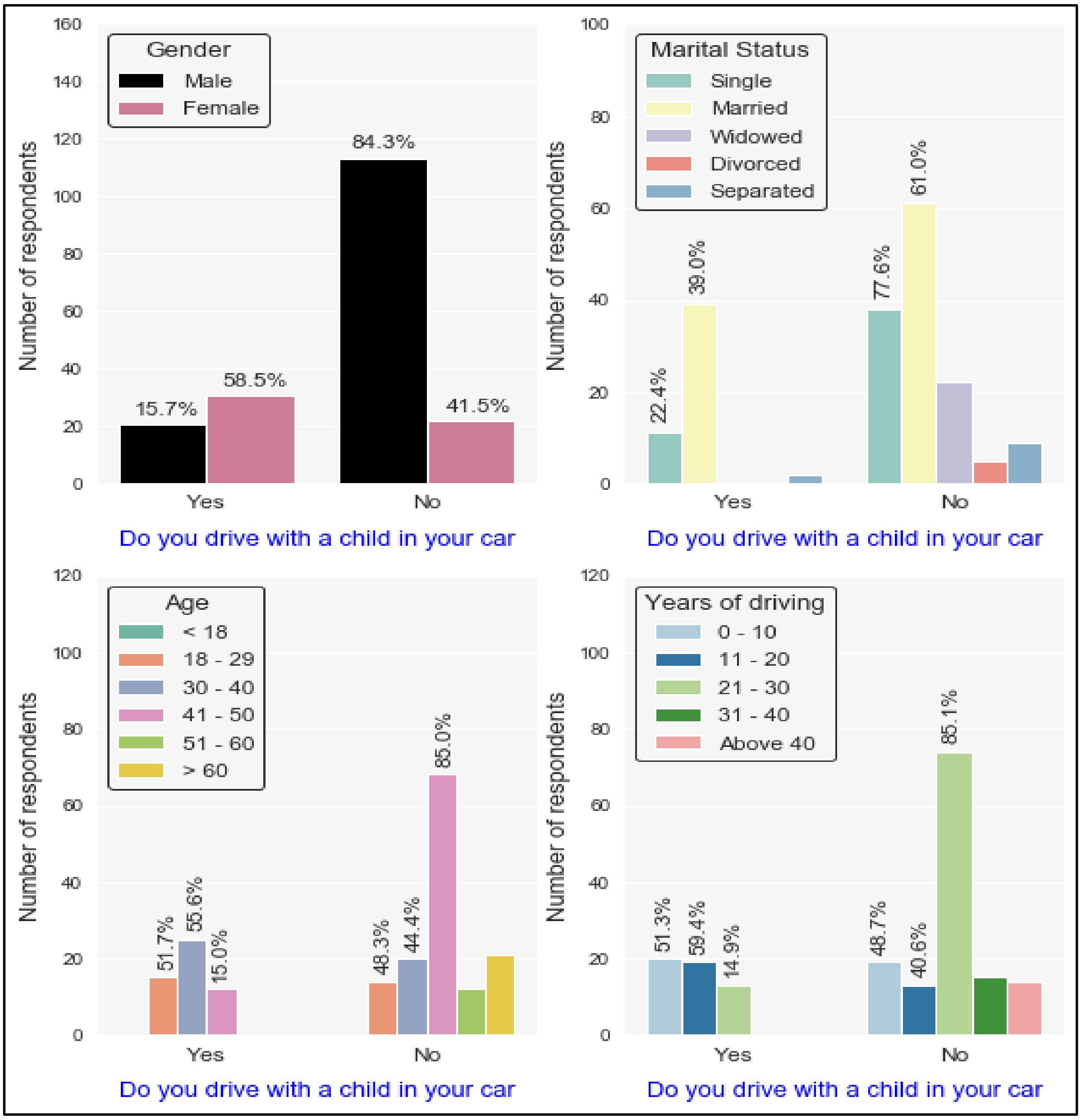

Figure 4.24: Relationship between gender, age, marital status, years of driving, and if respondents drive with a child in their cars.

Respondents between the ages of 30 – 40 admitted driving the most with a child in their cars compared to other age groups. 55.6% of respondents between the ages of 30 – 40 admitted driving a child in their cars. 51.7% of respondents between the ages of 18 – 29 admitted that they drive a child in their cars. The result showed that respondents below the age of 40 regularly drive with children who need child restraints in their cars while respondents above the age of 40 barely drive with children needing restraints in their cars, which might be due to the fact that their children might all be adults. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 44.77,\ df = 4,\ p = 0.001$) (see Appendix E62), which also provides strong evidence that there is a relationship between age and if respondents drive their children in their cars.

The relationship between how long respondents have been driving and if they drive with a child in their cars showed that 59.4% of respondents who have been driving for 11 – 20 years agreed that they drive with a child in their car while 51.3% of respondents who have been driving for 0 – 10 years agreed that they drive with a child in their car. Respondents who have been driving for more than 30 years indicated that they do not drive at all with a child in their car, implying that they do not require child restraints while driving. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 44.93,\ df = 4,\ p = 0.001$) (see Appendix E63), which provides strong evidence that there is a relationship between how long respondents have been driving and if respondents drive with children in their cars.

The relationship between the highest level of education received and if respondents drive with a child in their cars, show that the difference was statistically significant, however, the expected value for majority of the cells was less than 5 thereby violating the assumption of minimum expected value in Chi – square. This therefore indicates that the relationship between the highest level of education received and if respondents drive with a child in their car cannot be interpreted (see Appendix E64). With respect to level of education and driving with a child in their vehicles, the assumption here is that the driving respondents in Abuja, understand the need and safety implications of using child restraints when driving with children in their cars, especially as it concerns reducing the possibility of injury or death, in the event of a crash.

In order to find out about child safety, respondents who admitted driving with a child in their cars were asked if they have a child car seat. 55.8% of the respondents who agreed that they drive with a child in their car admitted to owning a child car seat. This shows that just above half of the respondents who drive with a child in their cars admitted to having a child car seat. The bivariate analysis is shown in Appendices E65 – E69 and also presented in Figure 4.25. Figure 4.25 shows that most of the respondents who admitted to driving a child in their cars and also having a child car seat, were female respondents. 80.6% of the female respondents who drive a child in their cars also have a child car seat while just 19% of male respondents who admitted to driving with a child in their cars have child car seats. This indicates that females in Abuja are more concerned about the safety of children while driving than the male respondents, or an indication that in Nigeria, the females tend to take care of children and have other child care responsibilities than males, thus the females spend more time with their children.

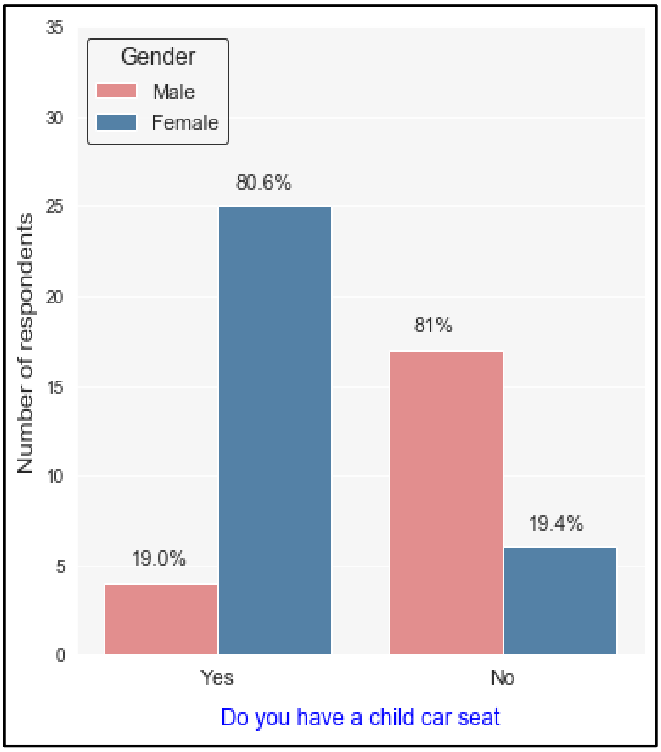

Figure 4.25: Child car seat ownership in Abuja.

The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 19.26,\ df = 4,\ p = 0.001$) (see Appendix E70), which provides strong evidence that there is a relationship between gender and if respondents have a child car seat.

The relationship between other demographic criteria (marital status, highest education received, age, driving experience) and if respondents who own vehicles and are licensed to drive have a child car seat was not statistically significant (see Appendices E71 – E74). Therefore there is no evidence to support that there is a relationship between the demographic criteria and if respondents have a child car seat.

Similarly, 55.8% of the respondents who own vehicles and are licensed to drive admitted driving their children with a child car seat in the past week while the rest 44.2% drove their children without using a child car seat. This shows that just a little above half of the respondents are aware of the need to restrain their children while driving, and have taken necessary steps to restrain their children while driving. The bivariate analysis in appendices E75 – E79 shows that majority of the respondents who own child car seats and drove with a child in the last week were female. Just as in the case of child car seat ownership, 80.6% of the female respondents drove their children with a child car seat in the past week while 19% of the male respondents drove their children in child car seat in the past week. This shows that female motorists in Abuja are consistently more concerned about child safety, and put measures in place to restrain their children while driving.

The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 19.26,\ df = 4,\ p = 0.001$) (see Appendix E80), which provides strong evidence that there is a relationship between gender and if respondents drove their children in the past week, using a child car seat. The relationship between other demographic criteria (marital status, highest education received, age, driving experience) and if respondents who own vehicles and are licensed to drive have a child car seat was not statistically significant (see Appendices E81 – E84). Therefore there is no evidence to support that there is a relationship between the demographic criteria and if respondents drove their children with a child car seat in the past week.

Results from the survey showed that about half of the respondents who drive their children in their cars do not own child car seat and those that own one do not regularly use them while driving their children. The need for road users in Abuja to buy and use child car seats regularly is important, as it helps in reducing about 60% of road traffic deaths as reported in the Global Status report 2018 (WHO, 2018).

4.3.6.4 Use of phone while driving

A good number of respondents that are licensed to drive, agreed that sometimes they use their phones while driving. 71.1% of the respondents that drive, use their phones sometimes while driving, while the other respondents (28.9%) reported that they never use their phones while driving (see Figure 4.26).

The distractions from phone use while driving are capable of causing road traffic crashes. The relationship between if respondents use their phones while driving and the demographic criteria showed that the differences were not statistically significant and this provided no evidence of the relationship between the associations (see Appendices E85 – E89).

The relationship between driving experience, and the use of phones while driving, shows that the p – value (0.154) was greater than the level of significance (see Appendix E89), therefore, there is no sufficient evidence to reject the null hypothesis which states that there is no relationship between driving experience and the use of phone while driving.

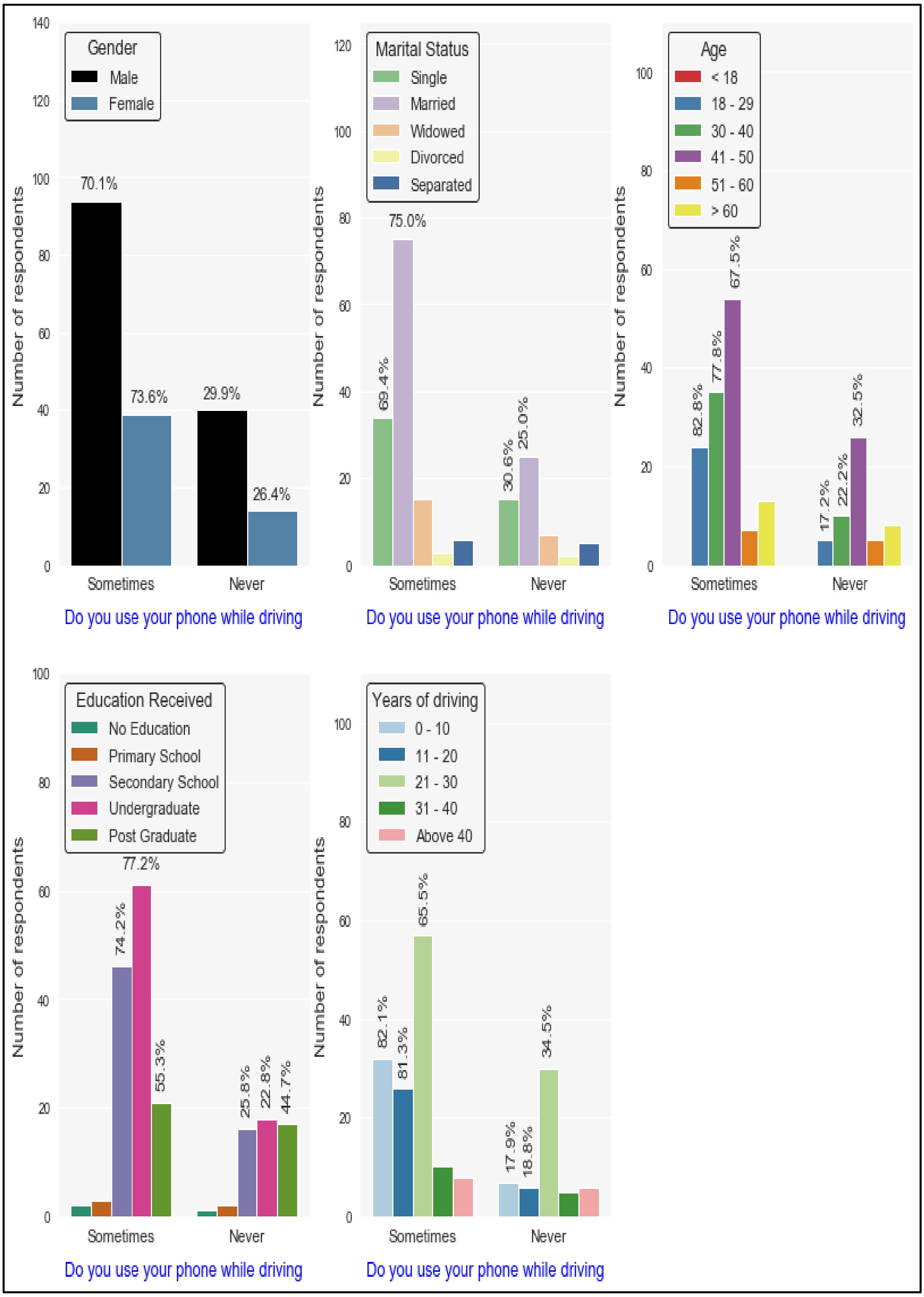

Figure 4.26: Relationship between gender, marital status, age, education received and years of driving, and if respondents use mobile phones while driving.

4.3.7 Unsafe driving behaviours

The unsafe driving behaviour that respondents licensed to drive admitted to committing most was not using indicators (see Figure 4.27). 21.3% of the respondents were in agreement that not using indicators when driving was the unsafe behaviour that they mostly engaged in while driving. The next unsafe behaviour respondents agreed to doing was driving without a seatbelt. The least unsafe behaviour exhibited by drivers was tailgating, only 2.6% of the respondents said they engaged in tailgating. Majority of the respondents were also in agreement that not using indicators was the unsafe driving behaviour they observed the most from other drivers, and this accounted for 22.6% of the unsafe driving behaviours respondents experienced from other drivers, as shown in Figure 4.27. The use of phones while driving (15.8%) was the second unsafe driving behaviour respondents experienced the most from other drivers. Drinking and driving (5%) was the least unsafe driving behaviour respondents admitted to have experienced from other drivers, as this cannot be determined without using a breathalyser or physically examining the other driver to ascertain their sobriety level.

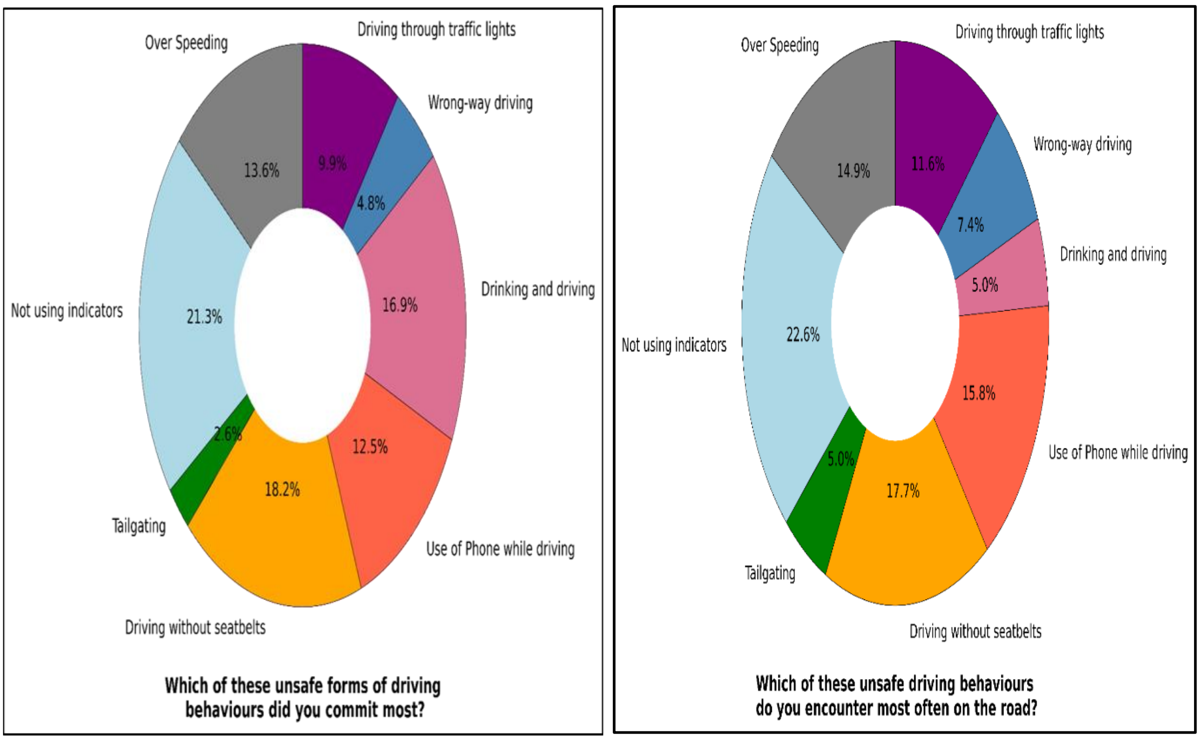

Figure 4.27: Unsafe driving behaviours

4.3.8 Traffic campaigns

The survey showed that respondents are quite aware of the road safety enlightenment campaigns by the Federal Road Safety Corps (FRSC) that goes on in the city. In terms on how frequently they experience such campaigns, 29.9% agreed to have heard a road safety enlightenment campaign in less than six months, 47.4% agreed that they have heard such campaigns in the last 6 – 12 months as at the time the survey was done (see Figure 4.28).

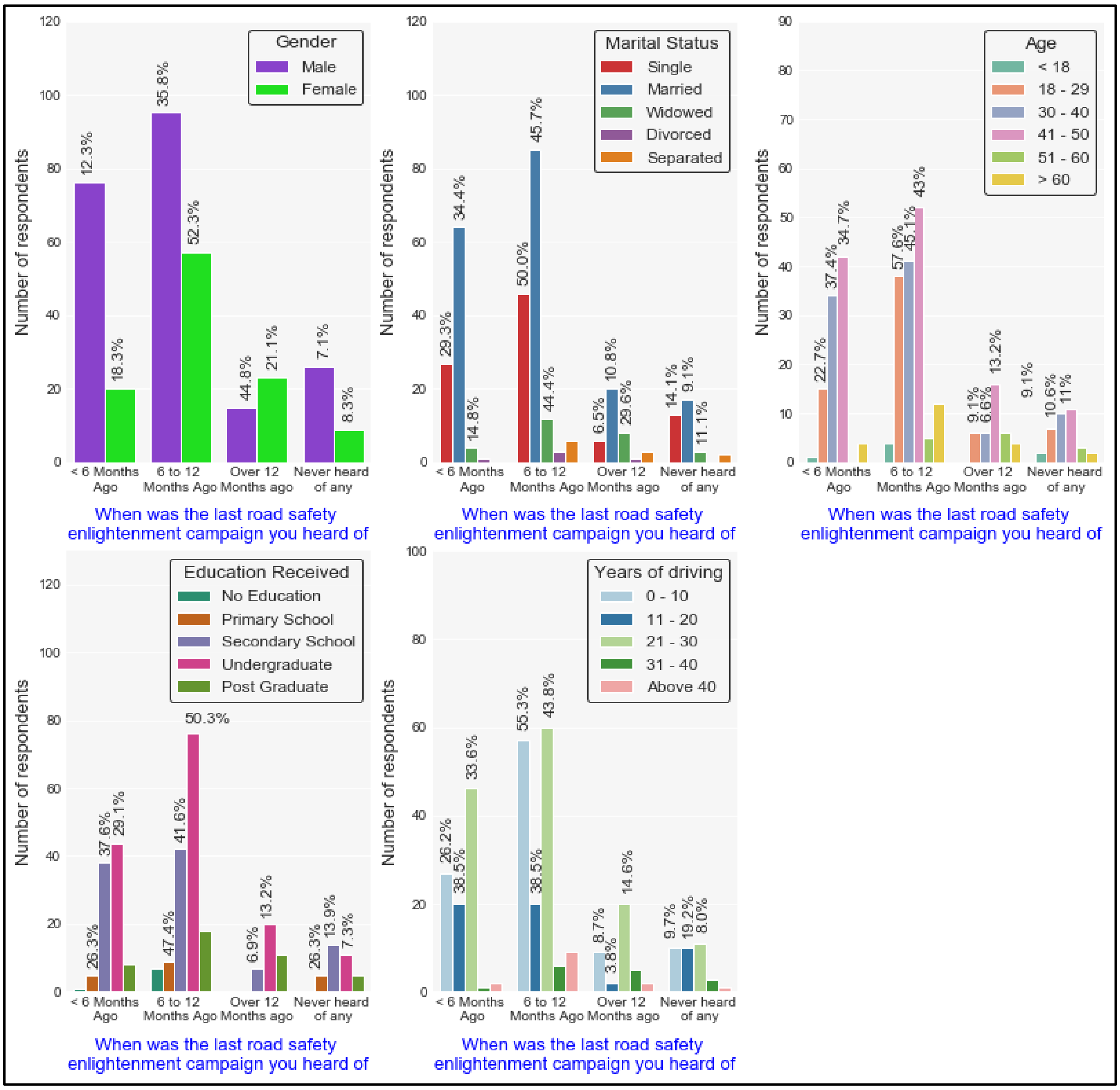

Figure 4.28: Relationship between gender, marital status, age, highest education received and years of driving, and if respondents have heard about any road safety enlightenment campaigns in recent times.

10.9% reported that they had never heard of any road safety enlightenment campaigns. The bivariate analysis (see appendices E90 – E94) also presented in Figure 4.28 shows that females are more aware of the road safety enlightenment campaigns going on in the city than male respondents. 18.3% of the female respondents agreed that the last time they heard such campaign was less than 6 months ago while 12.3% of the male respondents agreed the last time they heard such campaign was less than 6 months ago. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 21.25,\ df = 3,\ p = 0.000$) (see Appendix E95), which provides strong evidence that there is a relationship between the gender of the respondents and when last respondents heard about any road safety enlightenment campaign.

The relationship between how long respondents have been driving and when last they heard about any road safety enlightenment campaign showed that respondents with driving experience of 11 – 30 years are more aware about road safety enlightenment campaigns in Abuja compared to other drivers. 38.5% of the respondents with 11 – 20 years of driving experience last heard of such campaigns in less than 6 months while 33.6% of respondents with 21 – 30 years driving experience last heard of such campaign in less than 6 months. Respondents with 31 – 40 years of driving experience were the least aware of road safety enlightenment campaign in recent months. The difference was statistically significant at a level of significance of 0.05 ($\chi^2 = 26.1,\ df = 12,\ p = 0.010$) (see Appendix E96), which provides strong evidence that there is a relationship between how long respondents have been driving and when last they heard about any road enlightenment campaigns.

The main source of road safety enlightenment campaigns respondents indicated they were interested in, was via radio. 29.1% of the respondents reported that they prefer receiving enlightenment information on road safety through the radio while 10.5% prefer receiving road safety enlightenment campaigns from newspapers.

4.3.9 Interview with the Ministry of Transportation and the Federal Road Safety Corps (FRSC).

Interviews were conducted with representatives of the Federal Ministry of Transportation and the Federal Road Safety Corps (FRSC). The director, road transport and mass transit administration and her assistant director, road transport administration, provided responses to the interview questions on behalf of the Honourable Minister of Transportation. On the side of the Federal Road Safety Corps (FRSC), Assistant Corps Marshals (ACM) and Deputy Corps Marshals (DCM) provided responses to the interview questions on behalf of the Corps Marshal and Chief of the Federal Road Safety Corps, however, unlike their colleagues in the Ministry of Transportation, they preferred to be anonymous. The aim of the interview was to get general views on the major causes of road traffic crashes and associated road traffic deaths in Abuja and the efforts of the FRSC and Transport Ministry towards reducing the scourge in the capital. The responses to the interview questions are presented in the subsequent sections.

The interview methodology (how the interview was conducted and how the interview data was recorded), is described in Chapter 3, (see section 3.4.3).

4.3.9.1 Causes of Road Traffic Crashes in Abuja

Results from the interview showed that the major causes of road traffic crashes in Abuja were over speeding, route violation (driving against traffic) and lack of pedestrian bridges. From Figure 4.29, it can be seen that the interviewed respondents agreed that over speeding is the major cause of road traffic crashes in Abuja. Others were of the opinion that route violation (driving against traffic) is another major cause of road traffic crashes in Abuja while the rest indicated that lack of pedestrian bridges is the cause of road traffic crashes involving pedestrians.

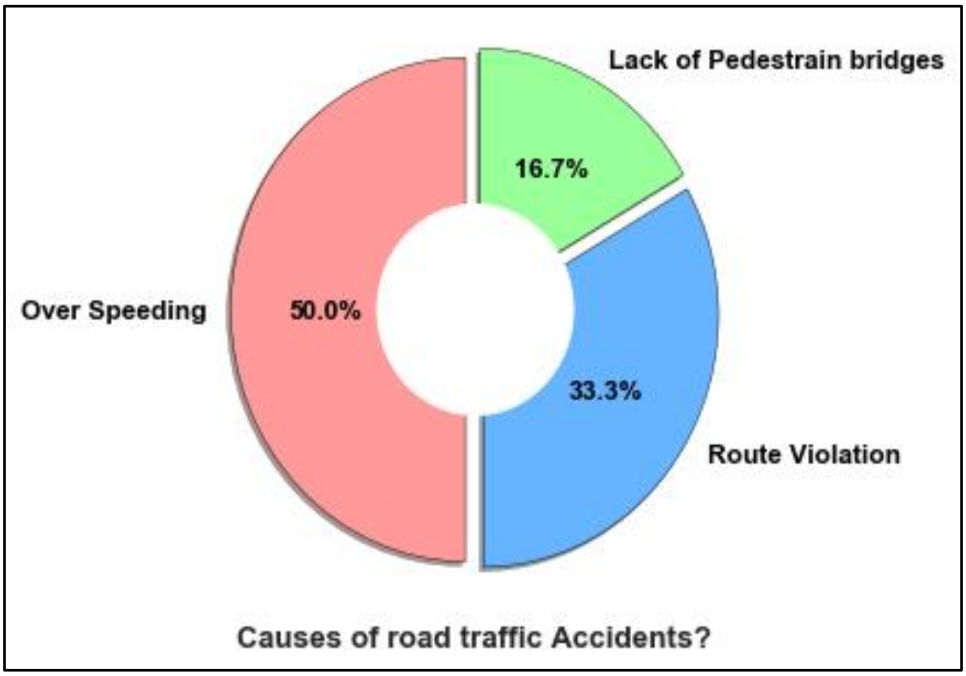

Figure 4.29: Causes of Road Traffic Crashes.

When asked if they have been involved in a Road Traffic Crash, all the managers responded that they have been involved in a Road Traffic Crash. 50% of the traffic managers indicated the reason they were involved in Road Traffic Crashes was due to aggressive driving from the other driver, 25% of the managers indicated that tyre burst led to loss of control which resulted in a crash, while 25% of the managers indicated that recklessness on the part of the other driver led to the driver running into their stationary vehicle.

4.3.9.2 Experience and types of training course for traffic officers

When asked about the traffic officers enforcing traffic laws, all the respondents opined that each patrol team/ patrol vehicle consists of 5 persons (marshals) per patrol team.

When asked about how much experience the traffic officers have, they opined that the patrol team members had basic experience in traffic enforcement. This is a source of concern, because if the traffic issues in Abuja are to be solved, more traffic officers need to go for more training courses in line with global standards, in order to be able to control the traffic situation in Abuja thereby reducing the fatalities in Abuja.

Most of the respondents were aware of the types of training required for a traffic officer. 75% of the traffic managers mentioned that officers and marshal basic courses are required at point of entry as well as several staff capacity building courses while on the job, while just 25% were not aware of the training courses required by traffic officers. This shows that traffic officer in Abuja are quite aware of the training courses required in order to be able to effectively perform their duties.

4.3.9.3 Traffic campaigns carried out in Abuja

When respondents were asked to describe the traffic safety campaigns in Abuja over the last 12 months, majority of the traffic managers mentioned that the campaigns involved enlightenment via radio and television programs, newspaper publications, church, mosque and school advocacies, Motor Park rallies, and town hall meetings, and were carried out in Abuja. A few traffic managers mentioned that they were aware of seminars and workshops/campaigns that were carried out in Abuja. This indicates that traffic managers were quite aware of the road safety campaigns that were carried out in Abuja in the last 12 months.

When asked about how effective the campaigns have been, 75% of the traffic manager agreed that the traffic campaigns have been effective indicating that it has served as a means of reaching out to the general public while 25% of the respondents opined that it had not been very effective, albeit road traffic crashes have reduced considerably in Abuja.

4.3.9.4 Ways to engage in more traffic safety awareness programs

When asked about ways to improve traffic safety awareness programs, 75% of the representatives from the Federal Ministry of Transportation and the Federal Road Safety Corps (FRSC) were of the opinion that deploying more resources and personnel to more places to create safety awareness will go a long way. 25% of the traffic managers were of the opinion that using of social media to pass messages about traffic safety will be a far better option.

Others suggested co-opting special marshals from the general public to engage in safety awareness.

4.3.9.5 Difficulties encountered in enforcing traffic safety laws

The traffic managers all stated that Nigeria has a working traffic safety law, however, motorists tend to disobey the laws, thus enforcement of traffic laws in Nigeria has been quite challenging. Some managers were of the opinion that top government officials also violate traffic laws and most times they cannot be brought to order. Others gave reasons for the difficulties faced with respect to enforcing safety laws as inadequate equipment required to carry out enforcement, such as breathalysers and hand – held speed guns to check drink driving and over speeding respectively. The issue of top government officials violating traffic laws is very common in Abuja and is a big concern as other civilians tend to emulate this behaviour and tend to have nonchalant attitudes towards obeying traffic laws. Inability of motorists to read and interpret traffic signs and symbols, lack of will and Non – adherence to traffic laws and regulations by motorists and wrong impression towards law enforcement agents, were also emphasised as the key difficulties encountered in enforcing traffic laws.

When asked about ways of improving the enforcement of traffic safety laws in Abuja, political will by the government to ensure strict enforcement of traffic laws was recommended. The Ministry of Transportation also suggested the training and retraining of drivers using English and the three major local Nigerian languages (Igbo, Hausa and Yoruba). The respondents were of the opinion that top government officials should be held accountable when they violate traffic safety laws to serve as a deterrent to other road users. Other respondents were of the opinion that enforcement personnel needed to be well equipped for proper enforcement of existing laws and regulations. Respondents also suggested road signs and road furniture should be improved within Abuja as well as enlightenment campaigns involving public and private individuals should be carried out to educate motorists and pedestrians on the consequences of violating traffic safety laws.

4.3.9.6 Traffic crashes risk reduction

When asked about ways of reducing road traffic crashes, the respondents suggested sensitization and traffic safety campaigns should be carried out to educate motorists and pedestrians about the dangers of road traffic crashes and the penalties for breaking road safety laws. Other respondents were of the opinion that the installation of traffic signs and symbols at all junctions will aid in crash risk reduction. They also opined that adequate marking of roads and well illuminating of streets with functional street lights will help cut down on the crashes that frequently happen at night due to poor vision. Some respondent also suggested the enforcement of traffic laws irrespective of status of the offenders, while others were of the opinion that improved road infrastructure and construction of pedestrian bridges will help reduce road traffic crashes in Abuja. This indicates that both the FRSC and the Ministry of Transportation are quite aware of the measures required to reduce traffic crashes in Abuja.

4.4 Traffic conflicts observations in Abuja

4.4.1 Sample locations for the study

The locations selected for the study are locations that had been identified by the Federal Road Safety Corps (FRSC) to have previous occurrences of Road Traffic Crashes in Abuja. The six selected observation locations shown in Figure 4.30 are Julius Berger roundabout, Bannex Junction, NICON Junction, ChurchGate Junction, Bolingo Junction, and CBN Junction.

Three of the locations namely Julius Berger roundabout, Bannex and NICON junctions are located on the Nnamdi Azikiwe Expressway, and are reported to have relatively higher road traffic flow and crashes than the other three junctions which are located on minor roads located in built up areas. The geographical coordinates of the 6 locations are presented in Table 4.6.

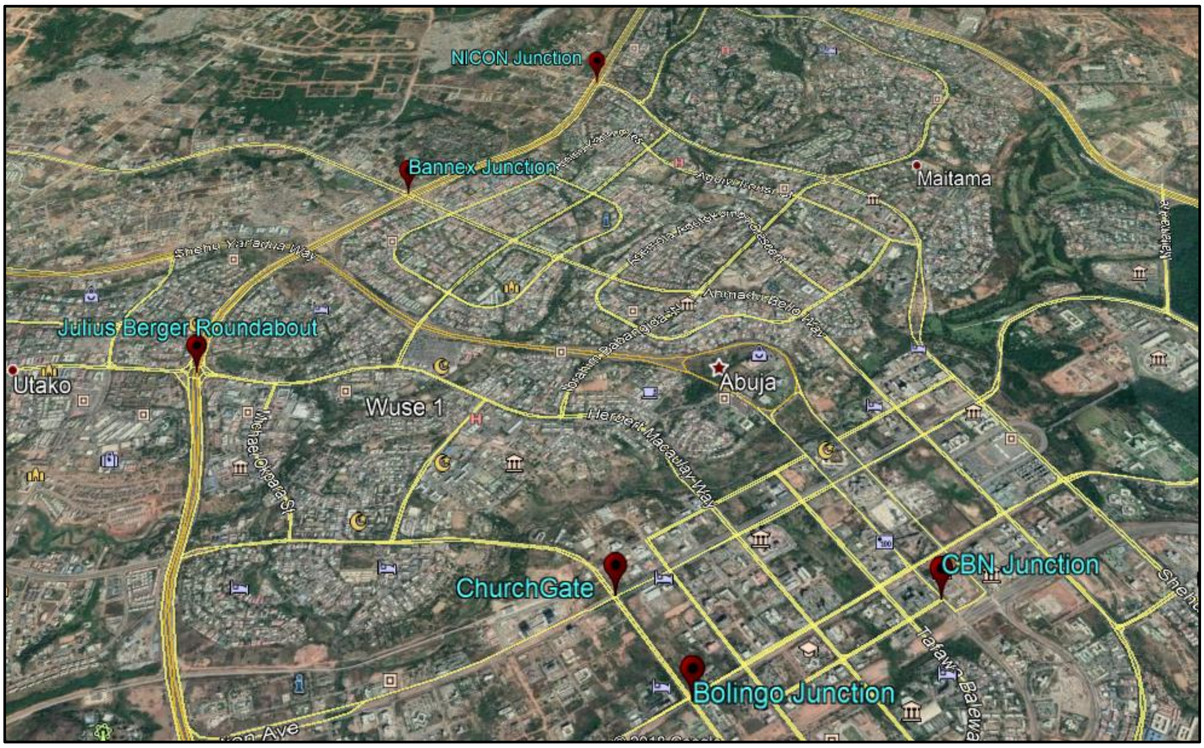

Figure 4.30: Locations of the six junctions to be studied (Source: Google Maps).

Table 4.6: Geographical coordinates of the study locations

Locations	Latitudes (Northing)	Longitudes (Easting)
Julius Berger Roundabout	9° 4'2.36"	7°27'6.82"
Bannex Junction	9° 5'0.18"	7°27'46.03"
NICON Junction	9° 5'44.47"	7°28'31.13"
ChurchGate Junction	9° 3'3.81"	7°28'38.47"
Bolingo Junction	9° 2'41.78"	7°28'52.48"
CBN Junction	9° 3'3.81"	7°28'38.47"

4.4.1.1 Characteristics of Julius Berger Roundabout

Julius Berger roundabout is on a 5 lane asphalt dual carriage road located on Nnamdi Azikiwe expressway. Three of the lanes serve as express lanes while the remaining two serve as minor lanes that either diverge or converge traffic. Approaching Julius Berger roundabout from the South, three of the lanes are connected to a flyover that links the South to the North of Nnamdi Azikiwe expressway, while the remaining two lanes give the option of connecting to Herbert Macaulay Way to the East or link to Nnamdi Azikiwe Expressway to the North as shown in Figure 4.31. Approaching Julius Berger roundabout from the North, two of the lanes are connected to a flyover that links the North to the South of Nnamdi Azikiwe expressway, while the other 2 lanes give the option of connecting to Obafemi Awolowo way to the West or connecting to Nnamdi Azikiwe expressway to the South. Julius Berger roundabout has a good road surface as seen in Figure 4.32, and is used by a mixture of road users with the exception of tricycles and motorcycles which were banned from plying the expressway in Abuja. The road user priority rules applied at the roundabout is for approaching traffic to yield to traffic on the roundabout, however, this rarely happens, which leads to conflicts at the roundabout.

Figure 4.31: Map showing Julius Berger Roundabout (Source: Google Maps).

Figure 4.32: Julius Berger Roundabout (source: Google street view).

The general speed limit for motorways including the carriage way “Nnamdi Azikiwe expressway” leading to the roundabout is 100km/hr (IRTAD, 2018), with no visible lane markings separating the lanes. Pedestrian walkways were provided but there was no indication of zebra crossings that would aid pedestrians in crossing the road. No traffic lights were at the junction but traffic wardens were present to control the flow of traffic.

4.4.1.2 Characteristics of Bannex Junction

Bannex Junction is on a 5 lane asphalt dual carriage road with a diamond interchange at the junction located on Nnamdi Azikiwe expressway. Approaching Bannex Junction from the South, three of the lanes serve as the main express lanes taking motorists to the North of Nnamdi Azikiwe expressway while the remaining two lanes serve as minor lanes which diverge traffic to Ahmadu Bello Way to the East as shown in Figure 4.33. Approaching Bannex Junction from the North, three of the lanes serve as main express lanes taking motorists to the South of Nnamdi Azikiwe while the other two lanes serves as minor lanes that diverge traffic to Ahmadu Bello to the West. There is a flyover at Bannex Junction that connects motorists from the West to the East of Ahmadu Bello Way and vice versa.

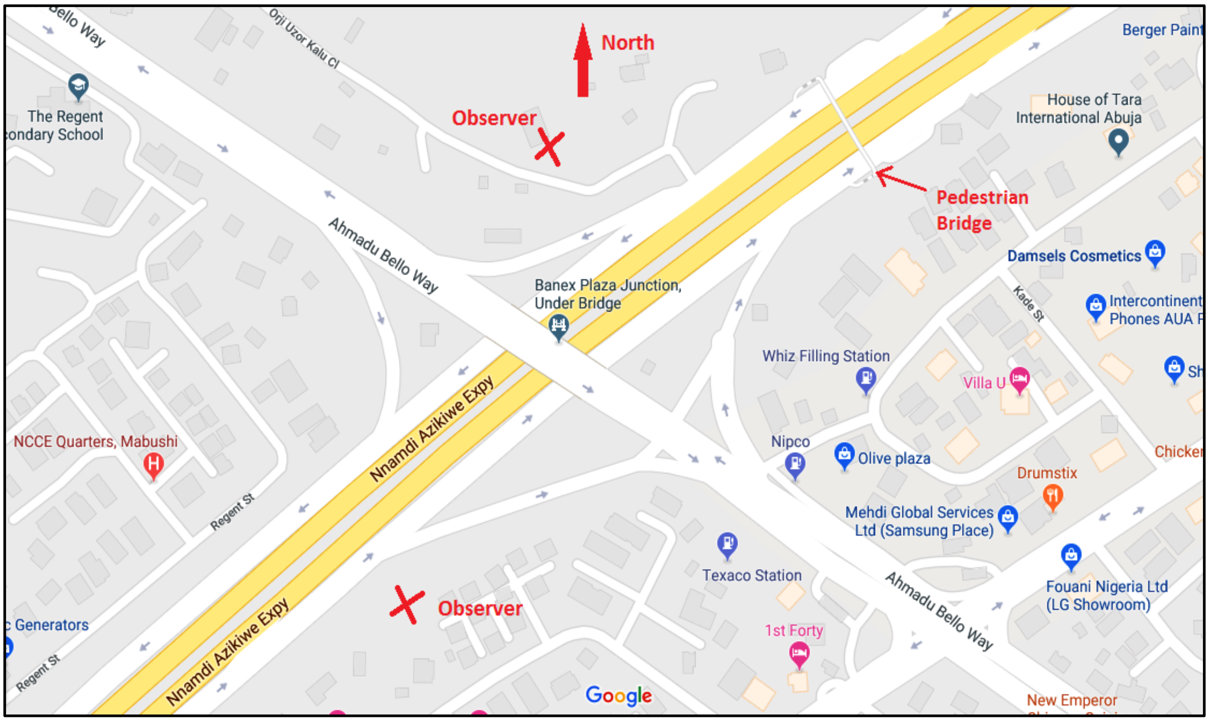

Figure 4.33: Map showing Bannex Junction (Source: Google Maps).

Figure 4.34: Bannex Junction (source: Google street view).

Bannex Junction has a good road surface as seen in Figure 4.34, and is used by a mixture of road users with the exception of tricycles and motorcycles which were recently banned from plying the expressway in Abuja. The speed limit for motorways including Nnamdi Azikiwe expressway is 100km/hr (IRTAD, 2018), and Bannex Junction had visible lane markings separating the lanes. Pedestrian walkways were also provided and a pedestrian bridge which is expected to aid pedestrians in crossing the road was located about 100m from Bannex Junction.

4.4.1.3 Characteristics of NICON Junction

NICON Junction is on a 5 lane asphalt dual carriage road located on Nnamdi Azikiwe expressway. Approaching NICON Junction from the south, three of the lanes serve as express lanes which connect the South to the North of Nnamdi Azikiwe expressway, while the remaining two lanes serve as minor lanes which connect Shehu Shagari Way to the east as shown in Figure 4.35. NICON Junction has a good road surface as seen in Figure 4.36, and is used by a mixture of road users with the exception of tricycles and motorcycles which were banned from plying the expressways in Abuja.

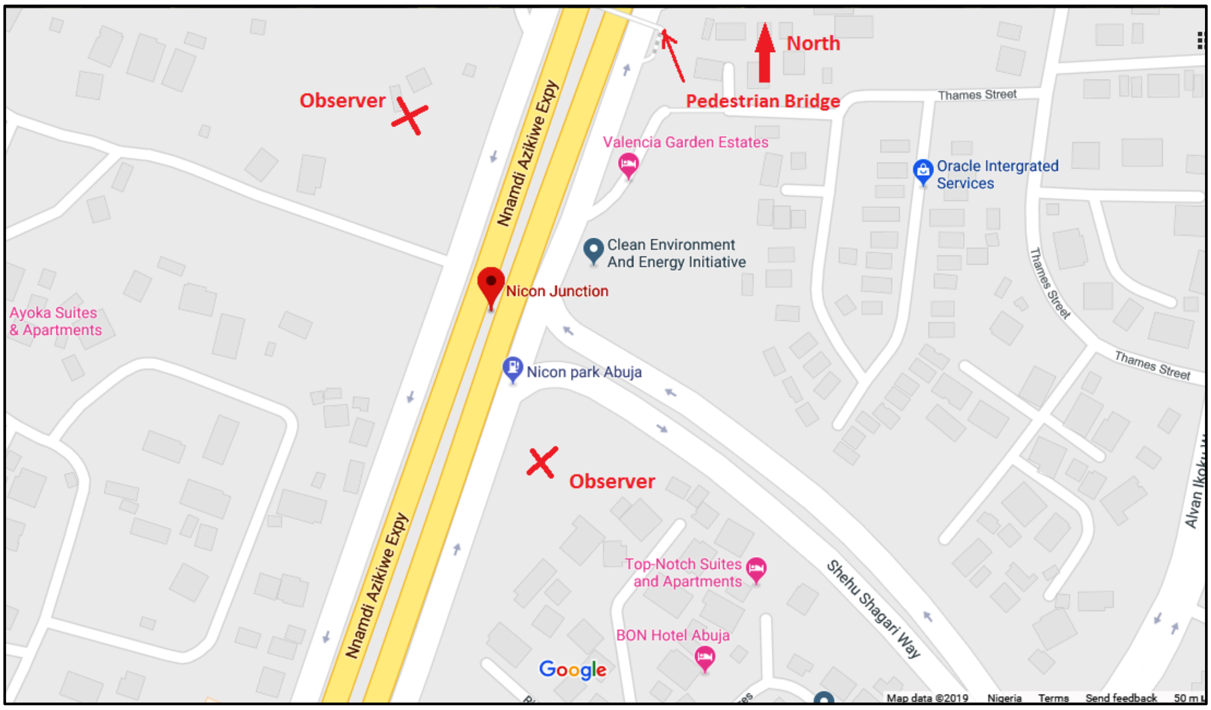

Figure 4.35: Map showing NICON Junction (Source: Google Maps).

Figure 4.36: NICON Junction (source: Google street view).

The speed limit for motorways including Nnamdi Azikiwe expressway is 100km/hr (IRTAD, 2018) and the NICON Junction had visible lane markings separating the lanes on the main carriageway. Pedestrian walkways were not provided but there was sufficient space where pedestrians can safely walk by the side of the road. A pedestrian bridge which will aid pedestrians in crossing the road was located at about 100m from NICON Junction.

4.4.1.4 Characteristics of ChurchGate Junction

ChurchGate Junction is on a 3 lane asphalt highway road located at the interchange of Constitution Avenue and Olusegun Obasanjo Way in Abuja. An underground bypass is located at the junction that connects Constitution Avenue from South West to the North East and vice versa as shown in Figure 4.37. ChurchGate Junction has a good road surface as seen in Figure 4.38, and is used by a mixture of road users including tricycles and motorcycles that sometimes ply the roads.

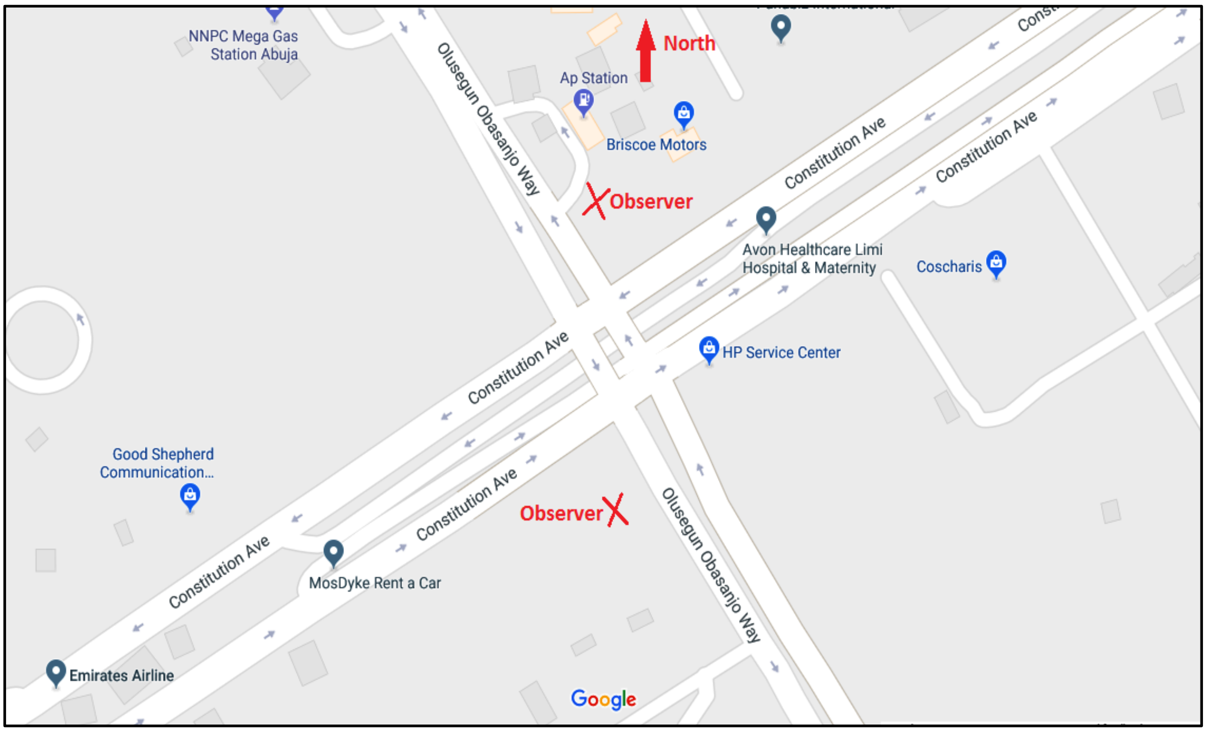

Figure 4.37: Map showing ChurchGate Junction (Source: Google Maps).

Figure 4.38: ChurchGate Junction (source: Google street view).

The speed limit for ChurchGate Junction is 80km/hr and the junction had lane markings separating the lanes but appeared to be faded. Pedestrian walkways were not provided but there was sufficient space that could be safely used as pedestrian walkways. There were no indications of zebra crossings that would aid pedestrians in crossing the road. Traffic lights were installed at the junction, but a traffic warden was also present to control the flow of traffic in a case where the traffic lights stop working due to power failure or any other fault in the traffic light.

4.4.1.5 Characteristic of Bolingo Junction

Bolingo Junction is on a 3 lane asphalt highway road located at the interchange of Independent Avenue and Olusegun Obasanjo Way in Abuja. An underground bypass is located at the junction that connects Independent Avenue from North East to the South West only, as the other lanes for the bypass that take traffic in the opposite direction has not been constructed yet as shown in Figure 4.39. Bolingo Junction has a good road surface as seen in Figure 4.40, and is used by a mixture of road users including tricycles and motorcycles that sometimes ply the roads. The speed limit for Bolingo Junction is 80km/hr and the junction had visible lane markings separating the lanes.

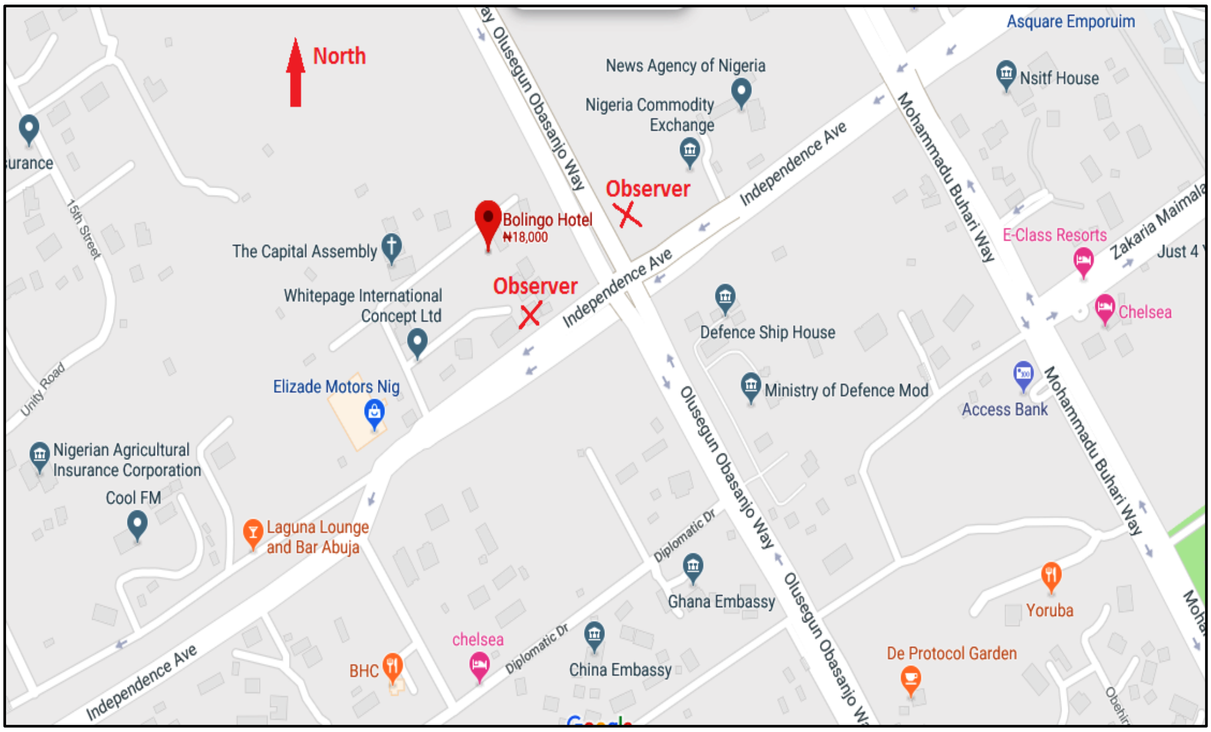

Figure 4.39: Map showing Bolingo Junction (Source: Google Maps).

Figure 4.40: Bolingo Junction (source: Google street view).

Pedestrian walkways were not provided but there was sufficient space that could be safely used as pedestrian walkways. There was no indication of zebra crossings that would aid pedestrians in crossing the road. Functional traffic lights were seen at the junction, however, a traffic warden was also present to control the flow of traffic in a case where the traffic light stops working due to power failure or any other fault in the traffic light.

4.4.1.6 Characteristic of CBN Junction

CBN Junction is a 3 lane asphalt road located on at the intersection of 7th Street and Zakaria Maimalari Street in Abuja. Figure 4.41. CBN Junction has a good road surface as seen in Figure 4.42, and it is used by mixtures of road users including tricycle and motorcycles that sometimes ply the roads.

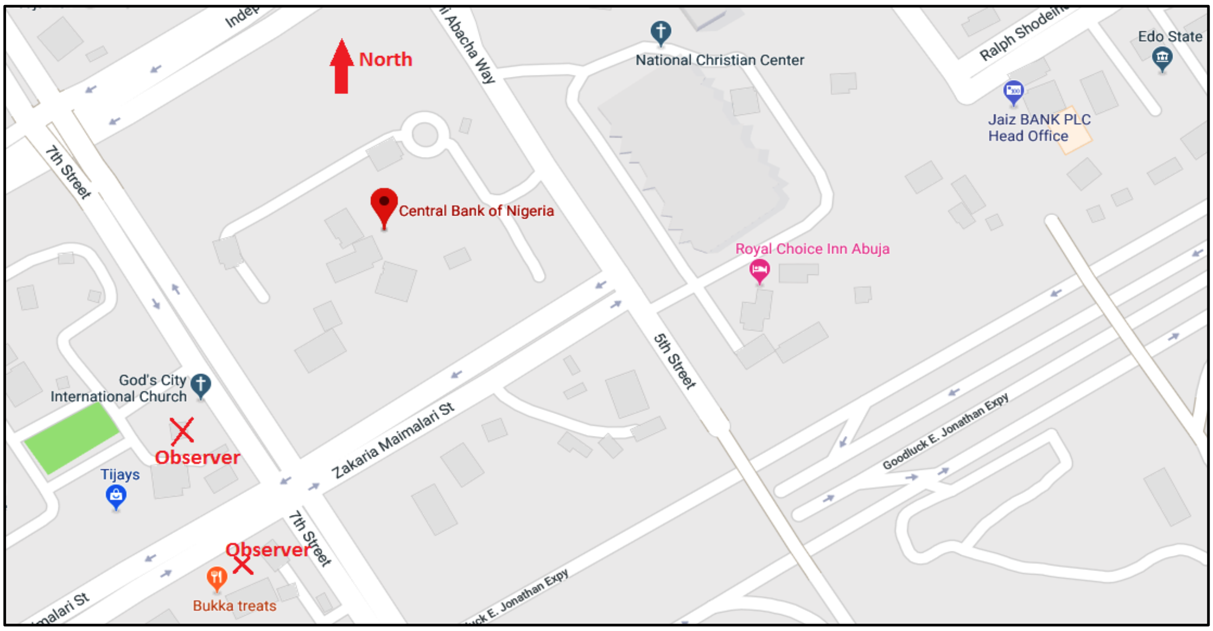

Figure 4.41: Map showing CBN Junction (Source: Google Maps).

Figure 4.42: CBN Junction (source: Google street view).

The speed limit for CBN Junction is 50km/hr and the junction had visible lane markings separating the lanes. Pedestrian walkways were provided and there was no indication of zebra crossing marking that would aid pedestrians in crossing of the road. Traffic lights were used at the junction but a traffic warden was also present to control the flow of traffic if the traffic light stopped working due to power failure or any fault in the traffic light.

4.4.2 Traffic Volume Count

The Traffic Volume Count (TVC) was done by Etteh Aro and Partners, and this was done both manually and automatically, using an Automated Traffic Counter (ATC) at the six observation locations. The traffic count was done for 4.5 hours daily for a duration of 7 days. The traffic count done by Etteh Aro and Partners covered all forms of traffic on the parallel and crossing roads. The results of the traffic volume count for the one week duration are presented in the form of Figures from Figures 4.43 – 4.48.

4.4.2.1 Traffic Count for Julius Berger Roundabout

Figure 4.43 shows the traffic volume count for road users at Julius Berger roundabout. The total traffic volume count of road users that used Julius Berger roundabout for the duration of the study was 42,108 road users. Passenger cars had the highest share of road users as 13,474 passenger cars used the roundabout for the duration of the study which makes up about 32% of the total road users. 10,695 of the road users were utility vehicles (pickup truck/4 wheel drive/mini – van) accounting for about 25.4% of the total road users.

Trucks (Heavy/Medium trucks) had the lowest count, as 4,295 trucks used the roundabout which makes up about 10.2% of the total road users. 8,296 pedestrians were counted to have used the roundabout which accounts for 19.7% of the total road users. The traffic volume count observed at Julius Berger roundabout was higher than the other locations, because it is relatively busier. It can also be observed from Figure 4.31 that Julius Berger roundabout is situated on an expressway connecting high density settlements, which contributes to the high volume of traffic experienced at the roundabout. For pedestrians, what counts as a pedestrian using the roundabout is that they have to either cross a road or walk alongside the road close to the observation points. The pedestrians do not count, when they are far off from the points of conflicts observation and with no potential to cause a traffic conflict.

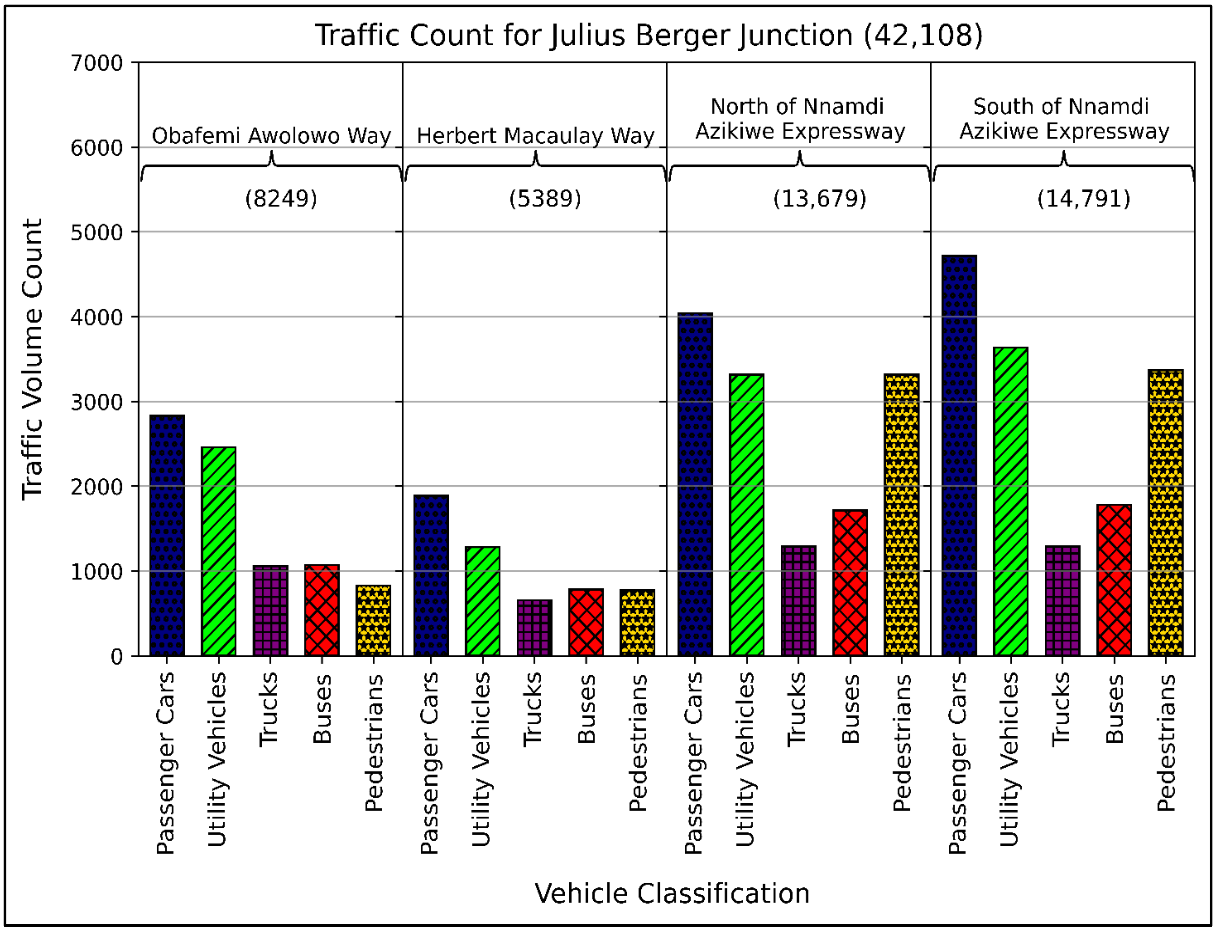

Figure 4.43: Traffic Volume count for Julius Berger Roundabout.

The distribution of the total number of road users at Julius Berger roundabout, as seen in Figure 4.43, showed that the highest number of road users at Julius Berger roundabout was at the southern end of Nnamdi Azikiwe expressway. For the duration of the traffic count, a total of 14,791 road users were recorded, and passenger cars accounted for 31.88% of the total road users on the southern end of Nnamdi Azikiwe expressway. The northern end of Nnamdi Azikiwe expressway recorded the second highest number of road users at Julius Berger roundabout. A total of 13,679 road users were recorded. There were 4,042 passenger cars and 3,316 utility vehicles on the northern end of Nnamdi Azikiwe expressway. The lowest number of road users at Julius Berger roundabout was recorded at Herbert Macaulay way, with 5,389 road users. Passenger cars accounted for the most road users at Herbert Macaulay way, with 1,886 passenger cars.

4.4.2.2 Traffic Count for Bannex Junction

The traffic volume count at Bannex Junction is presented in Figure 4.44. The total traffic volume count of road users that used Bannex Junction for the duration of the study was 39,414 road users. From Figure 4.44, it can be seen that Passenger cars account for the most traffic in the junction. A total of 14,069 passenger cars were counted at Bannex Junction for the duration of the study which accounted for 35.7% of the total road users. 8,473 utility vehicles were counted which accounts for 21.5% of the total road users, while the number of buses counted were 6,857 which accounted for 17.4% of the total road users. Trucks had the least traffic count with just 4,808 trucks counted for the duration of the study accounting for 12.2% of the total road users. The number of pedestrians counted at Bannex Junction were fewer than Julius Berger roundabout, with 5,207 count which accounted for 13.2% of the total road users that used Bannex Junction.

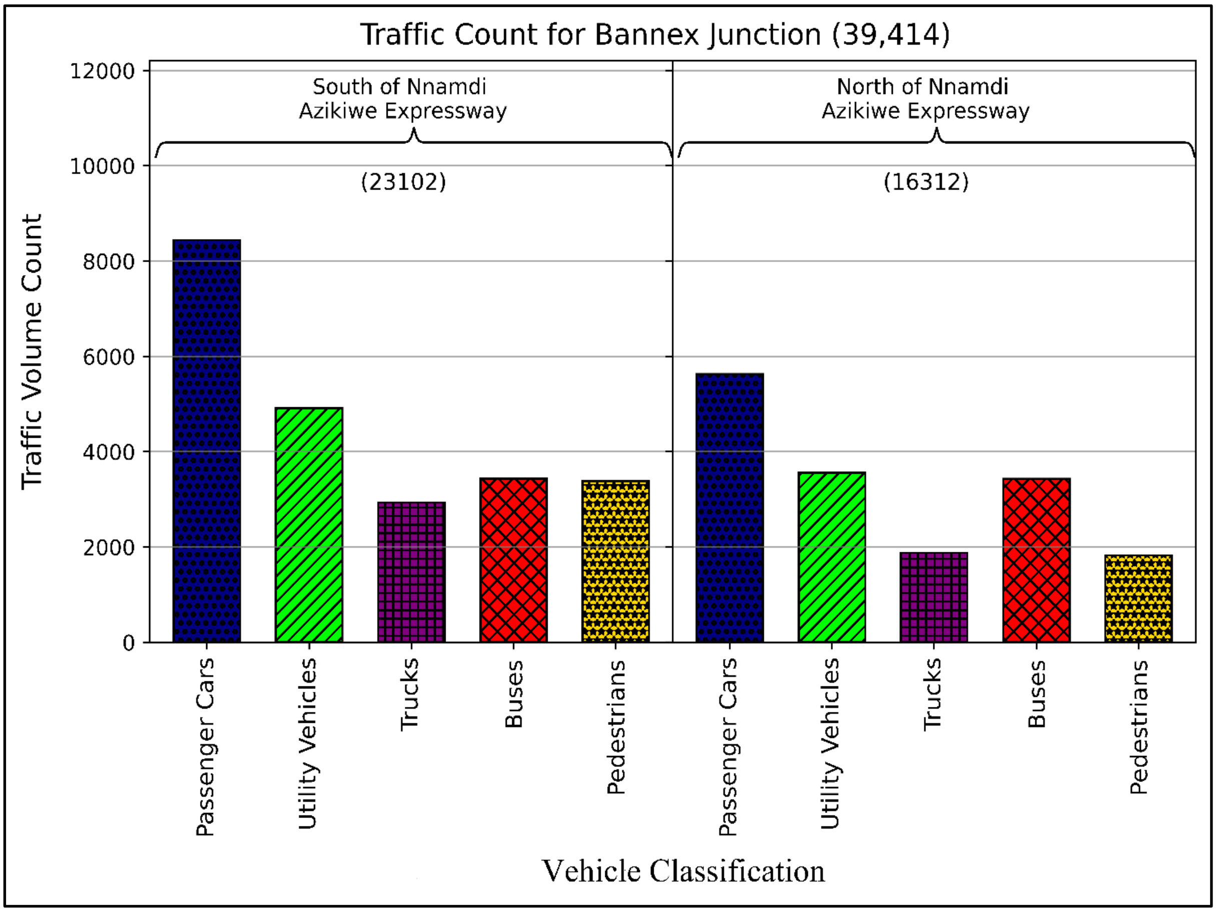

Figure 4.44: Traffic Volume count for Bannex Junction.

The distribution of the total road users at Bannex junction as seen in Figure 4.44, showed that the southern end of Nnamdi Azikiwe expressway had the highest number of road users. A total of 23,102 road users were counted on the southern end of Nnamdi Azikiwe expressway. Passenger cars accounted for most of the road users on the southern end of Nnamdi Azikiwe expressway. A total of 8,441 passenger cars and 4,914 utility vehicles were counted at the southern end of Nnamdi Azikiwe expressway.

4.4.2.3 Traffic Count for NICON Junction

The traffic volume count for NICON Junction is presented in Figure 4.45. The total traffic volume count of road users that plied NICON Junction for the duration of the study was 37,020 road users. Passenger cars accounted for the most road users at the junction while pedestrians accounted for the least road users. A total of 11,142 passenger cars were counted which accounted for 30.1% of the road users while 3,739 pedestrians were counted which accounted for 10.1% of the total road users that used the junction.

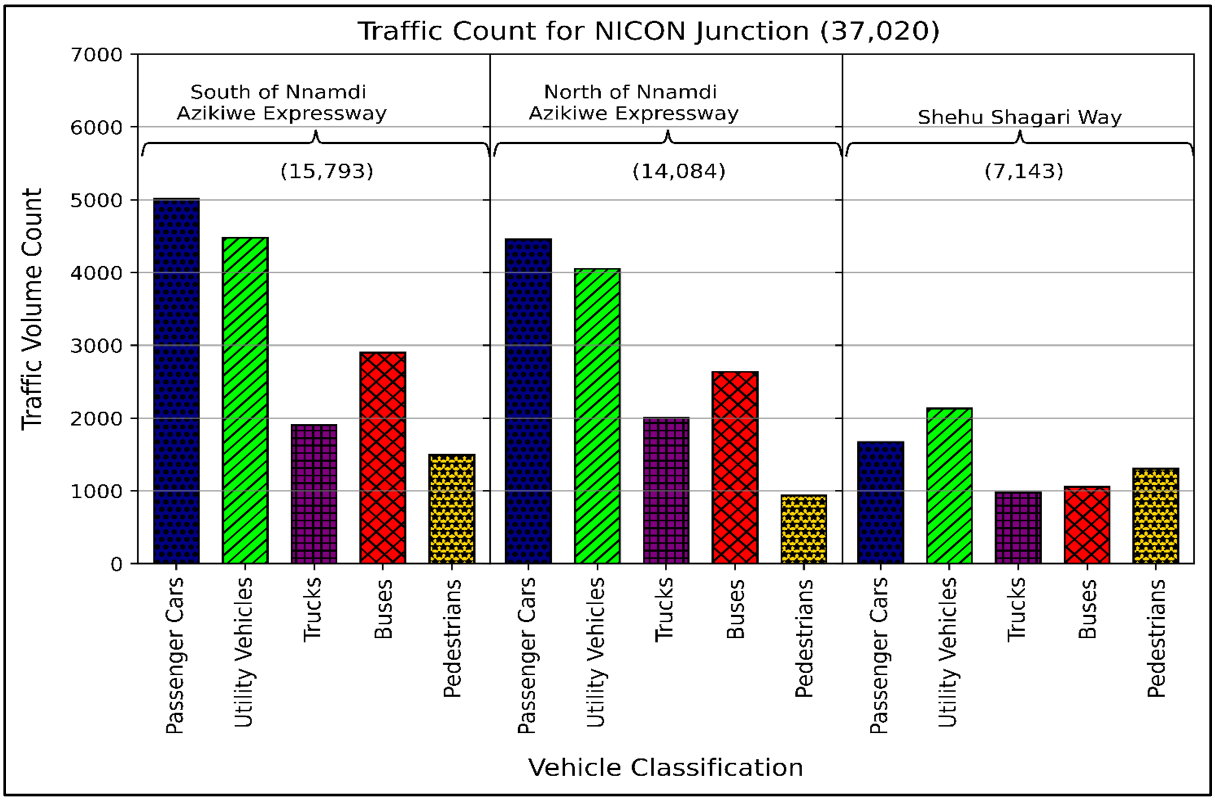

Figure 4.45: Traffic Volume count for NICON Junction.

NICON Junction had the least number of pedestrians out of the three junctions situated at Nnamdi Azikiwe Expressway in Abuja. 10,662 utility vehicles were counted which accounted for 28.8% of the total road users while 6,590 buses were counted which accounted for 17.8% of the total road users. The number of trucks at NICON Junction were more than the number counted for the other two junctions situated at Nnamdi Azikiwe Expressway. 4,887 trucks were counted at NICON Junction which accounted for 13.2%.

The distribution of the total road users at NICON junction as seen in Figure 4.45, showed that the southern end of Nnamdi Azikiwe expressway had the highest number of road users. 15,793 road users were counted on the southern end of Nnamdi Azikiwe expressway. Passenger cars accounted for most of the road users at the southern end of Nnamdi Azikiwe expressway. Passenger cars accounted for about 31.75% of the total road users counted on the southern end of Nnamdi Azikiwe expressway. The least number of road users at NICON junction was recorded on Shehu Shagari way located at the east of NICON junction. A total of 7,143 road users were recorded, which accounted for 19.29% of the total road users at NICON junction. Trucks were the least number of road users counted at Shehu Shagari way, while utility vehicles were the highest number of road users counted. A total of 977 trucks and 2,132 utility vehicles were counted at Shehu Shagari way, linking NICON Junction, which accounted for 13.68% and 29.85% respectively of the total road users counted on Shehu Shagari way.

4.4.2.4 Traffic Count for ChurchGate Junction

The traffic volume count for ChurchGate Junction is presented in Figure 4.46. The total traffic volume count of road users that used the junction was 31,181. Passenger cars and utility vehicles had the most traffic count. 10,403 passenger cars were counted which accounted for 33.4% of the total road users that plied ChurchGate Junction while 9,988 utility vehicles were counted which accounted for 32% of total road users.

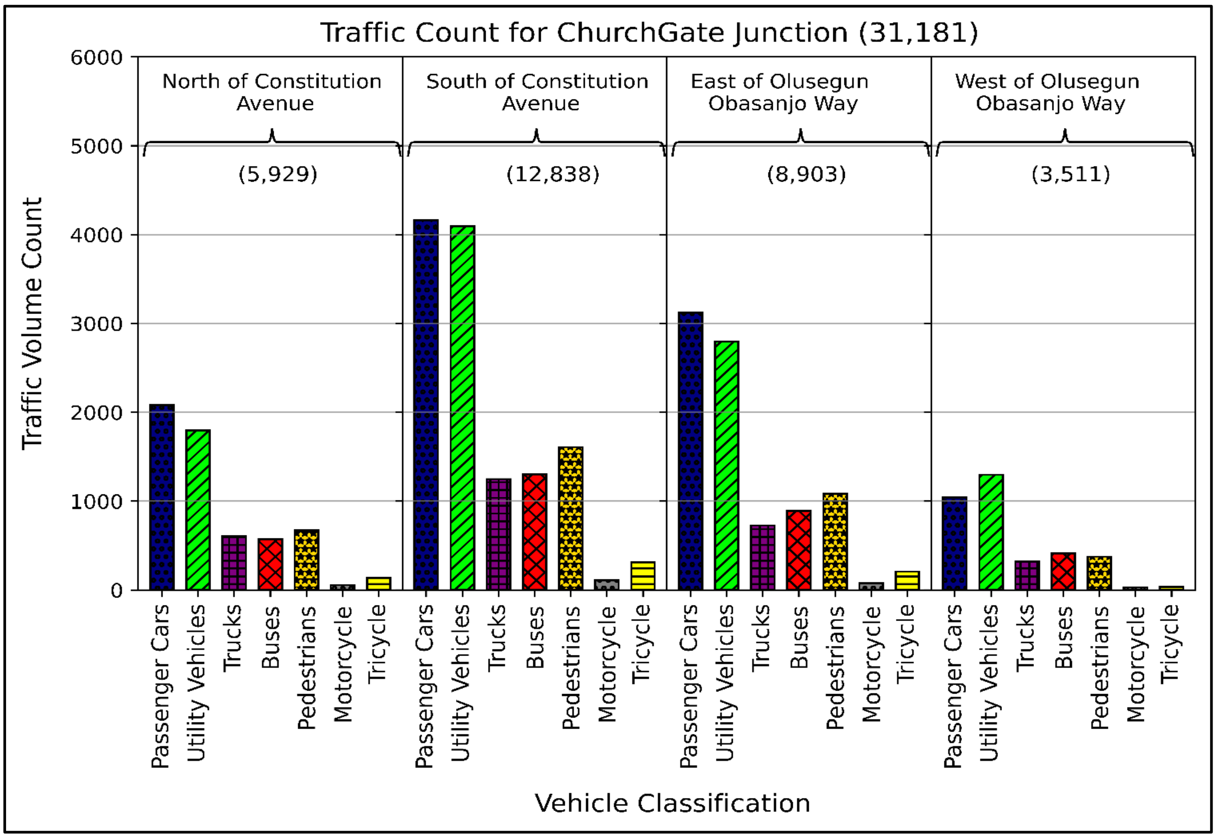

Figure 4.46: Traffic Volume count for ChurchGate Junction.

2,903 trucks were counted and that accounted for 9.3% of the total road users. Motorcycles had the least count with just 277 which accounted for 0.9% of the total road users. Tricycles were also counted at ChurchGate Junction with a total count of 691 which accounted for about 2.2% of the total road users. The low count in the motorcycles and tricycles is due to the regulation of the use of motorcycles and tricycles as a means of transportation in the Abuja. The use of tricycle and motorcycles are more predominant in other states. Uzondu et al., (2019) in their study of traffic conflict technique reported that 30% of the total road users were tricycle. The traffic count for pedestrians was 3,739 which accounted for 12% of the road users.

The distribution of the total road users at Churchgate junction as seen in Figure 4.46, showed that more road users were counted at the southern end of Constitution Avenue. A total of 12,838 road users were counted at the southern end of Constitution Avenue, which accounted for 41.18% of the total road users counted at Churchgate junction. The least number of road users recorded at the southern end of Constitution Avenue were motorcycle riders. A total of 111 motorcycle riders were counted. The least number of total road users at ChurchGate junction was counted at the western end of Olusegun Obasanjo way. A total of 3,511 road users were counted, with utility vehicles accounting for the most road users on the western end of Olusegun Obasanjo way. Passenger cars were the second highest road user on the western end of Olusegun Obasanjo way. The lowest number of road users at the western end of Olusegun Obasanjo way were motorcycle riders, with just 71 motorcycles counted.

4.4.2.5 Traffic Count for Bolingo Junction

Figure 4.47 shows the traffic volume count for Bolingo Junction. The total traffic volume count of road users that used Bolingo Junction was 35,600. Passenger cars accounted for the most road users while motorcycles accounted for the lowest number of road users.

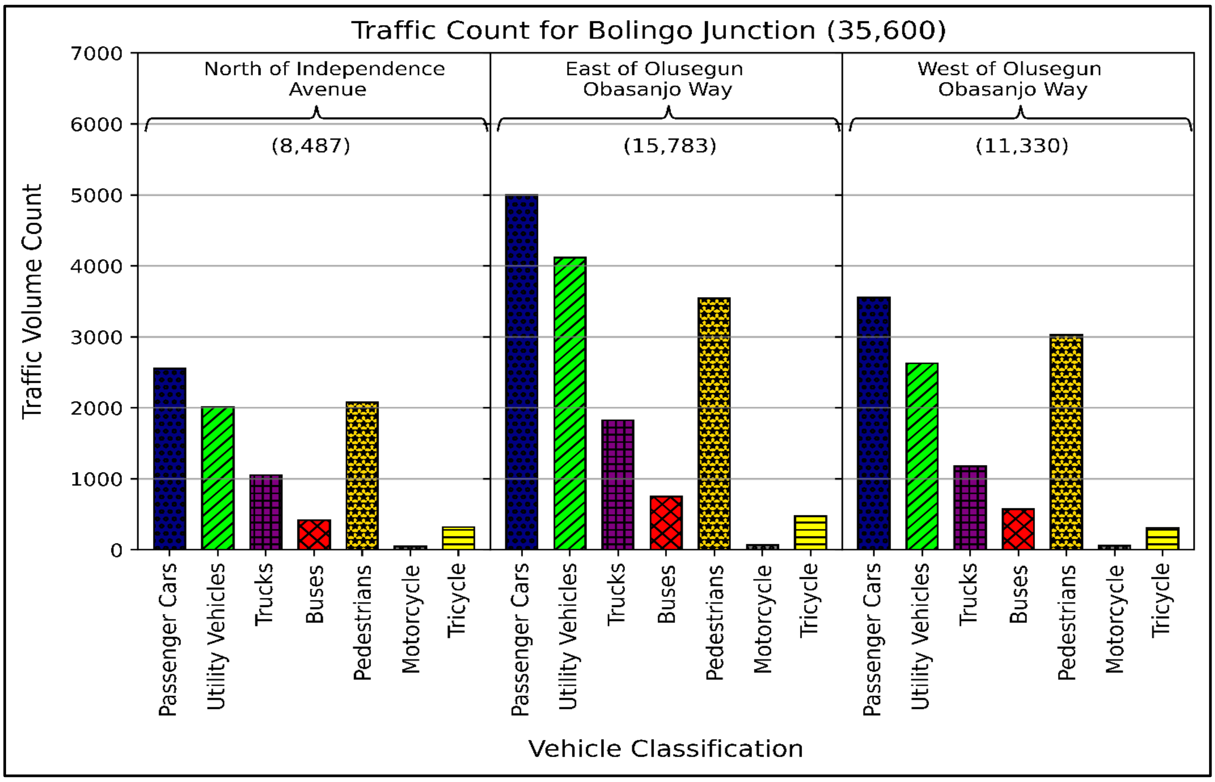

Figure 4.47: Traffic Volume count for Bolingo Junction.

11,107 passenger cars were counted which accounted for 31.2% of the total road users while 178 motorcycles were counted which accounted for 0.5% of the total road users that used

Bolingo Junction. 8,758 utility vehicles were counted which accounted for 24.6% of the total road users while 4,058 trucks were counted which accounted for 11.4% of the total road users. 8,651 pedestrians were counted which accounted for 24.3% of the total road users. Bolingo had the second highest number of pedestrian after Julius Berger. 1,744 buses were counted which accounted for 4.9% of the total road users while 1,104 tricycles were counted which accounted for 3.1% of the total road users.

The distribution of the total road users at Bolingo junction as seen in Figure 4.47, showed that the eastern end of Olusegun Obasanjo way had the highest number of road users at the junction. 15,783 road users were counted at the eastern end of Olusegun Obasanjo way. There were 4,998 passenger cars counted on the eastern end of Olusegun Obasanjo way which accounted for 31.68% of the total road users on the eastern end of Olusegun Obasanjo way. The least number of road users on the eastern end of Olusegun Obasanjo way, were motorcycle riders, as just 71 motorcycles were counted. The northern end of Independence Avenue recorded the least number of road users at Bolingo junction. 2,555 passenger cars, 2,014 utility vehicles and 1053 trucks were counted on the northern end of Independence Avenue. Motorcycle riders were also the lowest number of road users counted on the northern end of Independence Avenue, as just 71 motorcycles were counted.

4.4.2.6 Traffic Count for CBN Junction

The traffic volume count for CBN Junction is presented in Figure 4.48. The total traffic volume count of road users that used CBN Junction was 33,936. Passenger cars accounted for the most road users that used CBN Junction. 10,027 passenger car were counted which accounted for 29.5% of the total road users. 9140 utility vehicles were counted which accounted for 26.9% of the total road users while 7,265 pedestrians were counted which accounted for 21.4% of the total road users. Motorcycles were the least numbers of road users that used CBN Junction, just 341 motorcycles plied the junction which accounted for 1% of the total road users. 853 tricycles were counted which accounted for 2.5% of the total road user while 3,854 buses were counted which accounted for 11.4% of the total road users.

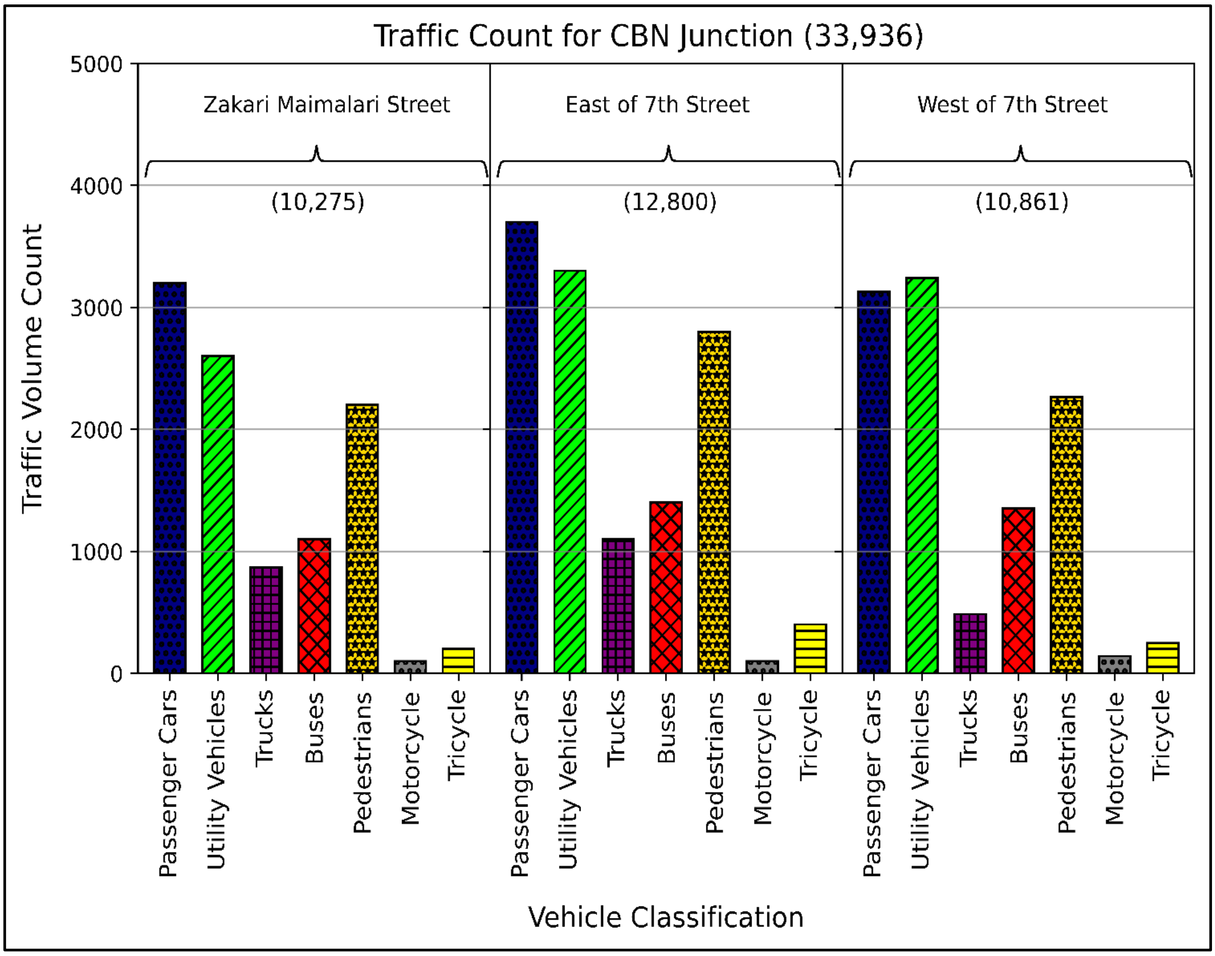

Figure 4.48: Traffic Volume count for CBN Junction.

The distribution of the total number of road users at CBN junction, as seen in Figure 4.48, showed that the highest number road users were counted at the eastern end of 7th street. A total of 12,800 road users were counted on the eastern end of 7th street. Passenger cars accounted for the highest number of road users on the eastern end of 7th street, while motorcycle riders accounted for the least number of road users. The least total number of road users were counted on Zakari Maimalari Street at CBN junction. Passenger cars accounted for the highest road users counted on Zakari Maimalari Street, while motorcycle riders accounted for the least number of road users counted.

4.4.3 Traffic Conflict Identification

Manual observation and identification of traffic conflicts at the six different traffic conflict observation locations, it was observed that a total of 2992 conflicts were identified at the six locations. The breakdown of the various types of conflict and the severity is detailed in the following subsections.

4.4.3.1 Traffic Conflicts at Julius Berger Roundabout

At Julius Berger roundabout, a total of 630 conflicts were observed for the duration of the study (4.5 hours daily for 7 days, amounting to 31.5 hours). Four major types of conflicts were identified at the Julius Berger roundabout and are presented in Table 4.7.

Table 4.7: Conflicts Observed at Julius Berger Roundabout.

S/N	Road Users	Conflicts Types	Number of conflicts		Conflict Description
			Slight Conflicts	Serious Conflicts	
1	Car – Car*	Same Direction (Right Turn)	85	71	First vehicle slows down to make a right turn thereby resulting to danger of a rear – end collision.
2	Car – Car*	Same Direction (Slow Vehicle)	113	94	First vehicle slows down while passing the junction placing the second vehicle in danger of a rear end collision.
3	Car – Pedestrian	Pedestrian	95	80	Pedestrian crossing the road in front of a vehicle resulting to danger of a vehicle hitting the pedestrian.
4	Car – Car*	Right turn, cross traffic Conflict	50	42	First vehicle on the right hand of the junction makes a right turn, placing the second vehicle at risk of a broadside or rear end collision.
Conflicts Observed			343	287	
Total Conflicts Observed			**630**		

***Car includes passenger cars, utility vehicles, and trucks/buses.**

Majority of conflicts experienced at Julius Berger roundabout were same direction conflicts between the cars and conflict between car and pedestrians. From Table 4.7, there were 156 same direction (right turn) conflicts and 207 same direction (slow vehicle) conflicts. It can be seen from the left figure in Figure 4.49, that vehicles coming from the North and South approach of Nnamdi Azikiwe Expressway heading towards Herbert Macaulay Way to the East or Obafemi Awolowo Way tend to slow down before making a right turn. This behaviour causes same direction (right turn) conflicts, and can result in a danger of a rear – end collision for the second vehicle (blue) as shown in the left figure in Figure 4.49 if an evasive action is not taken by the second vehicle.

Figure 4.49: Illustration of Same Direction (Right Turn and Slow Vehicle) Conflict at Julius Berger Roundabout.

The same direction (slow vehicle) conflict is a conflict that is commonly experienced in Abuja and other parts of Nigeria. This conflict is mostly caused by commercial vehicles that slow down to drop or pick passengers along the road side. From the manual observation of conflicts at Julius Berger roundabout, it was noted that commercial vehicles slow down at the junction to drop or pick passengers at Julius Berger roundabout thereby causing same direction (slow vehicle) conflicts. A total of 207 same direction conflicts were identified at Julius Berger roundabout. The 207 same direction (slow vehicle) conflicts were not only caused by commercial drivers who drop and pick up passengers along the road side. It was observed that private vehicles also tend to abruptly slow down at the junction without using indicators, while dropping off passengers.

A total of 175 car – pedestrian conflicts and a total of 92 right turn, cross traffic conflicts were observed. Pedestrian conflicts as seen on the left figure of Figure 4.50 was common due to the fact that there was no zebra crossing provided for pedestrians at Julius Berger roundabout and even if zebra crossing are provided, Nigerians in general do not really adhere to zebra crossing rules (Olawole and Olayiwola, 2018; Awom, 2008; Odeleye, 2002; Olawole, 2017). The pedestrian conflict was the second highest conflict observed at Julius Berger roundabout. The last conflict observed was the right turn, cross traffic conflict. This conflict was the least because of the design of the rotary intersection at Julius Berger roundabout which tends to reduce this conflict. These conflicts occurred due to vehicles coming from Herbert Macaulay Way from the east heading towards Nnamdi Azikiwe Expressway to the North thereby putting vehicles coming from the south of Nnamdi Azikiwe Expressway at risk of a rear – end collision as seen on the right figure of Figure 4.50.

Figure 4.50: Illustration of Pedestrian and Right Turn, Cross Traffic Conflict.

There were no traffic signs specifying the speed limits of the connecting roads, however, speed limits for motorways, rural roads and urban roads is 100km/hr, 80km/hr and 50km/hr respectively (FRSC, 2016; IRTAD, 2018; WHO, 2018).

Some other types of conflicts like opposite left turn, left turn, cross traffic from the right were not observed due to the design of the rotary intersection as the design of the rotary intersection tends to eliminate those types of conflicts. The severity of the conflicts observed at Julius Berger roundabout were evaluated using the Time To Collision approach and also evaluated on site according to how hard the driver brakes to avoid collision, if the evasive action was controlled or uncontrolled. The result of the rating of the severity are presented in a subsequent subsection (4.4.4).

4.4.3.2 Traffic Conflicts at Bannex Junction

A total of 536 traffic conflicts were experienced at Bannex Junction throughout the observation period. Five conflict types were identified at Bannex Junction and the results are presented in Table 4.8. A total of 198 same direction (right turn) conflicts were observed. These conflicts resulted from vehicles coming from the North – East and South – West of Nnamdi Azikiwe Expressway trying to connect to the flyover leading to Ahmadu Bello Way. Vehicles tend to slow down before making a right turn thereby leading to risk of a rear end collision of the second vehicle coming from behind as shown in the left figure of Figure 4.51. The same direction (slow vehicle) conflicts at Bannex Junction were mainly caused by a typical road design issue, which forces vehicles that missed making the right turn to Ahmadu Bello Way, to slow down and then reverse in order to make the right turn. This reversing behaviour caused by a faulty road design, puts the second vehicle in danger of a rear – end collision. A total of 104 same direction (slow vehicles) conflicts were observed at Bannex Junction. The illustration of this conflict is shown on the right figure of Figure 4.51. A total of 52 car – pedestrian conflicts were observed at Bannex Junction.

Table 4.8: Conflicts observed at Bannex Junction.

S/N	Road Users	Conflicts Types	Number of conflicts		Conflict Description
			Slight Conflicts	Serious Conflicts	
1	Car – Car*	Same Direction (Right Turn)	108	90	First vehicle slows down to make a right turn thereby resulting to danger of a rear – end collision.
2	Car – Car*	Same Direction (Slow Vehicle)	57	47	First vehicle slows down while passing the junction placing the second vehicle in danger of a rear end collision.
3	Car – Pedestrian	Pedestrian	28	24	Pedestrian crossing the road in front of a vehicle resulting to danger of a vehicle hitting the pedestrian.
4	Car – Car*	Right turn, cross traffic Conflict	82	68	First vehicle on the right hand of the junction makes a right turn, placing the second vehicle at risk of a broadside or rear end collision.
5	Car – Car*	Lane Change	17	15	First vehicle changes from one lane to another thereby placing the second vehicle at risk of a rear – end or sideswipe collision.
Conflicts Observed			292	244	
Total Conflicts Observed			536		

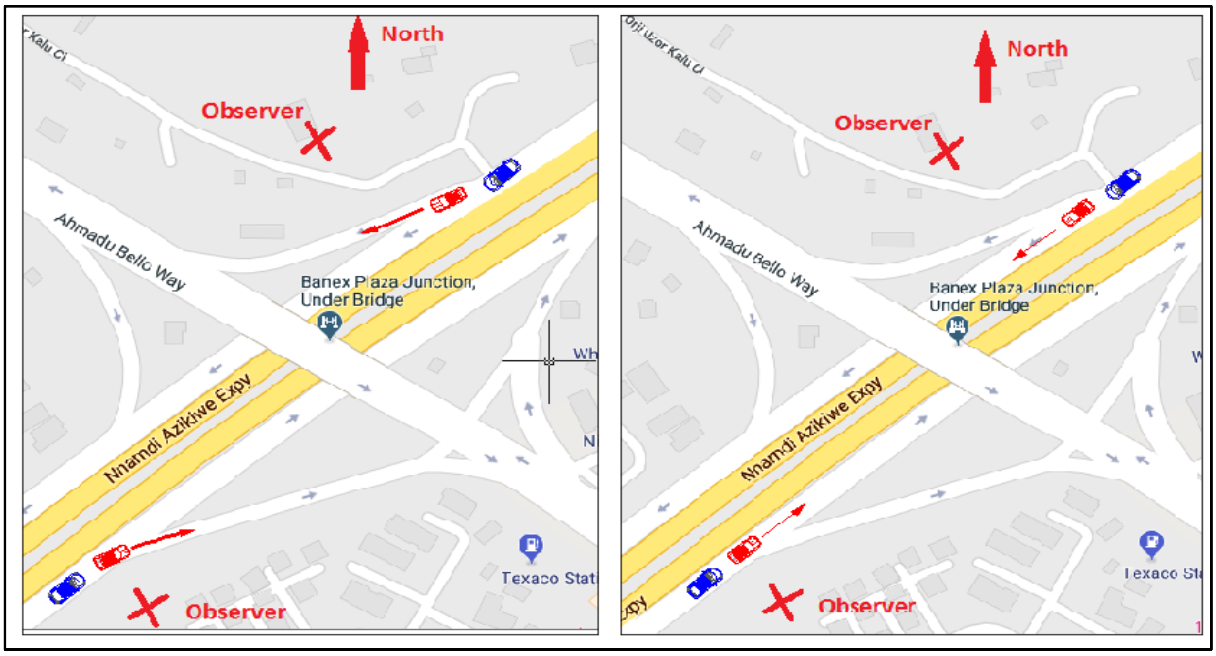

Figure 4.51: Illustration of Same Direction (Right Turn and Slow Vehicle) Conflict at Bannex Junction.

These conflicts were as a result of pedestrians that chose not to use the pedestrian bridge situated 100m away from Bannex Junction. Most pedestrians in Abuja and majority of pedestrians in Nigeria, tend to cross the road and expressways rather than using pedestrian bridge even though pedestrian bridges are provided. Most pedestrians do not like walking long distances to where the pedestrian bridges are situated and tend to take chance by crossing the expressway despite the presence of fast moving vehicles on both expressways and parallel roads.

Right turn, Cross traffic conflicts were also observed at Bannex Junction. A total of 150 right turn, cross traffic conflicts occurred which were the second most frequent conflict type observed at Bannex Junction. This conflict results from vehicles making a right turn from Ahmadu Bello way to Nnamdi Azikiwe Expressway thereby putting the second vehicle coming from Nnamdi Azikiwe Expressway at risk of a rear – end or broadside collision if an evasive action is not taken by the second vehicle as seen in the left figure in Figure 4.52. The last conflict observed at Bannex Junction was a lane change conflict as seen in the right figure in Figure 4.52.

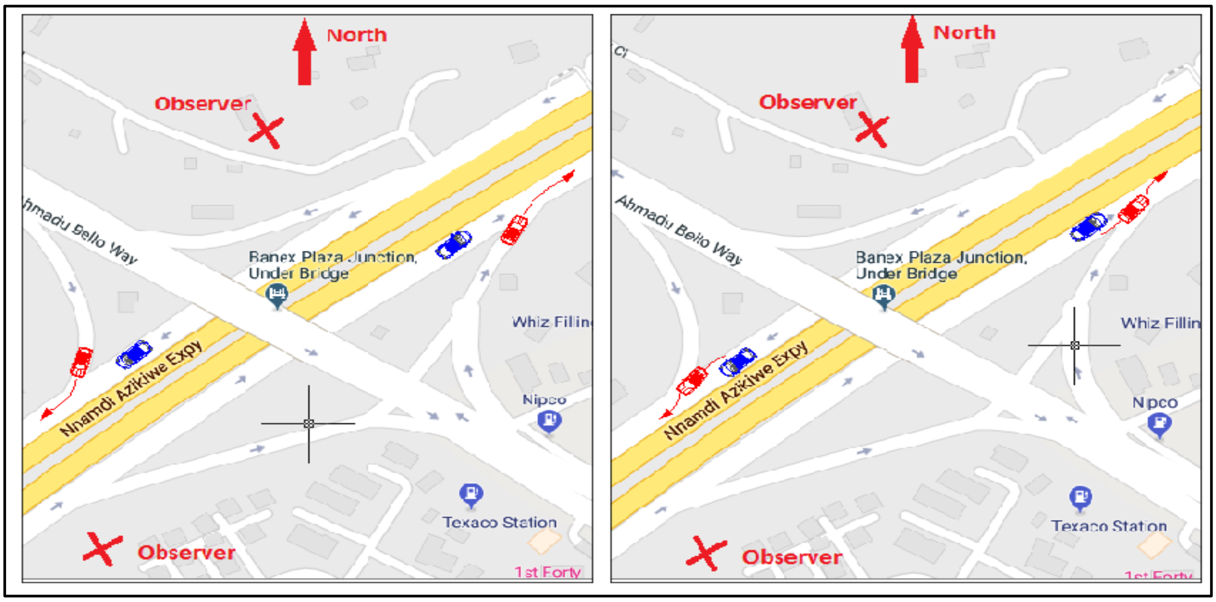

Figure 4.52: Illustration of Same Direction Right Turn and Lane Change Conflict at Bannex Junction.

A total of 32 lane change conflicts were observed and this type of conflicts were the least observed at Bannex Junction. The conflicts result from the first vehicle on Nnamdi Azikiwe Expressway changing lane without proper indication notifying the second driver behind, thereby leading to a rear – end or sideswipe from the second vehicle if the second vehicle does not strongly brake in time.

4.4.3.3 Traffic Conflicts at NICON Junction

NICON Junction had the least number of conflicts out of the junctions situated at Nnamdi Azikiwe Expressway with just 505 conflicts observed for the duration of observation. The fewer number of conflicts can be attributed to the fact that the junction is more like a T – junction thereby resulting in a lower number of possible conflict points. Five major conflict types were identified at NICON Junction and the result of the conflict observation for NICON Junction is presented in Table 4.9. From Table 4.9, there were 219 same direction (right turn) conflicts observed at the junction.

The same direction (right turn) conflicts were more at NICON Junction due to the fact that a commercial motor park is situated near the junction. Commercial vehicles coming for Nnamdi Azikiwe Expressway make right turns to NICON park road where they patiently load their vehicles with passengers. When commercial vehicles make right turns to the park they tend to slow down thereby resulting to a risk of collision for vehicles heading to the North of Nnamdi Azikiwe Expressway. A total of 114 same direction (slow vehicle) conflicts were observed at NICON Junction as shown in the right figure of Figure 4.53. These conflicts were caused by commercial drivers stopping to pick up and drop passengers at NICON Junction.

Table 4.9: Conflicts experienced at NICON Junction.

S/N	Road Users	Conflicts Types	Number of conflicts		Conflict Description
			Slight Conflicts	Serious Conflicts	
1	Car – Car*	Same Direction (Right Turn)	124	95	First vehicle slows down to make a right turn thereby resulting to danger of a rear – end collision.
2	Car – Car*	Same Direction (Slow Vehicle)	65	49	First vehicle slows down while passing the junction placing the second vehicle in danger of a rear end collision.
3	Car – Pedestrian	Pedestrian	42	33	Pedestrian crossing the road in front of a vehicle resulting to danger of a vehicle hitting the pedestrian.
4	Car – Car*	Right turn, cross traffic Conflict	29	23	First vehicle on the right hand of the junction makes a right turn, placing the second vehicle at risk of a broadside or rear end collision.
5	Car – Car*	Lane Change	26	19	First vehicle changes from one lane to another thereby placing the second vehicle at risk of a rear – end or sideswipe collision.
Conflicts Observed			286	219	
Total Conflicts Observed			**505**		

A total of 75 car – pedestrian conflicts were observed at NICON Junction. The number of pedestrian conflicts at NICON Junction was higher than Bannex Junction due to the commercial park at NICON Junction. More pedestrians tend to cross the expressway even though there is a pedestrian bridge provided about 100m away from NICON Junction. What was observed at the junction was that some pedestrians that alighted from commercial vehicles at NICON Junction do not want to make the effort to walk another 100m to utilize the pedestrian bridge to cross the expressway.

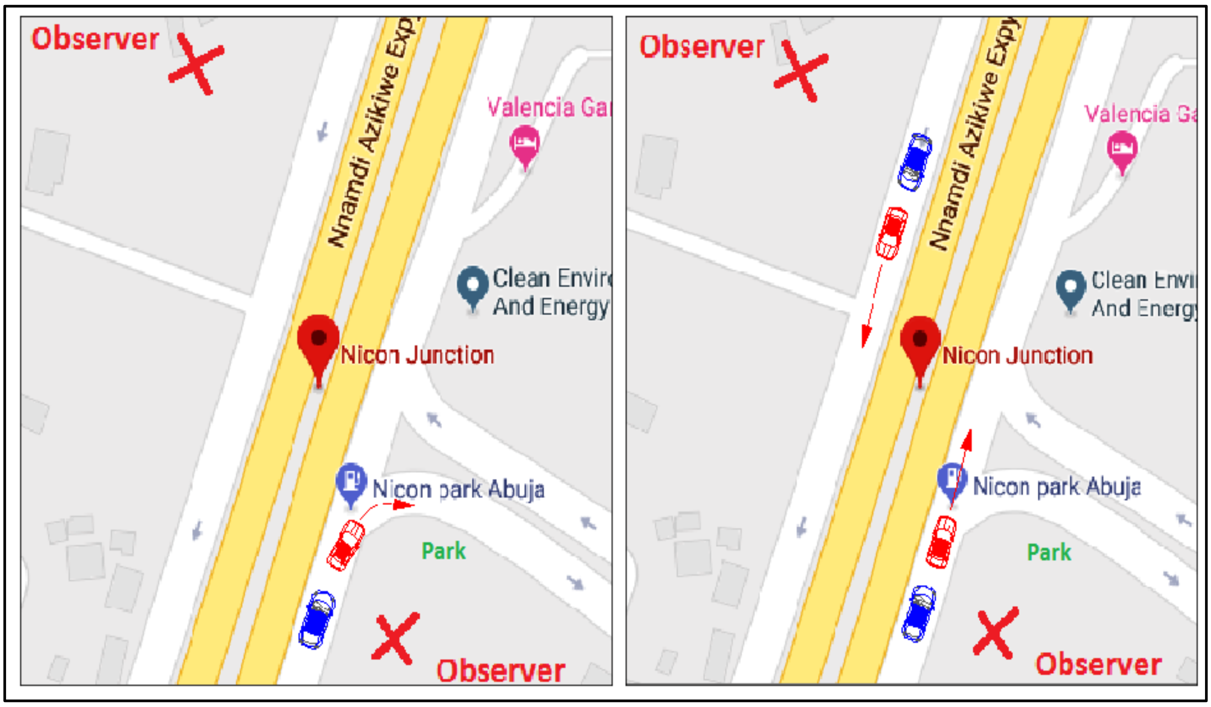

Figure 4.53: Illustration of Same Direction (Right Turn and Slow Vehicle) Conflict at NICON Junction.

A total of 52 right turn, cross traffic conflicts were observed at NICON Junction. Vehicles from NICON Park Street entering Nnamdi Azikiwe Expressway tend to slow down or even enter the expressway at high speed thereby resulting in possible rear – end or broadside collisions if an evasive action is not taken by the second vehicle as shown on the right figure in Figure 4.54. No right turn collisions were observed by the second observer as the road was not suitable for motor vehicles, this resulted to the low right turn conflicts observed at NICON Junction compared to Bannex Junction and Julius Berger roundabout. The last conflict type observed at NICON Junction was lane change as seen in the right figure in Figure 4.54. Vehicles moving on one lane switch to the other lane without properly alerting the second driver behind. This kind of conflict can result to rear – end or sideswipe collision if an evasive action such as braking or possible lane change by the second driver is not taken.

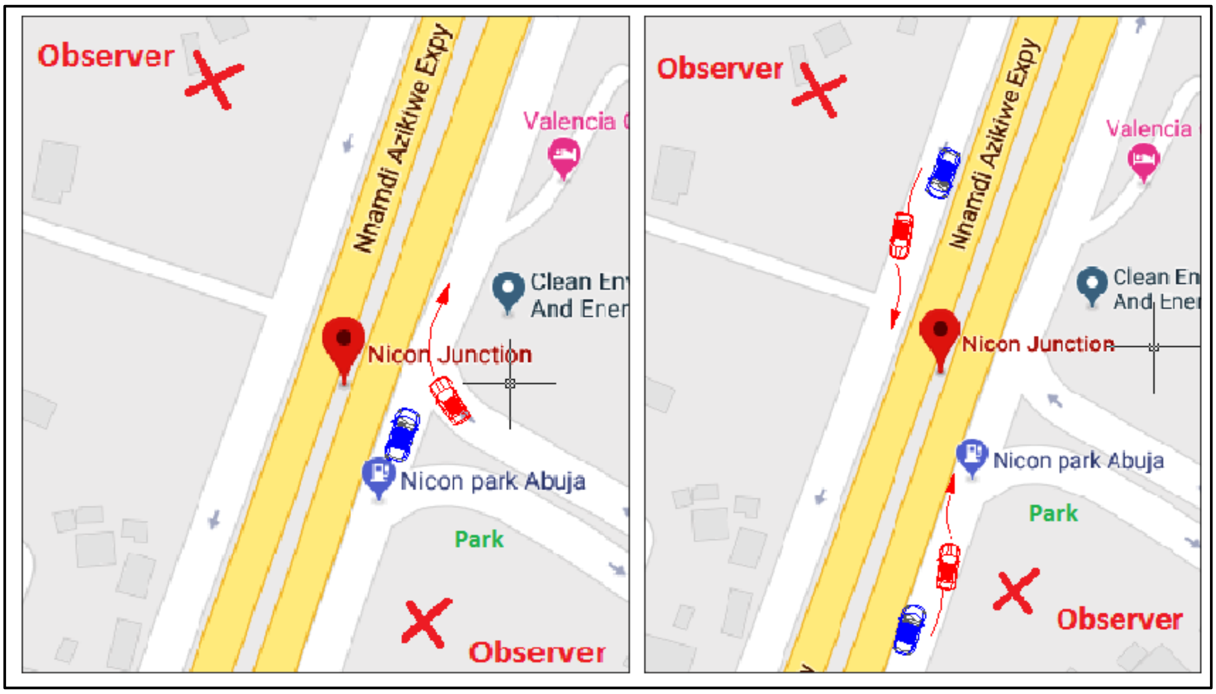

Figure 4.54: Illustration of Right turn, Cross Traffic and Lane Change Conflict at NICON Junction.

4.4.3.4 Traffic Conflicts at ChurchGate Junction

The total number of conflicts observed at ChurchGate Junction was 407 conflicts. The majority of the conflicts observed were cross traffic conflicts and the results are presented in Table 4.10. A total of 107 through cross traffic conflicts were observed between car – car, 29 through conflicts were observed between cars – tricycles and 10 through traffic conflicts were observed between cars – motorcycles as seen in the left figure of Figure 4.55. A total of 89 left turn cross traffic conflicts were observed between cars and 58 right turn cross traffic conflicts were observed at ChurchGate Junction, see right of Figure 4.55. Cross traffic conflicts predominates at ChurchGate Junction due to the design of the intersection, which is more like two cross intersections at one junction. Other conflicts observed at ChurchGate Junction were Car – Pedestrian, same direction (right turn) and lane change conflict. A total of 48 car – pedestrian conflicts was observed at the junction, while a total of 36 same direction (right turn) conflicts was noticed. A total of 36 lane change conflicts was observed at ChurchGate Junction.

Table 4.10: Conflicts experienced at ChurchGate Junction

S/N	Road Users	Conflicts Types	Number of conflicts		Conflict Description
			Slight Conflicts	Serious Conflicts	
1	Car – Car*	Through, Cross Traffic	59	48	When a vehicle on the right or left of a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
2	Car – Tricycle	Through, Cross Traffic	16	13	When a tricycle on the right or left of a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
3	Car – Motorcycle	Through, Cross Traffic	6	4	When a motorcycle on the right or left of a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
4	Car – Car*	Left Turn, Cross Traffic	49	40	When a vehicle on the left crosses and makes a left turn, thus placing a second vehicle on the major road in danger of a broadside or rear – end collision.
5	Car – Pedestrian	Pedestrian	26	22	Pedestrian crossing the road in front of a vehicle resulting to danger of a vehicle hitting the pedestrian.
6	Car – Car*	Right Turn, Cross Traffic Conflict	32	26	First vehicle on the right hand of the junction makes a right turn, placing the second vehicle at risk of a broadside or rear – end collision.
7	Car – Car*	Lane Change	16	14	First vehicle changes from one lane to another thereby placing the second vehicle at risk of a rear – end or sideswipe collision.
8	Road Users	Same Direction (Right Turn)	20	16	First vehicle slows down to make a right turn thereby resulting to danger of a rear – end collision.
Conflicts Observed			224	183	
Total Conflicts Observed			**407**		

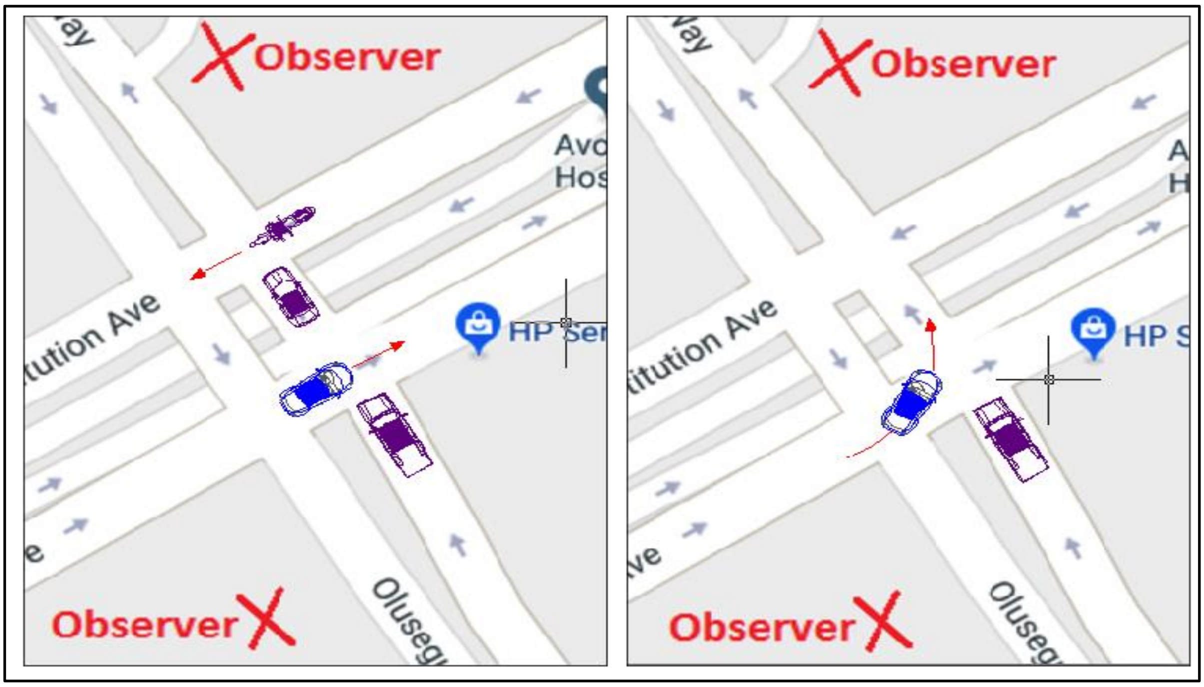

Figure 4.55: Illustration of Through, Cross Traffic and Left Turn, Cross Traffic Conflict at ChurchGate Junction.

4.4.3.5 Traffic Conflicts at Bolingo Junction

A total of 484 conflicts were observed at Bolingo Junction. The cross traffic conflicts were the highest number of conflicts observed at the junction and the results are presented in Table 4.11. A total of 85 cross traffic conflicts were observed between cars, 45 cross traffic conflicts were between car – tricycle and 19 were observed between car – motorcycle at Bolingo Junction as seen on the right figure in Figure 4.56. The same direction (right turn) conflicts were also observed at the junction. A total of 61 same direction (right turn) conflicts were observed as a result of vehicles coming from Independence Avenue heading towards Olusegun Obasanjo way. The second conflict type observed the most was the left turn, cross traffic conflict. A total of 89 left turn cross traffic conflicts were observed from vehicle coming from Independence Avenue heading toward Olusegun Obasanjo way as shown in the left figure of Figure 4.56. A total of 56 conflicts were observed for lane change and a total of 71 car – pedestrian conflicts were observed at Bolingo Junction. The high number of car – pedestrian conflicts were caused due to the fact that no zebra crossing was provided to aid pedestrians in crossing the road even though Bolingo Junction is situated in a built – up area.

Table 4.11: Conflicts observed at Bolingo Junction

S/N	Road Users	Conflicts Types	Number of conflicts		Conflict Description
			Slight Conflicts	**Serious Conflicts**	
1	Car – Car*	Through, Cross Traffic	44	41	When a vehicle on the right or left of a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
2	Car – Tricycle	Through, Cross Traffic	23	22	When a tricycle on the right or left of a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
3	Car – Motorcycle	Through, Cross Traffic	10	9	When a motorcycle on the right or left of a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
4	Car – Car*	Left Turn, Cross Traffic	46	43	When a vehicle on the left crosses and makes a left turn, thus placing a second vehicle on the major road in danger of a broadside or rear – end collision.
5	Car – Pedestrian	Pedestrian	36	35	Pedestrian crossing the road in front of a vehicle resulting to danger of a vehicle hitting the pedestrian.
6	Car – Car*	Right Turn, Cross Traffic Conflict	30	28	First vehicle on the right hand of the junction makes a right turn, placing the second vehicle at risk of a broadside or rear – end collision.
7	Car – Car*	Lane Change	29	27	First vehicle changes from one lane to another thereby placing the second vehicle at risk of a rear – end or sideswipe collision.
8	Car – Car*	Same Direction (Right Turn)	31	30	First vehicle slows down to make a right turn thereby resulting to danger of a rear – end collision.
Conflicts Observed			249	235	
Total Conflicts Observed			**484**		

Figure 4.56: Illustration of Through, Cross Traffic and Left Turn, Cross Traffic Conflict at Bolingo Junction.

4.4.3.6 Traffic Conflicts at CBN Junction

A total of 430 conflicts were observed at CBN Junction, with majority cross traffic conflicts and the results of the conflict observation are presented in Table 4.12. A total of 75 cross traffic conflicts were observed between car – car, 32 cross traffic conflicts were observed between car – tricycle and 18 cross traffic conflicts were observed between car – motorcycle. A total of 72 left turn, cross traffic conflicts were observed while a total of 56 car – pedestrian conflicts were observed at the junction. A total of 36 same direction (right turn) conflicts and a total of 46 lane change conflicts were also observed at the junction. Same direction (left turn) conflicts were also observed at CBN Junction. This conflict type was brought about by vehicles trying to make a U – turn at the junction thereby slowing down and resulting in the risk of a rear – end collision. A total of 30 same direction (left turn) conflicts were observed at CBN Junction. The last conflict observed was the right turn cross traffic conflict, a total of 65 right turn cross traffic conflicts were observed at CBN Junction.

Table 4.12: Conflicts observed at CBN Junction

S/N	Road Users	Conflicts Types	Number of conflicts		Conflict Description
			Slight Conflicts	Serious Conflicts	
1	Car - Car*	Through, Cross Traffic	41	34	When a vehicle on a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
2	Car - Tricycle	Through, Cross Traffic	17	15	When a tricycle on a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
3	Car - Motorcycle	Through, Cross Traffic	10	8	When a motorcycle a secondary road crosses straight in front of a vehicle on the major road, placing it in danger of a broadside collision.
4	Car - Car*	Left Turn, Cross Traffic	39	33	When a vehicle on the left crosses and makes a left turn, thus placing a second vehicle on the major road in danger of a broadside or rear – end collision.
5	Car - Pedestrian	Pedestrian	31	25	Pedestrian crossing the road in front of a vehicle resulting to danger of a vehicle hitting the pedestrian.
6	Car - Car*	Right turn, cross traffic Conflict	36	29	First vehicle on the right hand of the junction makes a right turn, placing the second vehicle at risk of a broadside or rear – end collision.
7	Car - Car*	Lane Change	25	21	First vehicle changes from one lane to another thereby placing the second vehicle at risk of a rear – end or sideswipe collision.
8	Car - Car*	Same Direction (Right Turn)	20	16	First vehicle slows down to make a right turn thereby resulting to danger of a rear – end collision.
9	Car - Car*	Same Direction (Left Turn)	16	14	First vehicle slows down to make a left turn thereby resulting to danger of a rear – end collision.
Conflicts Observed			**235**	**195**	
Total Conflicts Observed			**430**		

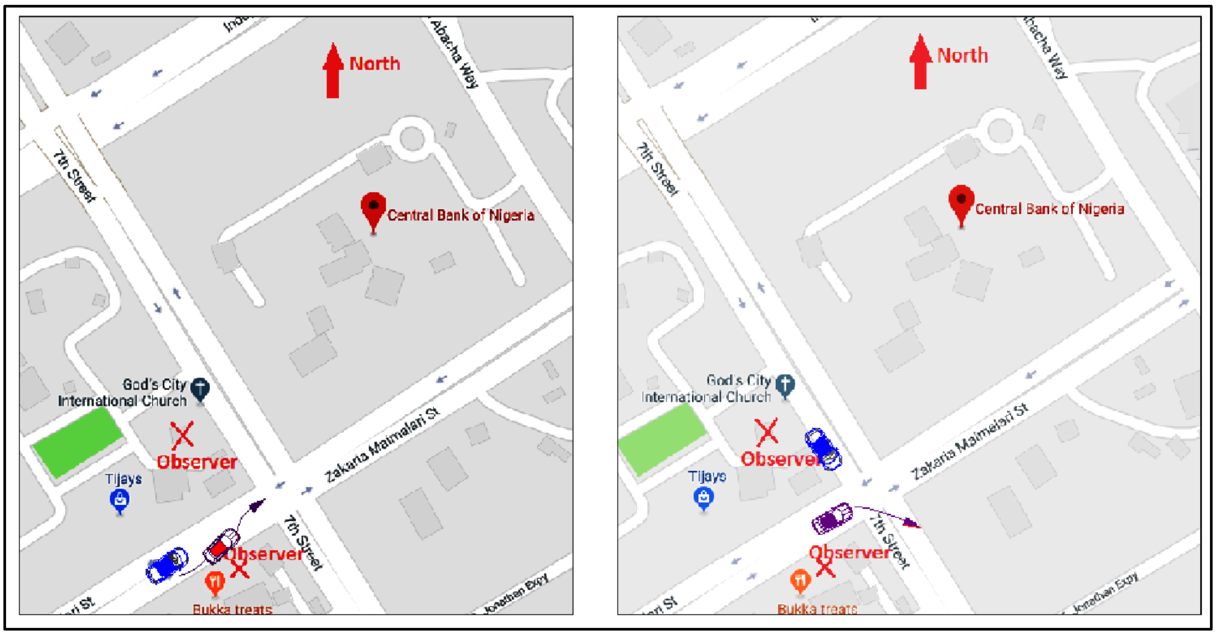

Figure 4.57: Illustration of Lane Change and Right Turn, Cross Traffic Conflict at CBN Junction.

4.4.4 Severity of Conflicts and Conflicts Risk

The rating of the severity of the conflicts was done on site by the trained observers and also a slightly modified DOCTOR approach was adopted in computing the minimum Time – To – Collision (TTC min). The modification to DOCTOR technique includes an increase in the total observation standard time of 18 hours per location spread across 3 days (6 hours per day, 2 hours per observation session) used by van der Horst et al., (2017) to 31.5 hours spread across 7 days (4.5 hours per day, 1.5 hours per observation session). This was necessary in order to cover the most important time periods in which crashes occur for all days of the week at the conflict study sites. The Post Encroachment Time (PET) was also not utilised in the rating of the severity, which is a deviation from the norms of the DOCTOR technique. The TTC min and probability of a collision occurring and the implications if a collision actually occurs were used for severity rating. Due to video recordings not being permitted by the Government, the TTC min was computed by obtaining the distance from when the driver is believed to have started applying the brakes to the moment the evasive action was completed. The distance was roughly obtained from the distance between trees and street lights, relative to the point where the observers were located. The speed of the vehicles were estimated speeds which were compared to earlier obtained values from hand – held radar guns. The speed estimates did not exceed 20% of the measured value. For pedestrians, no speeds estimates were needed. The advantages of the use of braking indicators in traffic conflicts measurement include; ease in identifying and counting conflicts, subjectivity can be avoided during data collection, and brakes are applied in all conflict categories. The deceleration of vehicles and the indication of brake lights were used as evidences of brake application in vehicles.

4.4.4.1 Severity of Conflicts at Julius Berger roundabout

From the observation of the traffic conflicts at Julius Berger roundabout for a duration of 31.5hours, a total of 630 conflicts were observed and are presented in Figure 4.58. After computation of the TTC min, a total of 287 traffic conflicts were rated as serious traffic conflicts (conflicts having TTC min < 1.5secs) while 343 conflicts were rated as minor traffic conflicts (TTC min between 1.5 to 3 secs). Conflicts with severity rated as 1, were conflicts in which the driver had time to make a controlled evasive action (either controlled braking or swerving) and was not in any form of risk of a collision and the TTC min was above 2secs. Conflicts with severity rated as 2, were conflicts where the driver had time to make a controlled evasive action and way not in any form of risk of a collision but the TTC min was between 1.5secs and 2 secs. Conflicts with severity rated as 3, were conflicts where the driver made either a control or an uncontrolled evasive action (forced braking or abruptly change of lane) but the possibility of a risk of collision was there and the TTC min was between 1sec and 1.5secs. Conflicts with severity rated as 4, were conflicts most often than not the evasive action is usually strong swerving and emergency braking, and there would have been a risk of collision if the evasive action was delayed and the TTC min was between 0.5sec to 1 sec. Conflicts with severity rated as 4 also include near miss cases and slight collisions. Conflicts with severity rated as 5, have TTC min from 0 to 0.5sec. A near miss which could have potentially resulted in a crash with severe consequences has a severity of 5.

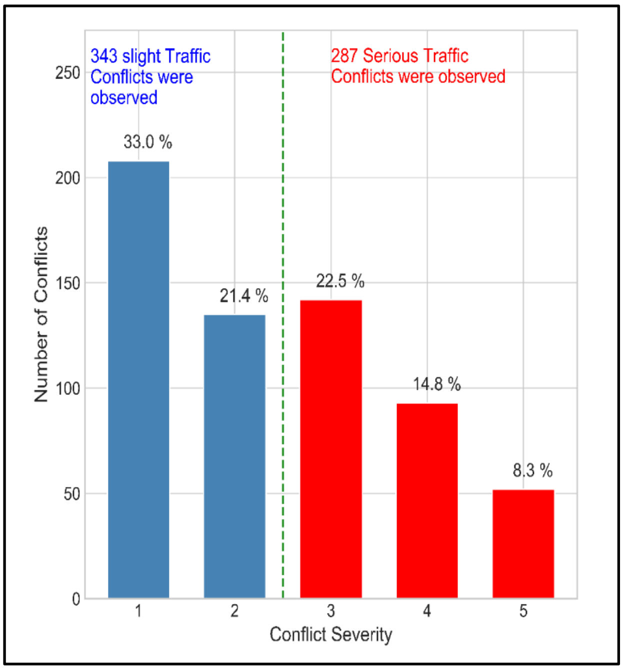

Figure 4.58: Severity of Traffic Conflicts at Julius Berger Roundabout.

208 traffic conflicts observed were rated as conflicts with severity score of 1 which accounts for 33.0% of the total number of conflicts observed at Julius Berger roundabout, while 52 traffic conflicts observed were rated as conflicts with severity score of 5 which is regarded as a near miss and could have potentially resulted in a crash. The difference between the 1 – 5 conflicts scores are also summarised in chapter 3 (see section 3.5.3, Table 3.2). The high number of minor traffic conflicts were attributed to commercial drivers indiscriminately dropping and picking up passengers along junctions which is kind of a normal practice by commercial drivers operating in Abuja and in Nigeria as a whole. One of the serious traffic conflicts observed was caused by a passenger car coming from Herbert Macaulay way from the east of Julius Berger roundabout heading towards the north of Nnamdi Azikiwe expressway almost colliding with a truck coming from Nnamdi Azikiwe Expressway from the south of Julius Berger roundabout heading towards the north of Nnamdi Azikiwe Expressway thereby resulting to a right – turn, cross traffic conflict.

4.4.4.2 Severity of Conflicts at Bannex Junction

A total of 536 traffic conflicts were observed at Bannex Junction and after computation of the TTC, a total of 244 conflicts were rated as serious traffic conflicts and 292 conflicts were rated as minor traffic conflicts (Figure 4.59). A total of 42 traffic conflicts observed at Bannex Junction were rated with severity score of 5 which accounts for 7.8% of the total traffic conflicts observed at Bannex Junction while 170 traffic conflicts were rated with severity scores of 1 which accounts for 31.7% of the total traffic conflicts observed at Bannex Junction.

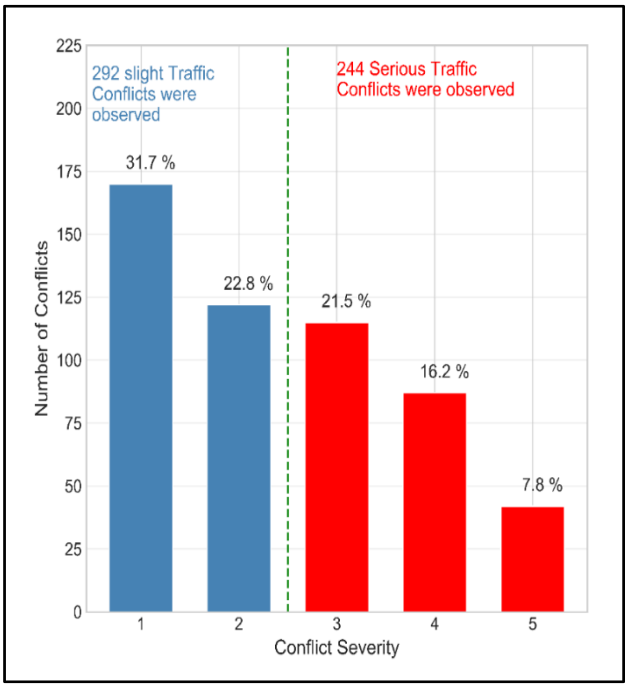

Figure 4.59: Severity of Traffic Conflicts at Bannex Junction.

87 traffic conflicts observed at Bannex Junction were rated with a severity score of 4 which accounts for 16.2% of the total traffic conflicts while 115 of the traffic conflicts observed at Bannex Junction were rated with a severity score of 3 which accounts for 21.5% of the total traffic conflicts.

4.4.4.3 Severity of Conflicts at NICON Junction

A total of 505 traffic conflicts were observed at NICON Junction and a total of 286 were rated as minor traffic conflicts after computation of TTC min and are presented in Figure 4.60. 219

traffic conflicts observed at NICON Junction were rated as serious conflicts. 36 traffic conflicts at NICON Junction were rated with a severity score of 5 which accounts for 7.1% of the total traffic conflicts observed at NICON Junction while 78 traffic conflicts were rated with a severity score of 4 which accounts for 15.4% of the total traffic conflicts observed at the junction.

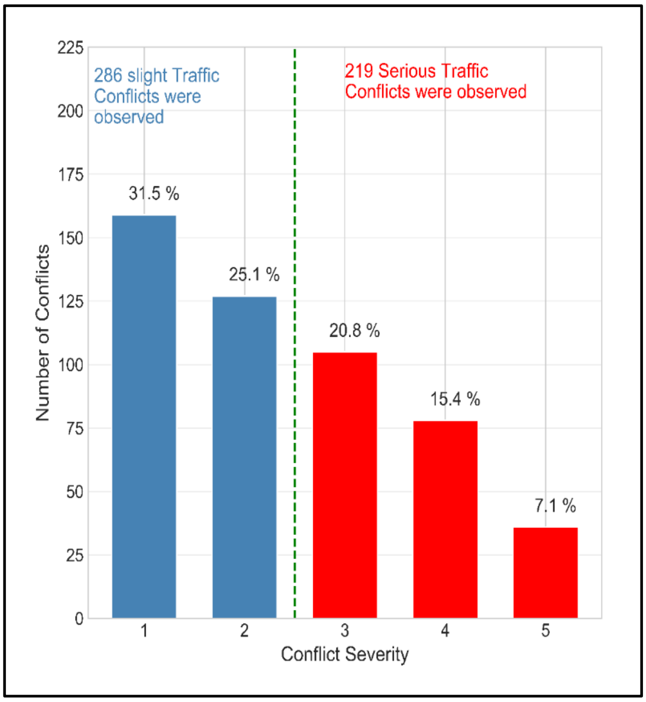

Figure 4.60: Severity of Traffic Conflicts at NICON Junction.

A total of 159 traffic conflicts at NICON Junction were rated with a severity score of 1 which accounts for 31.5% of the total traffic conflicts while 105 traffic conflicts were rated with severity score of 3 which accounts for 20.8% of the total traffic conflicts.

4.4.4.4 Severity of Conflicts at ChurchGate Junction

From the observation of the traffic conflicts at ChurchGate for a duration of 31.5hours, a total of 407 conflicts were observed and are presented in Figure 4.61. After computation of the TTC min, a total of 183 traffic conflicts were rated as serious traffic conflicts (conflicts having TTC min < 1.5secs) while 224 conflicts were rated as minor traffic conflicts. A total of 30 traffic conflicts were rated with severity scores of 5 which accounts for 7.4% of the total traffic conflict while 119 traffic conflicts observed at ChurchGate Junction were rated with a severity score of 1 which accounts for 28.7% of the total traffic conflicts.

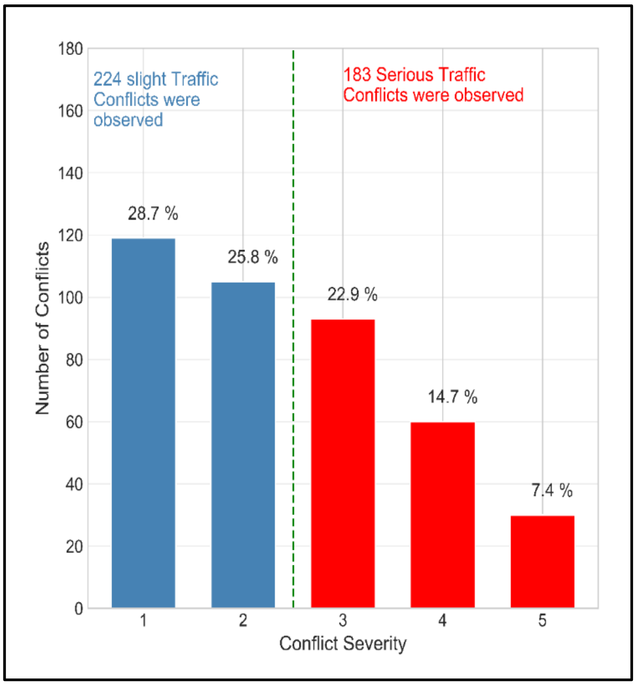

Figure 4.61: Severity of Traffic Conflicts at ChurchGate Junction.

A total 105 traffic conflicts were rated with a severity score of 2 which accounts for 25.8% of the total traffic conflicts at the junction while 93 traffic conflicts were rated with a severity score of 3 which accounts for 22.9 of the total traffic conflicts.

4.4.4.5 Severity of Conflicts at Bolingo Junction

For Bolingo Junction, 484 traffic conflicts were observed during the duration of the study, of which 235 traffic conflicts were rated as serious traffic conflicts and 249 traffic conflicts were rated as minor traffic conflicts (see Figure 4.62). A total of 130 traffic conflicts observed at Bolingo Junction were rated with a severity score of 1 which accounts for 26.9% of the total traffic conflicts observed while 34 traffic conflicts observed at the junction were rated with severity score of 5 with accounts for 7% of the total traffic conflict observed at the junction. 124 traffic conflicts were rated with severity score of 3 which accounts for 25.6% of the total traffic conflicts.

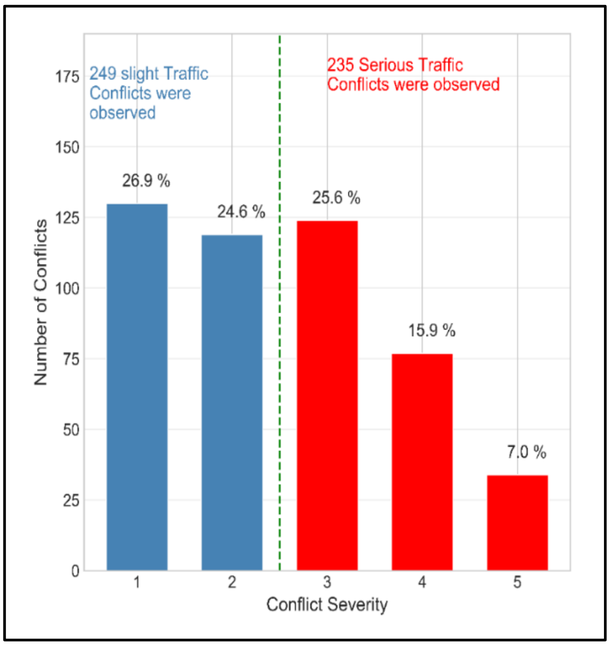

Figure 4.62: Severity of Traffic Conflicts at Bolingo Junction.

A total of 119 traffic conflicts observed were rated with severity score of 2 which accounts for 24.6% of the total traffic conflicts while 77 traffic conflict observed were rated with severity score of 4 which accounts for 15.9% of the total traffic conflicts observed at Bolingo Junction. Bolingo Junction had the closest split of serious and minor conflicts which is probably due to the proximity of Nigeria's Ministry of Defence (Ship House) and the barricade on the road close to Ship House, thus influencing driver behaviour as they approach Bolingo junction.

4.4.4.6 Severity of Conflicts at CBN Junction

At CBN Junction a total of 430 traffic conflicts were observed for the duration of the study, of which 235 conflicts were rated as minor traffic conflicts after computation of the TTC min and 195 of the total traffic were rated as serious traffic conflict and are presented in Figure 4.63. A total of 33 traffic conflicts observed at the junction were rated with severity score of 5 which accounted for 7.7% of the total traffic conflicts observed at the junction while 123 traffic conflicts observed were rated with a severity score of 1 which accounts for 28.6% of the total traffic conflict. 94 traffic conflicts were rated with severity score of 3 which accounts for 21.9% of the total traffic conflicts recorded. A total of 112 traffic conflicts observed were rated with severity score of 2 which accounts for 26% of the total traffic conflicts while 68 traffic conflicts observed were rated with a severity score of 4 which accounts for 15.8% of the total traffic conflicts observed at CBN Junction.

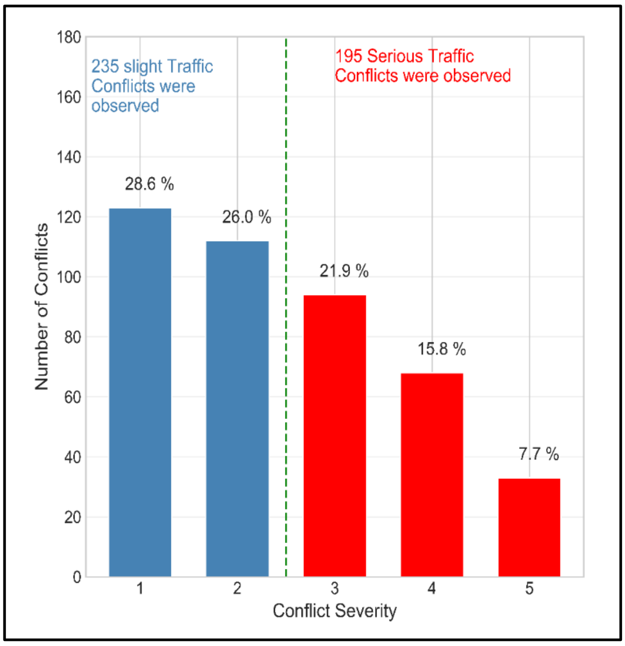

Figure 4.63: Severity of Traffic Conflicts at CBN Junction.

4.4.5 Conflict impact points at the selected junctions in Abuja

The conflict impact points for all the conflicts observation locations are presented in Figures 4.64 – 4.69.

At Julius Berger roundabout (see Figure 4.64), the highest number of conflicts were observed at the southern end of Nnamdi Azikiwe expressway. The observed conflicts at the southern end were mainly caused by: commercial drivers with a driving behaviour of slowing down to drop off and/or pick up passengers very close to the roundabout or at the middle of the road, and private vehicles making sharp right turns to connect Herbert Macaulay way. Most of the commercial drivers fail to use their indicators when slowing down to pick up passengers on the side of the road, or when making right turns to Herbert Macaulay Way. From the questionnaire analysis, most of the respondents agreed that the unsafe driving behaviour they commit the most was not using or forgetting to use their indicators when changing lanes or making turns.

This is consistent with the findings from the traffic conflict observation presented in this section. Majority of drivers in Abuja, and by extension Nigeria, generally forget to use their indicators and it is worst with commercial drivers due to a lack of proper driver education and the fact that most vehicles used for commercial purposes are fairly used vehicles without proper functioning indicators. The highest severity of conflicts were observed at Herbert Macaulay way. The conflict severity observed were mainly due to vehicles coming from the south of Nnamdi Azikiwe expressway and approaching Herbert Macaulay way with speed, thereby seriously putting the vehicles approaching from behind at serious risk of a collision. This study observed that vehicles approaching Herbert Macaulay way using the ramp (see Figure 4.64), failed to merge properly with traffic from Herbert Macaulay way. The severity of conflicts at this spot could result to crashes if evasive actions are not taken. In a case where crashes occur, it could be fatal due to speeding and the low compliance to seatbelt usage in Abuja.

As shown in Figure 4.64, car – pedestrian conflicts were also observed on the road linking the southern part of Nnamdi Azikiwe road to the eastern part of Herbert Macaulay way.

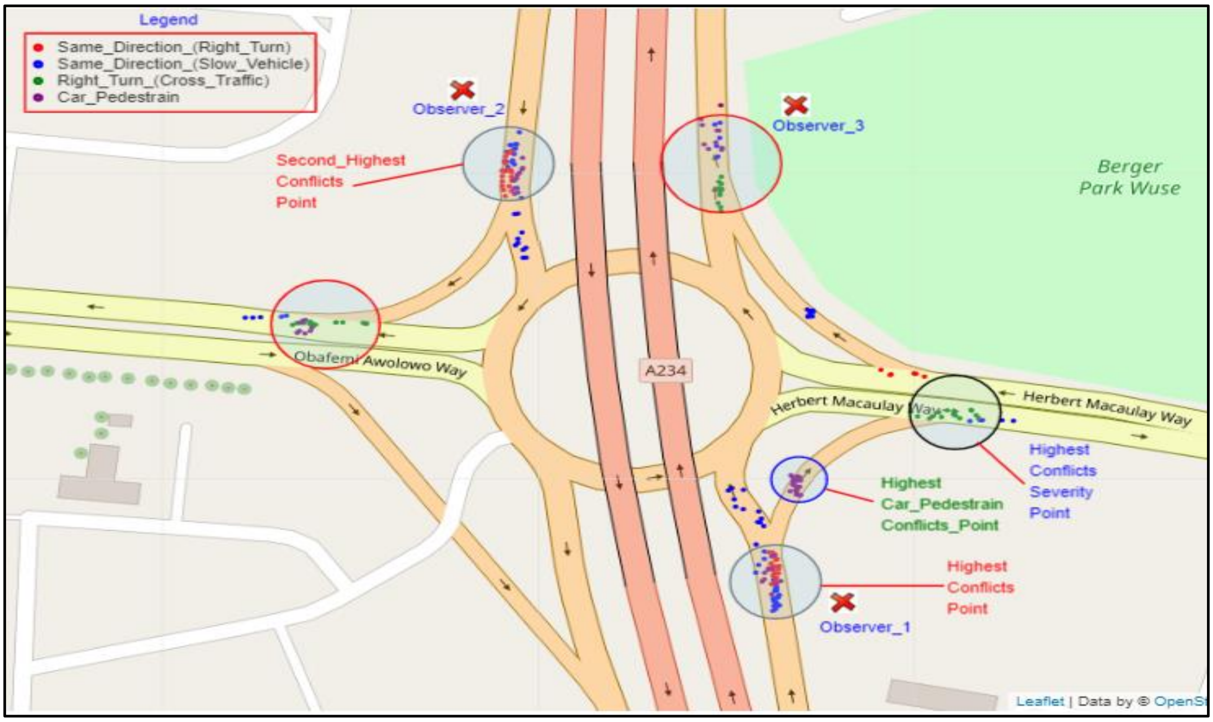

Figure 4.64: Conflicts Impact points at Julius Berger roundabout.

The observed car – pedestrian conflicts were mainly due to the commercial motor park "Berger Park" located a few meters from Julius Berger roundabout. In order to access the motor park, pedestrians prefer crossing at undesignated crossing areas, resulting in conflicts between cars and pedestrians. The car – pedestrian conflicts were also caused by vehicles failing to give right of way to pedestrian traffic, even in cases where there are clear zebra crossing markings on the road. This is a common sight on Nigerian roads, as vehicles fail to give right of way to pedestrians, even when designated crossing areas are provided for pedestrians.

At Bannex junction (see Figure 4.65), the highest number of traffic conflicts were observed at the south – western end of Nnamdi Azikiwe expressway. The observed conflicts at the south – western end of Nnamdi Azikiwe expressway were mainly caused by commercial drivers slowing down to drop off and/or pick up passengers very close to the junction or at the middle of the road, and private vehicles making right turns to connect Ahmadu Bello way. Conflicts were also caused by drivers not using their indicators, coupled with the fact that most drivers tailgate thereby giving very little space for a second driver (trailing driver) to have a normal reaction in order to abruptly break, swerve and change lane from the leading vehicle.

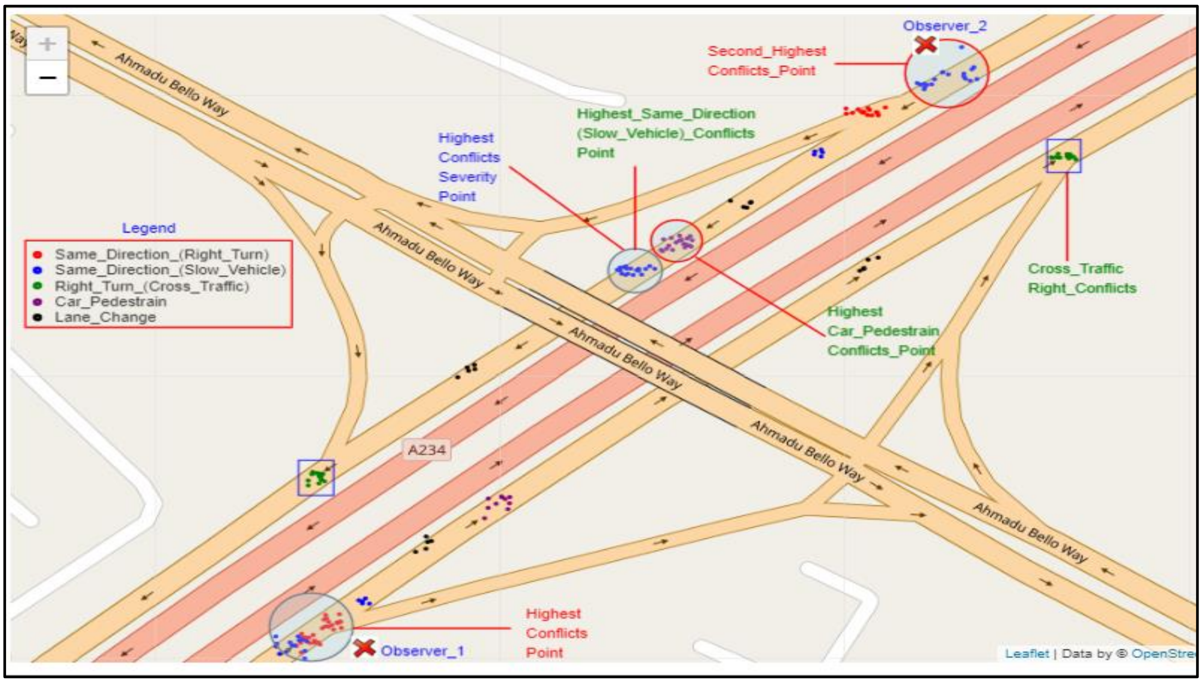

Figure 4.65: Conflicts Impact points at Bannex Junction.

The highest severity of conflicts were observed at the north – eastern end of Nnamdi Azikiwe expressway, which is shown in Figure 4.65. The conflict severity observed were due to vehicles slowing down on the expressway to drop off passengers, thus putting oncoming vehicles at a serious risk of a rear – end collision. Car – pedestrian conflicts were also observed at the north - eastern end of Nnamdi Azikiwe expressway which was mainly due to passengers dropping along the expressway and crossing at undesignated crossing areas, so as to access the popular Bannex plaza, which in turn increases the chances of a collision between an oncoming vehicle and pedestrians crossing the roads.

At NICON junction (see Figure 4.66) the highest number of conflicts were observed at the southern end of Nnamdi Azikiwe expressway. Most of the conflicts were due to vehicles slowing down (same direction, slow vehicle conflict), thereby resulting in a rear end collision. Most of the observed conflicts were caused by commercial vehicles heading to NICON Park.

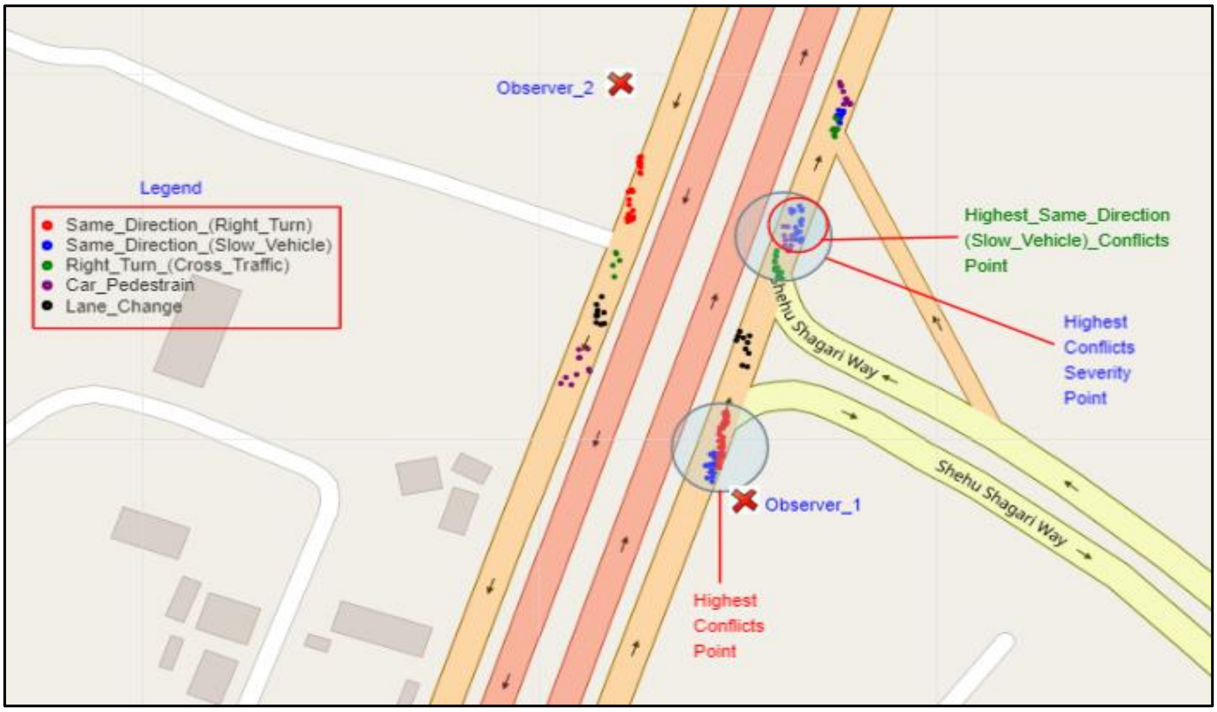

Figure 4.66: Conflicts Impact points at NICON Junction.

This study observed that most commercial vehicle owners rarely had properly functioning indicator lights. This study also observed that most commercial vehicles stop abruptly without any form of indication or signals which puts the vehicle behind at a serious risk of collision if an evasive action is not quickly taken. The highest conflicts severity at NICON junction occurred at the connection between Shehu Shagri way and Nnamdi Azikiwe expressway, as shown in Figure 4.66. Most drivers approaching Shehu Shagari way fail to yield to traffic on Nnamdi Azikiwe expressway, and join the expressway with speed, thereby increasing the risk and severity of traffic conflicts.

At ChurchGate junction (see Figure 4.67), most of the conflicts experienced were predominately through traffic conflicts. It is important to note that there were functioning traffic lights at ChurchGate junction, with a few cases of drivers running through red lights. However, this occurrence (running a red light), was reduced drastically due to the presence of traffic wardens and traffic police officers.

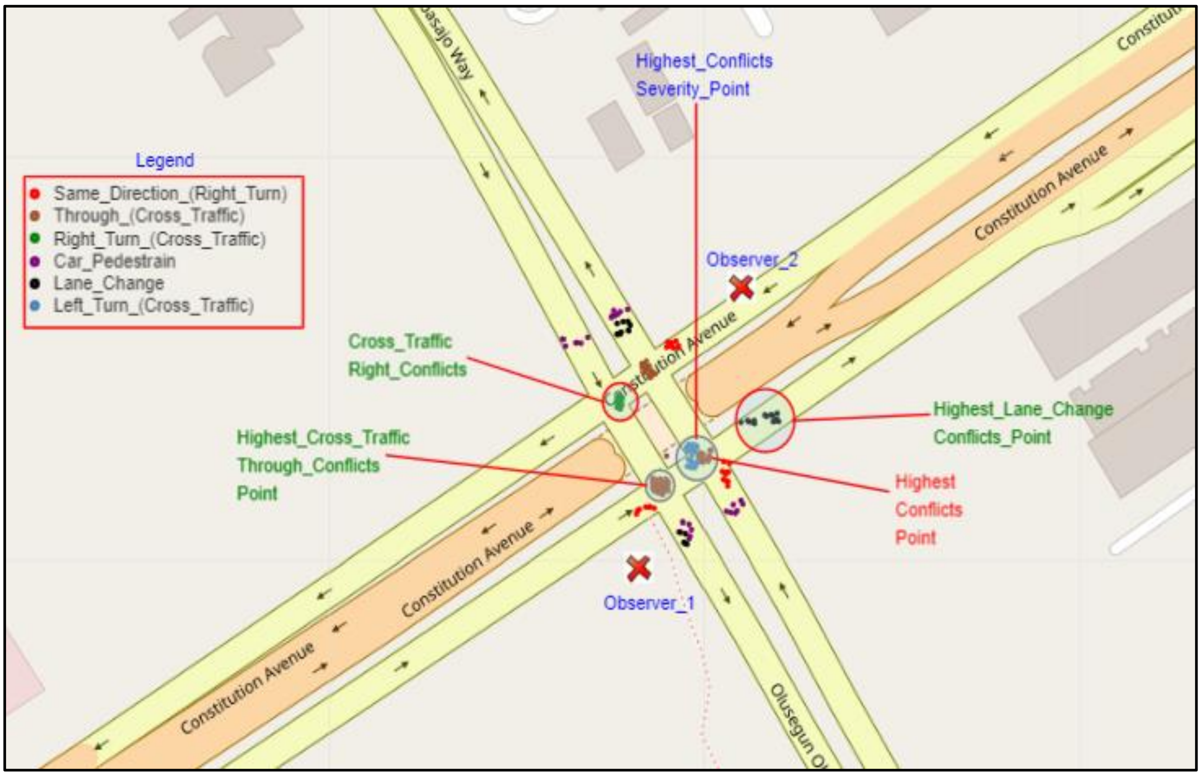

Figure 4.67: Conflicts Impact points at ChurchGate Junction.

Through conflicts between cars (car – car) were the conflicts experienced the most at ChurchGate junction. It was observed that in the absence of traffic wardens, and when the traffic lights stop functioning probably due to power cuts, vehicles coming from the southern end of constitution avenue fail to give way to traffic on the left coming from the western end of Olusegun Obasanjo way and heading to the northern end of constitution avenue, thus contributing to the conflicts as shown in Figure 4.67. These through conflicts are predominant at most intersections in Abuja, and by extension in Nigeria.

For Bolingo junction (see Figure 4.68), the highest number of conflicts were observed at the intersection of independence avenue and Olusegun Obasanjo way. Just as in ChurchGate junction, functioning traffic lights were spotted at this junction, however, as with most traffic lights within the city, there is a lack of total compliance to the traffic light rules by drivers, especially when there are no traffic wardens or police officers present at the junction.

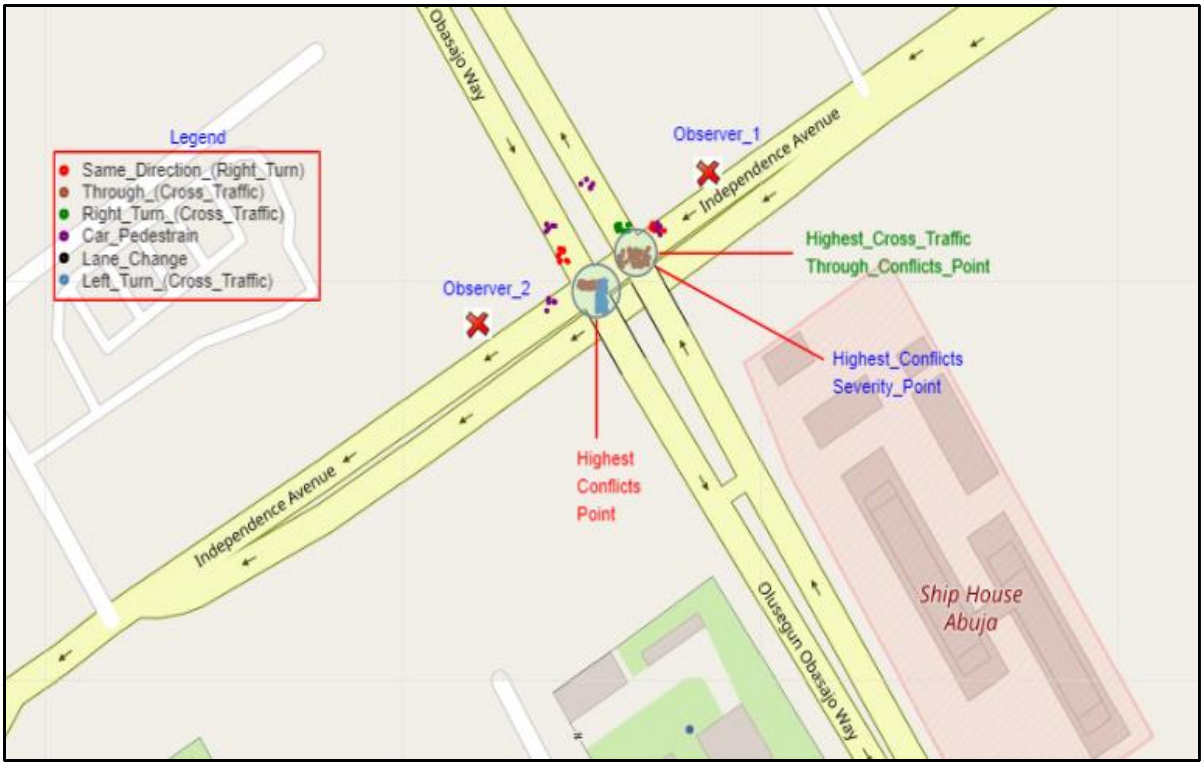

Figure 4.68: Conflicts Impact points at Bolingo Junction.

Most of the conflicts observed at Bolingo junction were due to vehicles coming from the north of Independence Avenue heading to the south of Independence Avenue and failing to yield to traffic from the east of Olusegun Obasanjo way. The highest severity of conflicts were observed at close proximity to where the highest number of conflicts were observed, as shown in Figure 4.68. These conflicts were as a result of speeding vehicles from the east of Olusegun Obasanjo way approaching the intersection and failing to yield to traffic coming from the north of Independence Avenue.

At CBN junction, the highest number of conflicts and highest severity of conflicts were located at the same spot on Tafa Balewa way, as shown in Figure 4.69. A significant number of the conflicts observed at this spot were caused mainly by vehicles making U – turns and vehicles coming from the western end of Tafa Balewa way failing to yield to traffic on the left.

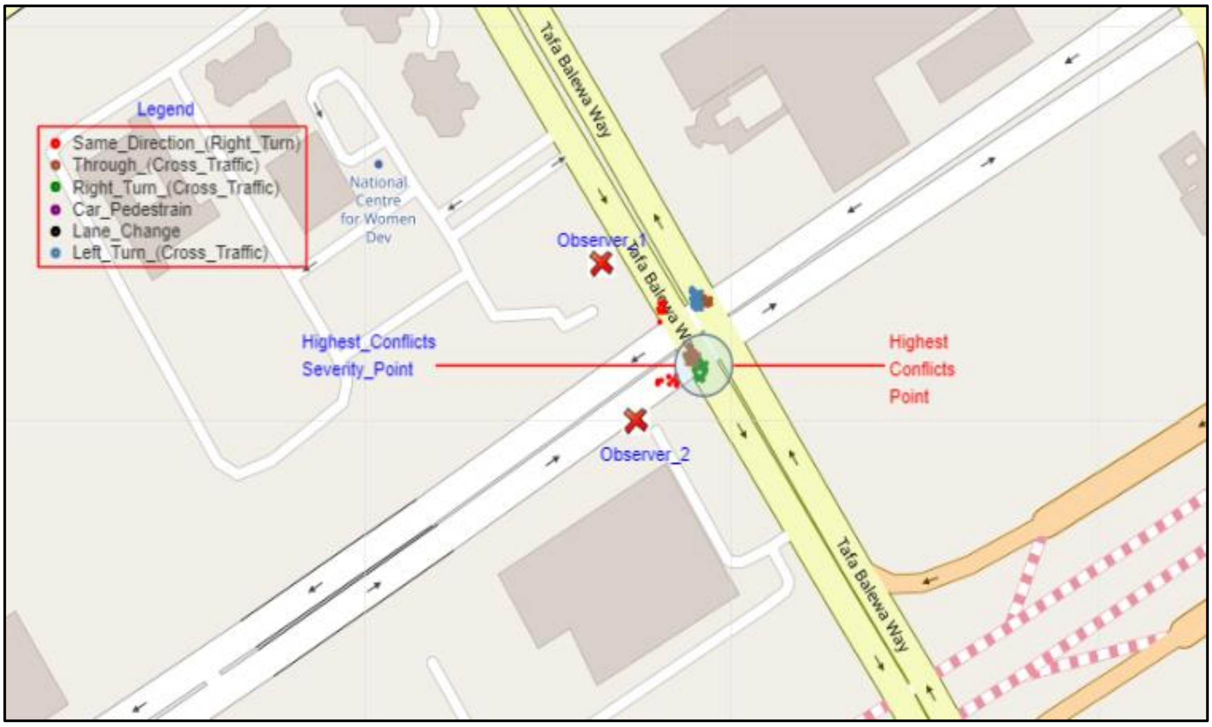

Figure 4.69: Conflicts Impact points at CBN Junction.

The research findings have been extensively presented and analysed in this chapter. These findings are further discussed in chapter 5.

CHAPTER FIVE
DISCUSSION

CHAPTER FIVE

DISCUSSION

5.1 Introduction

The research made several findings based on the research problem, and these key findings are briefly discussed in the following subsections:

5.2 Projection of crash fatalities in Nigeria

Nigeria's crash fatalities trend from 1990 – 2016 is shown in Figure 4.1. Asogwa, (1992), Iyanda, (2019), and Oluwasanmi, (1993), all reported in their studies that the crash fatalities trend in Nigeria showed a steady increase from 1960 – 1989. Shyngle, (1978), and Osime et al., (2007), attributed this increasing trend prior to 1990 to a number of factors. First, the oil boom experienced in Nigeria in the 1970s translating to increased income, thus making it easier for working class Nigerians to afford new cars. This led to an increase in the number of cars on Nigerian roads, thereby increasing the risk of Road Traffic Crashes. Inexperienced and unlicensed driving also led to an increase in crash fatalities as most of the new car owners were relatively new to driving, with little or no knowledge of driving and traffic safety rules.

The general slight decrease in Road Traffic Crashes and fatalities observed in the 1990 – 2016 crash data set is attributed to the establishment of the Federal Road Safety Corps (FRSC) in 1988, who were adequately funded and tasked with the primary responsibility of increasing road traffic safety in Nigeria (Olagunju, 2018, and Iyanda, 2019). Another factor is an improved awareness of traffic safety rules by road users in Nigeria. The recent slight reductions in crash fatalities from 2013 till 2016 is evidence that Nigeria is making some efforts (albeit insufficient) towards reducing Road Traffic Crashes and associated crash fatalities.

The FRSC crash fatalities data (1990 – 2016) shows a 1.5% average annual reduction and a 16.5% total reduction from 2011 to 2016. If the average annual reduction of crash fatalities from 2011 – 2016 is used to project the total crash fatalities reduction then Nigeria's crash fatalities would have reduced by 29.7% from 2011 levels by 2020 which is far from the 50% reduction expected by the United Nations Decade of Action for Road Safety 2011 – 2020 and the Sustainable Development Goal 3, target 6.

The crash fatalities trend for Abuja is shown in Figure 4.3 and displays an inconsistent pattern of spikes and dips for the period under consideration. The overall trend clearly shows a rise in crash fatalities from 1990 – 2013, followed by a slight decrease from 2013 – 2016. Figure 4.2 on the other hand shows the crash fatalities trend for the 36 states in Nigeria. It can be observed from the graphs in Figure 4.2 that 10 states show increasing trends, while the other 25 states show either constant or decreasing crash fatalities.

Despite the decrease in crash fatalities in recent years, the data obtained from FRSC has shown that the road safety efforts in Nigeria, have not been significant enough to achieve the Decade of Action for Road Safety 2011 – 2020 goal and the Sustainable Development Goal 3, target 6 which is a 50% reduction in crashes and fatalities by the end of 2020.

5.2.1 Geographical mapping of crash fatalities in Nigeria

The crash fatalities in Nigeria for 2016 is presented in Figure 4.4, and shows that Kaduna state recorded the highest crash fatalities in which 505 persons died, while Bayelsa recorded the least crash fatalities with 11 deaths. Abuja was ranked fourth with 253 crash fatalities. From Figure 4.4, it can be observed that out of the top 10 states with the highest crash fatalities, seven are located in the Northern part of Nigeria, giving the impression that more fatal crashes occur in Northern Nigeria, which is consistent with the various studies done by Adebayo, (2015), Gbadamosi, (2015), Iyanda, (2019) and Aderamo, (2012a).

The geographical distribution of the crash fatalities in Nigeria is shown in Figure 4.5, and it can be observed that there is a pattern in which fatal crashes occur in Nigeria. Nigeria is divided into six geo – political zones namely; the North – East, North – Central, North – West, South – East, South – West and South – South. It can be observed from Figure 4.5, that crash fatalities are predominant in three geo – political zones namely the North – Central, North – West and the South – West. The South – West comprising of states like Ekiti, Lagos, Ogun, Ondo, Osun and Oyo recorded the highest average crash fatalities while the North – Central comprising of states like Benue, Kogi, Kwara, Nassarawa, Niger, Plateau and the Federal Capital Territory (Abuja) recorded the second highest average crash fatalities. Adogu et al., (2009), and Iyanda, (2019), in their studies, attributed the high crash fatalities and severity in the North to the high illiteracy levels in the North. The North – East region comprising of states like Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe have the highest levels of illiteracy in Nigeria, as Borno and Taraba rank among the top 3 states in Nigeria with the highest illiteracy levels. However, contrary to the studies by Adogu et al., (2009) and Iyanda, (2019), Figure 4.5 shows that the North – East does not fall among the top three regions with the highest crash fatalities, which is likely due to the activities of the Boko Haram terrorists ravaging the North – Eastern states of Borno and Adamawa, which has drastically negatively affected the patronage of road transportation.

From Figure 4.5, it can be observed that the regions with the highest crash fatalities have either housed the capital of Nigeria, or are currently housing the capital of Nigeria. Lagos which is located in the South – West was the former capital of Nigeria, and is still regarded as the commercial capital, while Abuja located in the North – Central is the current capital of Nigeria and seat of power. These cities are known to experience relatively better economic stability, compared to other Nigerian states, which makes it attractive and appealing to Nigerians. The pattern observed in Figure 4.5, shows that all boundary states with Abuja and Lagos had high crash fatalities, which is attributed to Nigerians travelling from neighbouring states to these two states for business and work on a daily basis, thereby increasing the occurrence of crashes and crash fatalities in these zones. This is consistent with the 2016 FRSC Annual Report, which reported that majority of the crash fatalities recorded in these two regions were recorded on highways linking these states (FRSC, 2016). These crashes and crash fatalities might be due to commuting to work very early in the morning (when visibility is very low), in order to arrive at work before official hours and also driving long distances back home, already fatigued from a long day at work.

According to the 2016 FRSC Annual Report, (FRSC, 2016), Abuja – Lokoja road which is a 175km road linking Kogi state to Abuja, recorded more crash fatalities than any other road in the country. In 2016, about 273 crash fatalities were recorded on Abuja – Lokoja road which accounts for 57.3% of the total crash fatalities recorded in both Abuja and Kogi state. Abuja – Kaduna road recorded 108 crash fatalities which accounts for 14.2% of the total crash fatalities recorded in both Abuja and Kaduna state. Lagos – Ibadan expressway, a highway linking Oyo, Ogun and Lagos states recorded 229 crash fatalities which accounts for 30.3% of the total crash fatalities in these three states. The high percentage of crash fatalities occurring on highways linking states to either Abuja or Lagos clearly shows that more crash fatalities occur on these highways than on roads within the states.

In order to confirm if the high crash fatalities that occurred in 2016 were one – offs or have repeatedly occurred over the years, the average crash fatalities from 2006 to 2016 were computed and the crash fatalities, mapped in order to understand the distribution of the crash fatalities in Nigeria from 2006 to 2016. Figure 4.6 shows the average crash fatalities while Figure 4.7 shows the geographical distribution of the crash fatalities for 2006 – 2016. From Figure 4.6, Kaduna had the highest crash fatalities of 471 while Bayelsa had the least with 38 fatalities. Abuja had the third highest crash fatalities of 340. These results show that when compared to other states, the crash fatalities observed in Abuja and Kaduna in 2016 have been consistently high for a number of years and no significant change has been made in decreasing these fatalities.

The geographical distribution of crash fatalities from 2006 – 2016 shows a similar pattern as to what was observed in 2016. The three geo – political zones with the highest number of crash fatalities were the North – Central, South – West and North – West with average crash fatalities of 213, 212, and 189 respectively. This indicates that these regions have continuously been associated with a high number of fatal crashes for years and regions like the South – South and South – East have been associated with relatively low number of crash fatalities.

5.2.2 Geographical mapping of crash fatalities per 100,000 population in Nigeria.

The severity of crashes cannot be ascertained by merely looking at the crash fatalities data, as it does not give an idea of how serious these crashes are, with respect to a country or state. Several measures have been used by various researchers to evaluate the severity of Road Traffic Crashes. Iyanda, (2019), used the severity index to evaluate how severe RTC are, for different states in Nigeria. The severity index evaluates the ratio of crash fatalities to the number of crashes. Adebayo (2015), and Aderamo, (2012a) used crash fatalities per 100,000 population to investigate the severity of RTC in different Nigerian states. This research however employed the use of crash fatalities per 100,000 population, which is the number of deaths in every 100,000 people due to Road Traffic Crashes. The crash fatalities per 100,000 population for Abuja in 2016 is presented in Figure 4.8. From Figure 4.8, it can be seen that Abuja (13.13) recorded the highest crash fatalities per 100,000 population in 2016. This means that in 2016, 13 in every 100,000 residents of Abuja died as a result of Road Traffic Crashes. Nassarawa and Kaduna recorded crash fatalities per 100,000 population of 7.5 and 6.03

respectively while Bayelsa recorded the least crash fatalities per 100,000 population of 0.47. The high crash fatalities per 100,000 population shows how fatal RTC are in Abuja relative to other states. If the crash fatalities were to be considered alone, Kaduna would have been considered more unsafe and would have led to the conclusion that the impact of RTC is more severe in Kaduna than in Abuja. However, the fatalities per 100,000 population shows that the impact of Road Traffic Crashes is higher in Abuja than in Kaduna, as people are twice as likely to die as a result of Road Traffic Crashes in Abuja than in Kaduna state.

Figure 4.9 shows the geographical distribution of crash fatalities per 100,000 population. It is evident that the North – Central Zone is far more unsafe than any other geopolitical zone, while the South – West is the next most dangerous zone. The crash fatalities per 100,000 population revealed that people who reside in the North – Central are about 1.6 times or more likely to die as a result of Road Traffic Crashes compared to other zones. This is consistent with the findings of Adebayo, (2015), who noticed similar patterns in the crash fatalities per 100,000 population. To check the consistency of the aforementioned pattern, the average crash fatalities per 100,000 population was computed for 2006 – 2016 and the results are presented in Figure 4.10, while the mapping of the crash fatalities per 100,000 population is presented in Figure 4.11. From Figure 4.10, the average crash fatality was as high as 20.54 in Abuja indicating that an average of 21 persons out of every 100,000 people died annually as a result of Road Traffic Crashes from 2006 – 2016. This shows that Abuja has consistently had a quite poor road safety record, compared to other states.

Figure 4.11, also clearly shows that the North – Central Zone is much more unsafe than any other zone in terms of crash fatalities per 100,000 population. Residents of the North Central Zone are almost twice or more likely to die as a result of RTC compared to other zones, as shown in Figure 4.11.

5.2.3 Geographical mapping of crash fatalities per 10,000 vehicles in Nigeria

Data for the fatalities per 10,000 registered vehicles in Nigeria for 2016, shows that Kogi State had the highest fatalities per 10,000 registered vehicles while Lagos State had the least fatalities per 10,000 registered vehicle as shown in Figure 4.15. The fatalities per 10,000 registered vehicles is the number of road deaths associated with every 10,000 registered vehicles. From Figure 4.13, it can be observed that Lagos State which had the highest number of registered vehicles had the lowest number of fatalities per 10,000 vehicles while Kogi which had the fourth least number of registered vehicles had the highest fatalities per 10,000 registered vehicles. Figure 4.16 shows the geographical distribution of fatalities per 10,000 registered vehicles for Nigeria in 2016. It can be observed that the North – West and North – East regions of the country had the highest number of fatalities per 10,000 registered vehicles, which shows that a possible increase in vehicle ownership in Northern Nigeria could lead to an increase in crash fatalities.

Summarily, it has been shown that as alarming as the crash fatalities statistics which have been presented in the previous chapter, and discussed in this chapter might seem, the underreporting associated with the FRSC safety data is evident, which makes the safety situation in Nigeria worse than the Federal Road Safety Corps (FRSC) data describes, and a far cry from reality. This is also evident from the findings of Bhalla et al., (2013), where it was reported that the official fatalities rate in Nigeria is 14 times underreported. Bhalla et al., (2013), also reports that with 52.4 deaths per 100,000 population, Nigeria has the highest road fatalities rate for any country in the world, which calls for urgent changes mainly with respect to the strict enforcement of traffic laws, as well as changes in road user behaviours in Nigeria, post the UN decade of action for road safety 2011 – 2020.

5.3 Road user behaviours

5.3.1 Involvement in road traffic crashes

This study showed that a majority of the road users in Abuja were seriously bothered about the high occurrence of road traffic crashes in Abuja. This study also showed that male road users are more concerned about traffic crashes than their female counterparts. Road users between the ages of 41 – 50 were the most bothered about Road Traffic Crashes than any other age groups. Road users whose highest level of education was primary school level, showed little concerns about traffic crashes, which may be due to not fully understanding the dangers and consequences of Road Traffic Crashes on human life and the economy. This study also showed that road safety education should be geared more towards female road users, younger drivers and road users with little or no education.

On the involvement in a Road Traffic Crash in the last 6 months, this study showed that about one third of the respondents admitted to experiencing a Road Traffic Crash. This study also showed that young road users between the ages of 18 – 29 were involved in more Road Traffic Crashes than any other age groups. This study showed that there was a negative correlation between the road user involvement in Road Traffic Crashes and the age of the road users. Older age groups were the least involved in Road Traffic Crashes while younger age groups were the most involved in Road Traffic Crashes. Several studies have linked most Road Traffic Crashes to younger drivers. Maycock et al., (1991), in their study reported that 17 year old drivers have twice as many crashes as 25 year old drivers, and have up to 85% more crashes than 50 years old drivers. There was also a negative correlation between involvements in Road Traffic Crashes and the number of years drivers had been driving. Maycock et al., (1991), also stated that both age and inexperience are the two human behavioural factors that play a major role in Road Traffic Crashes in younger drivers. Petridou and Moustaki, (2000), in their study, suggested that most dangerous human behavioural factors such as inexperience, alcohol and drug use, overestimation of one's driving capabilities, and habitual speeding that results in Road Traffic Crashes are observed in younger drivers. The study also showed that just a few older Abuja road users were involved in Road Traffic Crashes in the last 6 months. Road Traffic Crashes in older drivers can be due to poor vision and lack of understanding of the geometry of the road particularly at night. Crashes among older drivers are caused by visual acuity and reduced visual attention (Owsley et al., 1991). The issue of Road Traffic Crashes among young drivers can be checked by ensuring that young drivers undergo rigorous driving lessons and driving tests should be conducted before driving licences are issued to younger drivers.

The responses to the question on injuries from Road Traffic Crashes in the last 6 months showed that more male drivers sustained injuries than female drivers. There were twice as many injured male drivers as female drivers, which may be due to unsafe driving habits associated with male drivers. Risky driving is particularly noticed among male young drivers, as they overestimate their driving skill due to "macho" attitudes and engage in reckless driving habits including over speeding. This study also showed that younger drivers especially drivers between the ages of 30 – 40 sustained more injuries from Road Traffic Crashes in the last 6 months than any other age groups.

5.3.2 Behavioural factors

Over 90% of Road Traffic Crashes are caused by human behavioural factors such as inexperience, excessive speeding, driving under the influence of alcohol/ recreational drugs, dangerous driving, and stress (Petridou and Moustaki, 2000; Hingson et al., 1996; Elander et al., 1993). Hingson et al., (1996), stated that changes in driver behaviours, offers the largest opportunity towards the reduction of Road Traffic Crashes. The various human behavioural factors observed in the survey conducted among road users in Abuja are discussed in this section. The behavioural factors include:

Seatbelt use

The responses from the survey on the regular use of seatbelts among road users in Abuja revealed that majority of the road users do not use seatbelts when driving or when been driven in a car. Nearly two – third (64.2%) of the respondents admitted to not regularly using seatbelts which is consistent with the observation from other studies. The compliance rate for seatbelt use observed in previous studies in most Nigerian states was low. Observational studies in Ibadan, Benin City, Enugu and Makurdi revealed an average compliance rate of 18.7%, 52.3%, 38% and 27.3% respectively (Sangowawa et al., 2010; Iribhogbe and Osime, 2008; Agu et al., 2017 and Popoola et al., 2013). The low compliance rate to the use seatbelts is not just peculiar to Nigeria, as most developing countries experience non – use of seatbelts. Afukaar et al., (2010) reported that the compliance rate of seatbelt use in developing countries is less than 55%, which is a contrast from what is obtainable in developed countries. According to Glassbrenner, (2002), the compliance rate to the use of seatbelts in the United States of America reached 75% in 2002 and continues to show a steady pattern of increase. Norway which is regarded as one of the safest countries in the world in terms of road traffic fatalities, has a seatbelt compliance rate of about 96 – 97% (IRTAD, 2019).

The low seatbelt compliance rate in Abuja should be a cause of concern as several studies have identified the use of seatbelts as an important behavioural factor that could help reduce fatalities from road traffic crashes. Hingson et al., (1996), reported that the mandatory use of seatbelts by front seat occupants reduced fatalities in the United Kingdom by 20% and the European Transport Safety Council (ETSC) estimates that within the European Union, seatbelts currently reduce driver fatalities by 40%. WHO, (2018) also reported that wearing a seatbelt reduces the risk of death of vehicle occupants by 40 – 45%. Mandatory use of seatbelts in Abuja could also see the high fatality rates reduce by a significant percentage.

When the compliance level of seatbelts use was compared with the demography of the respondents, it was observed that majority of the elderly road users regularly use their seatbelts compared to the younger road users. This observation is also similar in other studies which observed higher compliance rates among elderly occupants (Burns et al., 2003; Sangowawa et al., 2010; Afukaar et al., 2010; and Ouimet, et al., 2008). The reasons for the low compliance of seatbelt usage among younger vehicle occupants may be due to youthful exuberance and downplaying the risk of injuries or even death from Road Traffic Crashes.

This study shows that vehicle occupants with highest level of education as secondary school (high school) had a lower seatbelt compliance, compared to occupants with higher academic qualifications. This is consistent with the findings of Begg and Langley, (2000), and Sangowawa et al., (2010), who in their studies also reported low seatbelt compliance among vehicle occupants with low education levels. The low seatbelt use among vehicle occupants with low academic qualifications in Abuja, is due to the lack of understanding of the dangers and implications of not obeying traffic safety rules.

In terms of driving experience, this study showed that vehicle occupants who have been driving for more than 20 years regularly, use their seatbelts more than those who have fewer years of driving experience. This can be attributed to developing the habit of using seatbelts over the years and the constant educational campaigns they come across on the implications of not using seatbelts. Several studies have tried to attribute the non – use of seatbelts to various reasons. Begg and Langley, (2000) attributed the non – use of seatbelts among youths in New Zealand to forgetfulness, discomfort associated with seatbelts usage and downplaying the risk of injury. Agu et al., (2017), attributes low compliance in seatbelt usage in Enugu, Nigeria to the lack of enforcement of the seatbelt laws by the Federal Road Safety Corps (FRSC).

For high compliance of seatbelt usage in any country, there must be a proper legislation, enforcement and publicity about the dangers associated with the non – use of seatbelts. Enforcement of seatbelt laws has been a problem in most developing countries. The low compliance of the use of seatbelts in Abuja is especially due to the attitude and behaviour of road users and the poor enforcement of the functions conferred to the FRSC, by (510 (4) of the FRSC Act, 2007 establishment).

Drink driving

From this study (see chapter 4, section 4.3.6.2), the association between drink driving and marital status showed that overall, married respondents were more involved in drink driving than single respondents, and the association was statistically significant. Contrary to the findings by Oginni et al., (2018), the association between drink driving and age showed that older people also tend to drink and drive, like the younger drivers in Abuja. With respect to the association between drink driving and driving experience, this study showed that more experienced drivers in Abuja engaged in drink driving than the less experienced drivers. This was also contrary to the findings of Oginni et al., (2018), which reported that "alcohol use decreased significantly with increasing years of experience". The association between drink driving and age, and drink driving and driving experience, were however not statistically significant.

Several studies have shown that alcohol consumption decreases reaction time, eye – hand coordination and also impairs driver performance (Ogden and Moskowitz, 2004; West et al., 1993; Deery and Love, 1996). Although there is a maximum Blood Alcohol Concentration of 0.05g/100ml in Nigeria, there has been very little evidence of enforcement of this limit or real time testing of drivers and motorcyclists due to the lack of breathalysers. Ogazi and Edison, (2012), reported that the lack of testing by the FRSC is partly due to budget constraints, which in turn frustrates the enforcement of the BAC limits for recalcitrant drivers.

Adekoya et al., (2011), reported that a good fraction of long distance commercial drivers in Ilorin, Nigeria, admitted to drinking alcohol before embarking on long journeys. This is consistent with the study by Oginni et al., (2018), where drivers also admitted employing various measures to overcome fatigue and enhance their performance. However, in 2017, the FRSC annual report (FRSC, 2017), indicates that only 54 in 10,972 road traffic crashes (0.49%) were caused by "driving under alcohol/drugs". Horwood and Fergusson, (2000), correlated drink driving to other general bad driving behaviours like reckless driving, and over speeding. Zhao et al., (2014), corroborated this in their study, suggesting that excess alcohol consumption by drivers, enhances their bad driving habits, and is responsible for a high proportion of RTC. The 2017 FRSC annual report (FRSC, 2017) reports that over 60% of the road traffic crashes in Nigeria were caused by speed violation (44.1%), loss of control (11.7%) and dangerous driving (8.2%). This report suggests that some of the causes of RTC attributed to over – speeding and dangerous driving by the FRSC might have been as a result of drink driving.

As highlighted above, the lack of breathalysers for alcohol testing in Abuja and particularly in Nigeria is a major issue that needs to be addressed. Presently, very little data exists on the effects of drink driving on road traffic fatalities in Nigeria and more work should be done by the FRSC on limiting drink drinking.

The problem of drink driving in Abuja and Nigeria in general can be effectively mitigated preferably by instituting measures to reduce the incidence of drink – driving rather than measures to find and punish drink – drivers. More media campaigns are therefore advised to educate road user about the hazards and dangers associated with drink driving, as well as a strict enforcement of the existing traffic laws in Nigeria. The traffic laws are advised to be reviewed to capture current traffic realities.

Child restraint

This study showed that 27.8% of the driving respondents admitted driving with a child in their car regularly. It was observed that the female respondents drove more with children in their cars than the male respondents. According to the WHO, (2018) it is required that all children below the age of ten years or not more than 135cm in height should be restrained when in a car. This study also showed that of all the respondents who admitted driving with a child in their car, only 55.8% owned child car seats. Sangowawa et al., (2006) in their study reported that child restraints among motorist in Ibadan, Nigeria was just 4.1%, compared to 48% for the drivers. This shows low child restraint efforts in Nigeria, thereby putting children at risk of traffic injuries or even death in the event of a traffic crash.

With respect to the relationship between gender and if a car owner uses a child restraint, this study showed that females were more bothered about owning a child car seat, as 80.6% admitted to having a child car seat in their cars. This might be due to the child caring responsibilities of the females which requires them to spend more time with their children.

Use of mobile phones while driving

Mobile phone use while driving could adversely affect road safety (Woo and Lin, 2001). This study showed that about 70% of the driving respondents admitted using their mobile phones while driving. Similar findings were observed in other studies. For example, Bener et al., (2009) in their study reported that 73.2% of Qatari drivers involved in a crash made use of their mobile phones while driving, similarly, Olubiyi et al., (2017), reported that 86.6% of the motorists in Zaria, Nigeria admitted to the use of their mobile phones while driving. The use of mobile phones and other electronic gadgets while driving has a negative effect on drivers, causing drivers to commit more driving errors. According to Redelmier and Tribshirani, (1997), the risk of collision due to the use of mobile phones while driving increases fourfold compared to driving without a mobile phone. This is attributed to distraction or the division of attention from the “primary task” of driving to “secondary tasks” not related to driving. Violanti and Marshall, (1996), in their study attributed the error committed by drivers using a mobile phone to the extra workload done by the memory in managing both tasks simultaneously.

The association between the use of mobile phones while driving and gender showed that more female respondents engaged in the use of mobile phones while driving than their male counterparts, however, this association was not statistical significant. The findings from this study was contrary to findings from some other studies. Most studies reported that the use of mobile phones was observed more in male drivers than in female drivers (Akande and Ajao, 2006; Olubiyi et al., 2017). These studies also reported that young drivers tend to use their mobile phones while driving than older drivers.

In order to reduce the use of mobile phone use in Abuja, more education and enlightenment campaigns about the hazards associated with the use of mobile phones while driving should be carried out. Another possible step towards reducing the use of mobile phones while driving is the enforcement of stiffer penalties including community service on traffic offenders.

5.4 Observed traffic conflicts

Prior to this work and within the literature identified, the author was unable to find any previous studies using the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) in the observation of traffic conflicts in Nigeria. For this study, the DOCTOR TCT was applied in observing traffic conflicts at 6 different study sites. The conflict observation was done alongside traffic volume counts. The identified traffic conflicts and the road users involved have been presented in the previous chapter (see chapter 4, section 4.4.3).

The pedestrian and vehicular traffic volume counts revealed that Julius Berger roundabout had the highest traffic volume count with 42,108 road users for an observation time of 4.5 hours daily for a duration of 1 week. Bannex and NICON junctions had a traffic volume count of

39,414 and 37,020 road users respectively. The least traffic volume count of 31,181 was recorded at Churchgate Junction. For the traffic count, passenger cars were the most observed, accounting for 30 – 39% of the total traffic volume count at the six different study locations.

A total of 2,992 conflicts were observed at all the conflicts study locations, with Julius Berger roundabout accounting for 21.1% of the total conflicts. Uzondu et al., (2019), in their study of traffic conflicts in Imo State, Nigeria, observed a total 946 traffic conflicts for three locations for an observation time of 3 hours per day, for a total duration of 1 week.

The high levels of traffic conflicts observed in various cities in Nigeria is as a result of inappropriate road designs, low safety measures, poor safety education, poor traffic management, risky driving behaviour, ineffective regulation and enforcement of traffic laws put in place to check unsafe driver behaviours (Uzondu et al., 2018; Idris et al., 2018).

The number of conflicts recorded at Bannex and NICON Junctions were 536 and 505 respectively. The least observed conflicts were at Churchgate Junction with 407 conflicts. The same direction conflict was one of the most observed traffic conflicts. The same direction conflict is as a result of commercial taxi drivers stopping at non – designated bus – stops to drop off or to pick up passengers, thereby causing a rear – end collision, if an evasive action is not taken by the driver coming from behind.

According to Laureshyn et al., (2010), "*a severity hierarchy provides a description of the safety situation and trade – off between safety and efficiency in the traffic system*". In this study, the relevant severity consequence adopted in evaluating the relative traffic safety at each location was the Time – to – Collision (TTC) and the speed of the road user.

A total of 1,363 severe conflicts (DOCTOR severity score 3, 4 and 5) were identified after computing the TTC, which accounted for 45.6% of the total conflicts observed at all locations. Julius Berger roundabout had the highest number of serious traffic conflicts with 287 identified for the observation duration, accounting for 45.6% of the total conflicts observed at Julius Berger roundabout. This calls for improvements in traffic safety levels at the roundabout. A total of 244 serious conflicts were identified at Bannex Junction, while 219 serious conflicts were observed at NICON Junction. Churchgate recorded the lowest number of serious conflicts with just 183 serious conflicts identified.

The serious conflicts identified in this study were similar to those identified by van der Horst et al., (2017) in their Bangladesh study. van der Horst et al., (2017) in their study identified serious conflicts for an 18 hours period (6 hours per day) of video recordings. The number of hours for analysis was reduced by a factor of four and limited to 4.5 hours per location and period. 64 serious traffic conflicts per location were then observed for the 4.5 hours analysis.

Since this PhD thesis did not involve a before and after period, the traffic conflict effects, infrastructural measures, estimates of speed reduction, implementation of crash and fatality reduction measures and other intervention measures were unable to be estimated to make a comparison. However, suggestions for possible future road safety improvement measures given have been proposed in chapter 6.

5.5 Implications of research findings

The adopted research methodology in Chapter 3 consists of three major components. The first component is a trend analysis of Nigeria's available crash data (1990 – 2016) provided (on request) by the Federal Road Safety Corps (FRSC). The second component utilises questionnaires and interviews to understand road user attitudes and behaviours contributing to the high crash and fatality rates in Abuja, compared to other states in Nigeria. The third and final component is the observation and identification of traffic conflicts using the Dutch Objective Conflict Technique for Operation and Research (DOCTOR). The findings from the three methodological components have been presented in chapter 4 and discussed extensively in this chapter. The findings from the three components independently complement each other and together help in arriving at the conclusions presented in chapter 6.

The first component evaluates the road safety situation in Nigeria, and the country's performance with respect to the goals of the United Nations Decade of Action for Road Safety, and the Sustainable Development Goals (SDG) Goal 3, target 6, which is a 50% reduction in crash fatalities by the end of 2020. The findings show that Nigeria's crash data displays a trend of spikes and dips, which is an indication that despite the overall slight decrease in crash fatalities noticed from 2013 – 2016, there is still a strong tendency of an increase in crash fatalities in later years. This increase is evident in the number of crash fatalities recorded in 2017 (IRTAD, 2018; FRSC, 2017) which is due to the inconsistencies in crash reporting and recording by the FRSC. Based on the findings from the safety analysis in the first component, which shows that despite the high levels of education of the residents of Abuja (a majority are educated, when compared to the residents of other northern Nigerian states), and arguably the best road infrastructure (although with identifiable road design failures), and FRSC presence in the country, Abuja, consistently has one of the worst annual crash statistics in Nigeria. Questionnaires were therefore produced and administered to road users in Abuja Nigeria, as well as interviews with the FRSC and the Federal Ministry of Transportation to understand the factors contributing to Abuja's rather high crash statistics. The choice of a study area and the production of questionnaires were based on the findings in the first component. From the survey and interview, this study was able to utilise the opinion of regular road users to identify those road user behaviours contributing to Abuja's relatively high crash fatalities statistics. Since it has been established in the first component that the FRSC data has known quality issues, as well as the ethical issues associated with waiting for a crash to occur before evaluating the causes of a crash or to collect sufficient data, the research opted for a safety evaluation using a surrogate for traffic crashes. The conflicts observation using the Dutch

Objective Conflict Technique for Operation and Research (DOCTOR) was able to classify in broad terms those contributory factors which are all attributed to road user behaviours.

The overall contributions to knowledge made by this study is presented in the concluding chapter (chapter 6).

CHAPTER SIX
CONCLUSIONS
AND
RECOMMENDATIONS

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The key conclusions drawn from this study, are presented in this chapter. This chapter starts with a brief introductory section, followed by an itemisation of a summary of the key research findings and conclusions made. The limitations encountered in the conduct of this study, follow next and are presented in section 6.3. The chapter finally concludes in section 6.4, with a few recommendations.

6.2 Conclusions

The major findings, contributions to knowledge and conclusion drawn from this study can be summarised as follows:

- Despite the quality issues like underreporting associated with the available road safety data in Nigeria, the analysis of the current road safety situation indicates that Nigeria is still far from meeting the set goals of the United Nations Decade of Action for Road Safety 2011 – 2020, and the SDG goal 3, target 6 by the end of 2020. This research, contributes to the existing knowledge of road safety analysis in Abuja, Nigeria, and also highlights the challenges encountered in the collection of credible road safety data in Nigeria, which is common in most Low and Middle Income Countries (LMIC). With respect to the road traffic data collection in Nigeria, the non – systematic collection and recording of safety data (by Nigeria's lead safety agency, the Federal Road Safety Corps) is responsible for the large annual fluctuations in reported crashes and crash fatalities. Recommendations to improve the data collection and recording methods currently employed by the Federal Road Safety Corps (FRSC), are highlighted in section 6.4.

- The study has identified behavioural risk factors and the major causes of RTC in Abuja, Nigeria, using questionnaires for road users, and interviews for representatives of the Federal Ministry of Transportation and the Federal Road Safety Corps (FRSC). These include:
    - Poor use of seatbelts while driving.
    - Over speeding.
    - Drink driving.
    - Low use of child restraints while driving.
    - Aggressive driving.
    - Loss of control due to tyre burst.
    - Use of mobile phones while driving.
    - Poor use of indicators.
    - Tailgating.
    - Driving against traffic flow.
    - Lack of pedestrian bridges close to the junctions as well as crossing at undesignated places.
- The research also discovered that the majority of road users in Abuja, are very bothered about road traffic crashes and suggest the following methods of reducing RTCS in Abuja:
    - Regular road safety education of children and young road users, as well as the incorporation of Road Safety education into formal school curriculums and programmes.
    - Traffic Enlightenment and safety awareness programs via social media, radio, television, bill boards and fliers using local Nigerian languages aimed at reaching road users who do not understand the English language.

- Strict enforcement of traffic safety laws irrespective of status and class in society.

➢ Majority of the Traffic Safety Evaluation (TSE) studies in Nigeria have been registry – based, utilising historical crash data from the FRSC, however, there is no evidence of a previous successful use of the Dutch Objective Conflict Technique for Operation and Research (DOCTOR) as a Traffic Conflict Technique (TCT) to evaluate traffic conflicts in the country. This research adopted a non – crash based evaluation of traffic safety and is the first study to adopt a holistic approach using DOCTOR as a TCT despite its ease of implementation and its cost – effectiveness. The method has been used to successfully observe traffic interactions, identify the types of conflicts and the severity of the conflicts recorded at 5 junctions and a roundabout in Abuja, Nigeria. This study contributes to the small literature of studies on the use of traffic conflict techniques for traffic safety evaluation, in Low and Middle Income Countries (LMIC). This therefore provides road safety investigators in Nigeria with the opportunity to utilise surrogate safety measures to complement traffic safety evaluation in similar traffic locations, and in cases where crash based approaches seem unreliable due to crash data unavailability and/or low quality of the crash records if available.

This study summarily evaluates the general state of road safety in Abuja (and by extension Nigeria), as well as the performance of the country with respect to achieving the goals of the United Nations Decade of Action for road safety and the Sustainable Development Goal (SDG) goal 3, target 6. This study also highlights road user behaviours responsible for the high rates of Road Traffic Crashes and crash fatalities in Nigeria, as well as the observation and identification of traffic conflicts using the Dutch Objective Conflict Technique for Operation and Research (DOCTOR), which is first of its kind in Nigeria.

Since this study uses Abuja, Nigeria, as a study area, and goes further than just a conflict study by combining crash data analysis and the use of questionnaires and interviews to understand road user behaviours, the review of this study, serves as a spring board for further studies in Nigeria that intend to combine other methods with the Dutch Objective Conflict Technique for Operation and Research (DOCTOR). With the foundation laid by this pilot study in identifying common traffic conflict types in Abuja, their severity, and the road users involved in such conflicts using onsite manual observation and conflict scoring, the scope and objectives of future traffic safety evaluations can be extended to incorporate video recordings in order to establish a more robust collection of traffic conflicts data in Nigeria.

The benefits of this study is chiefly the opportunity it provides transport administrators and decision makers from the Ministry of Transportation, the Federal Road Safety Corps (FRSC) and the Federal Capital Territory Administration (FCTA) in Nigeria, to proactively apply Traffic Conflict Techniques in identifying traffic conflicts and unsafe traffic interactions with the potential to result in Road Traffic Crashes or near – misses before they occur. It also informs the administrators of the common contributory factors and the road users involved in unsafe traffic behaviours and traffic conflicts at different road intersections in Abuja, which is lacking in the road safety data provided by the FRSC. This study, therefore, provides the FRSC a quicker alternative for the evaluation of before and after effects of road safety intervention measures at crash hotspots in Abuja, as well as highlights the importance and need for road design and traffic management improvements in Abuja. This study is also beneficial as it can also serve as a general guide for traffic conflict studies using DOCTOR as a TCT in other Nigerian states and other Low and Middle Income Countries (LMIC) where road transportation systems are similar and existing literature on conflict studies is currently lacking.

6.3 Research limitations

The application processes involved in data collection is overly bureaucratic and the difficulty in obtaining permissions and getting a response from the Ministry of Transportation and the Federal Road Safety Corps (FRSC), is very lengthy and a totally manual process. This should be reviewed to allow for hassle – free electronic requests of data in the future.

The research utilises secondary road traffic crash records from 1990 to 2016 provided by the Federal Road Safety Corps (FRSC), which is Nigeria's official road transport safety agency. For some states (Abia, Bayelsa, Delta, Ebonyi, Ekiti, Enugu, Gombe, Jigawa, Kebbi, Kogi, Nasarawa, Osun, Taraba, Yobe and Zamfara), prior to 1990 and 1996, there were no crash records, as shown in the official FRSC data (see Appendix A). These states are mostly states created from already existing states in 1991 and 1996, thus, the FRSC crash data for these states before 1991 and 1996, are captured in the parent states which these states were carved out from. Furthermore, the FRSC crash data stops at 2016, since the 2016 data was the latest available data at the time the research commenced and the time of data request from the FRSC.

Also, the total population of Nigeria and the break down on a state by state basis are estimated, and could either be overestimated or underestimated. The last official population census conducted in Nigeria was by the National Population Commission (NPC) in 2006. Nigeria does not have a comprehensive and real – time birth and death register, thus births and deaths in most rural areas go unreported. This is common, most especially in areas where there are no modern hospitals or health centres and where child births and deliveries are handled by local and traditional birth attendants, thus, births and deaths at these centres are shrouded in secrecy. The practice of some religious faiths burying their deceased within 24 hours of death, without an autopsy to determine the cause of death, also contributes to quality issues associated with road fatality figures in Nigeria. However, the data used in this research, are the official statistical data provided by the Federal Road Safety Corps (FRSC), and the National Bureau of Statistics (NBS).

The composition of the respondents to the survey questionnaire was another limitation encountered. For example, only a few respondents had been involved in road traffic crashes and these were without injuries or disabilities, while a few others had survived near fatal road crashes in the past. Therefore, this represents a likely underestimation of the road safety challenges, since the survey responses do not stem from survivors of severe or fatal road traffic crashes. However, their regular use of the Nigerian road transport system provides them the opportunity to give informed, appropriate and relevant responses to the questionnaires. The questionnaires were produced in the English language, but might more usefully have also been produced in Pidgin English and the three major languages in Nigeria (Igbo, Hausa and Yoruba), for easier understanding by road users. Furthermore, the traffic conflict observations were done manually, relying only on the subjective conflicts scoring by the observers, since approval was not granted for the use of video observations. To improve inter observer reliability, observers were trained and acquired some on – site practical experience using a test conflict observation which the observers had similar conflict records.

6.4 Recommendations for further study

6.4.1 Recommendations for Nigeria

The following are recommendations to the Federal and State authorities, for consideration in future:

- Based on the findings of this study, and in line with the aim of improving road safety by Nigeria's lead road safety agency, the Federal Road Safety Corps (FRSC), the following are recommended to the Federal Government of Nigeria:

- The development of a Nigerian Road Safety Strategic Plan (RSSP), founded on the five strategic pillars of the United Nations Decade of Action for Road Safety plan, modified with inputs and representation from all the 36 state governments of the Federation. This is necessary in the light of Nigeria's performance with respect to actualising the goal of the United Nations Decade of Action for Road Safety. Apart from the representatives of the state and local governments, inputs are also expected from academia, non – governmental organisations, the civil society organisations, the media, the private sector, and the general public. In setting realistic targets post – 2020, the RSSP must take cognisance of the peculiarities of the road safety challenges at the local level. For example, the literacy level in the Federal Capital Territory is not the same in Kano State in the North West, or Abia State in the South East. This implies, that the efforts required for road safety education in the south is less than would be required in the North with higher illiteracy levels. State commands of the FRSC and that of FCT are therefore expected to liaise with the Local Government authorities to draw up and set interim targets which can be reviewed periodically based on the prevailing realities, which is aimed at addressing the challenges observed in the various local governments that make up their states. These targets are to be regularly assessed and reviewed using Key Performance Indicators (KPIs), like blood alcohol concentration testing, the prosecution of traffic law offenders, regular use of seatbelts, and the successful enforcement of speed limits.
- The installation of speed cameras at crash hotspots and unsafe roads as identified by the FRSC, to ensure the strict enforcement of speed limits. In the event of a traffic crash and/or traffic fatality, footage from the speed cameras will aid in the identification of the contributory human, road, vehicle or environmental factors that led to the crash, as well as in the assessment of the pre and post – crash events. The footage would be

beneficial in identifying those prevalent unsafe road user behaviours contributing to the occurrence of road traffic crashes. The footages would also be beneficial for future non – crash based traffic safety evaluations using Traffic Conflict Techniques (TCT).

- Improved funding for the FRSC to aid the purchase of breathalysers as well as the training of FRSC marshals to carry out and interpret the results from, on the spot Blood Alcohol Concentration (BAC) tests. The BAC tests are to be randomly administered on both commercial and private drivers at any time of the day. This will involve the employment of newly educated FRSC marshals to support the existing FRSC patrol teams.
- To address the data quality issues and inaccuracies associated with the FRSC data, a switch from the currently used manual data collection system to a digital data collection system is recommended. This digital switch aims at improving the credibility of the existing crash database. The digital data collection portal should synchronise crash data from hospitals (including crash victims who die within 30 days after a crash), and the FRSC data collected by the patrol team at the scene of a crash. Although the FRSC claims to have an existing portal (www.frscrtcis.com.ng/) for digital data collection, a quick web search of the website shows the website does not exist.

- Based on the observations from the field study/traffic conflict observation, the roads in Abuja, though wide, smooth and free from pot holes, are saddled with road design issues. In order to improve these road designs, this study recommends the following measures: installation of rumble strips on shoulders and centre lines, the redesign of roads with safety edges; improvement of turning lanes and lining ramps; installation of pedestrian refuge areas and walkways; installation of traffic lights and signs; and the installation of median barriers. With respect to traffic management, this study also suggests: the expansion of lanes during peak periods and the provision of real time travel information by the FRSC.

6.4.2 Recommendations for future work

For further studies, the following are recommended:

- Since Nigeria has 36 states and a Federal Capital Territory (FCT), similar observational studies in the area of Road Traffic Crashes (RTC) and Traffic Safety, utilising the same methodology, are recommended for further studies in the other 36 States of Nigeria.
- It is also recommended that for future studies on Road Traffic Crashes in Nigeria, the different major Nigerian languages (Igbo, Hausa and Yoruba) should be adopted in the design and administering of questionnaires as well as in other data collection processes.
- For future traffic conflict studies in Nigeria, the use of video recordings are suggested as it provides the opportunity for the re – evaluation of already observed traffic conflicts and other safety related events. The video recordings can also serve educational purposes, for example in the training of conflict observers.

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APPENDICES

Appendix A

- Request for road crash data.
- Response from the Federal Road Safety Corps (FRSC).
- Data singled out on State basis (1990 – 2016) from the official FRSC data.

Request for road crash Data:

UNIVERSITY OF BIRMINGHAM

College of Engineering and Physical Sciences

School of Civil Engineering
Professor M.R. Tight
[redacted]

The Corps Marshal and Chief Executive
Federal Road Safety Corps (FRSC)
FRSC Corporate Headquarters
4, Maputo Street
Wuse Zone 3
Abuja
Nigeria.

March 31, 2017

Dear Sir,

REQUEST FOR ROAD ACCIDENT DATA FOR PHD RESEARCH

This is to certify that **Mr. Uchenna Nnabuihe Uhegbu** with student **ID:**[redacted], is a registered **PhD Civil Engineering student**, here at the **University of Birmingham**. He is currently conducting a research on the sustainability of transportation in Nigeria under the supervision of **Professor Miles Tight**, and **Dr. Michael Burrow**.

He needs to collect available detailed road accident data ideally for as many years as possible up to as near to the current date as possible from your organisation, in order to assist him in his research. The data can focus on the Federal Capital Territory; however, general data for all the states is also acceptable. On completion of his work, you are welcome to preview his research. I assure you that there will be no misuse of this information and he will be responsible for any misuse if any misuse whatsoever, eventually arises.

It is my hope that in the light of the above, you will grant him the required information. Your kind cooperation will be highly appreciated.

Yours sincerely

[redacted]

Professor Miles Tight
Professor of Transport, Energy and Environment

Response from the Federal Road Safety Corps (FRSC):

POLICY RESEARCH AND STATISTICS <prs@frsc.gov.ng> | Uchenna Uhegbu | 1 | 18/04/2017

FW: REQUEST FOR ROAD ACCIDENT DATA FOR PHD RESEARCH

Flag for follow up.

RTC DATA ON STATE BASIS (1990 - 2016).docx
174 KB

From: POLICY RESEARCH AND STATISTICS
Sent: Thursday, April 13, 2017 11:43 AM
To: [redacted]
Cc: NWACHUKWU Albanus
Subject: RE: REQUEST FOR ROAD ACCIDENT DATA FOR PHD RESEARCH

This is in respect of your request for Road Traffic Crash Data dated 31st March, 2017.

The data has been compiled on State basis (1990-2016) from which the focus on Federal Capital Territory data can be sieved out.

Find the data as attached, please.

Accept the warm regards and best assurances of the Corps Marshal.

ACM Kayode OLAGUNJU PhD, FCILT
Head Policy Research and Statistics Department
Federal Road Safety Corps (FRSC)

Data singled out on State basis (1990 – 2016) from the official FRSC data:

Abia State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	35	50	37	122	43	89	132
1992	135	206	77	418	151	371	522
1993	149	228	86	463	180	451	631
1994	136	207	84	427	171	406	577
1995	97	121	59	277	128	224	352
1996	123	122	40	285	139	208	347
1997	56	49	11	116	67	80	147
1998	103	52	14	169	108	130	238
1999	101	40	4	145	131	183	314
2000	97	46	20	163	122	126	248
2001	121	89	45	255	142	211	353
2002	49	116	59	224	101	362	463
2003	28	58	26	112	80	203	283
2004	18	46	18	82	31	179	210
2005	21	45	26	92	37	348	385
2006	9	70	12	91	16	251	267
2007	35	182	21	238	78	449	527
2008	27	126	56	209	131	404	535
2009	21	42	34	97	72	225	297
2010	14	58	9	81	26	206	232
2011	37	69	18	124	65	552	617
2012	21	69	18	108	33	430	463
2013	35	81	10	126	55	533	588
2014	22	58	7	87	38	284	322
2015	21	55	10	86	41	292	333
2016	26	65	11	102	54	371	425

Adamawa State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	172	220	130	522	229	489	718
1991	163	232	166	561	207	681	888
1992	143	178	60	381	186	554	740
1993	142	145	28	315	180	502	682
1994	89	106	10	205	103	302	405
1995	47	27	18	92	64	101	165
1996	79	76	42	197	152	173	325
1997	62	93	75	230	120	247	367
1998	87	187	86	360	239	523	762
1999	168	253	239	660	488	1058	1546
2000	130	216	221	567	558	987	1545
2001	78	117	114	309	342	504	846
2002	61	307	53	421	189	1043	1232
2003	146	313	77	536	233	724	957
2004	66	101	52	219	90	465	555
2005	24	42	44	110	21	227	248
2006	83	141	19	243	98	344	442
2007	27	204	41	272	52	481	533
2008	45	76	32	153	70	322	392
2009	46	447	28	521	74	984	1058
2010	58	299	43	400	102	979	1081
2011	74	384	53	511	57	1117	1174
2012	49	308	18	375	108	803	911
2013	55	356	7	418	88	984	1072
2014	45	231	12	288	72	806	878
2015	37	120	6	163	71	428	499
2016	25	128	9	162	42	462	504

Akwa Ibom State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	105	240	92	437	116	405	521
1991	203	288	88	579	230	511	741
1992	187	278	66	531	219	496	715
1993	183	269	79	531	209	508	717
1994	125	212	58	395	136	336	472
1995	179	243	90	512	180	383	563
1996	105	147	62	314	124	283	407
1997	129	184	29	342	186	383	569
1998	115	147	34	296	135	316	451
1999	154	164	38	356	187	460	647
2000	157	207	41	405	189	518	707
2001	228	276	79	583	265	493	758
2002	41	58	10	109	54	96	150
2003	20	36	3	59	60	72	132
2004	128	126	126	380	121	409	530
2005	44	197	46	287	98	581	679
2006	36	72	17	125	100	193	293
2007	14	55	18	87	33	129	162
2008	29	141	69	239	188	857	1045
2009	22	77	51	150	49	268	317
2010	33	61	54	148	58	223	281
2011	46	94	100	240	92	297	389
2012	28	44	25	97	65	238	303
2013	30	61	8	99	55	213	268
2014	18	34	5	57	23	111	134
2015	22	24	4	50	41	95	136
2016	24	24	3	51	34	198	232

Anambra State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	317	457	335	1109	455	1129	1584
1991	247	411	204	862	363	815	1178
1992	215	361	219	795	254	605	859
1993	180	249	192	621	234	464	698
1994	140	279	193	612	194	345	539
1995	64	127	98	289	71	183	254
1996	116	139	85	340	105	221	326
1997	137	189	144	470	170	404	574
1998	152	245	149	546	194	559	753
1999	58	125	98	281	91	220	311
2000	138	177	187	502	224	385	609
2001	46	109	99	254	136	336	472
2002	68	140	189	397	132	333	465
2003	67	118	54	239	110	410	520
2004	115	229	86	430	145	308	453
2005	38	83	38	159	102	218	320
2006	16	20	4	40	41	171	212
2007	28	69	25	122	84	250	334
2008	42	60	19	121	59	472	531
2009	46	138	42	226	65	447	512
2010	16	51	30	97	39	250	289
2011	34	92	20	146	61	507	568
2012	67	178	66	311	90	629	719
2013	67	170	57	294	129	607	736
2014	82	160	30	272	110	640	750
2015	91	143	21	255	193	687	880
2016	55	132	43	230	77	578	655

Bauchi State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	224	254	136	614	332	1225	1557
1991	317	232	97	646	416	969	1385
1992	243	171	82	496	380	1045	1425
1993	171	163	99	433	185	860	1045
1994	228	155	104	487	267	576	843
1995	203	175	107	485	285	711	996
1996	272	189	82	543	357	854	1211
1997	124	114	33	271	182	428	610
1998	95	61	69	225	133	468	601
1999	178	126	114	418	253	730	983
2000	163	98	56	317	223	742	965
2001	187	161	69	417	307	845	1152
2002	43	69	29	141	117	452	569
2003	25	61	19	105	46	207	253
2004	22	76	19	117	49	210	259
2005	23	57	40	120	54	153	207
2006	46	73	12	131	136	410	546
2007	59	83	29	171	98	577	675
2008	71	79	33	183	80	414	494
2009	79	177	60	316	196	1067	1263
2010	68	122	10	200	140	698	838
2011	89	214	21	324	289	1174	1463
2012	102	186	45	333	356	1397	1753
2013	43	105	64	212	78	504	582
2014	147	297	49	493	269	1773	2042
2015	86	137	3	226	187	964	1151
2016	89	213	6	308	226	1232	1458

Bayelsa State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1997	1	18	18	37	2	37	39
1998	7	10	0	17	17	21	38
1999	10	15	3	28	13	22	35
2000	17	42	21	80	1	59	60
2001	22	80	38	140	24	79	103
2002	30	35	18	83	32	97	129
2003	11	29	20	60	26	65	91
2004	11	29	7	47	18	103	121
2005	14	71	24	109	15	198	213
2006	20	37	23	80	41	96	137
2007	31	74	31	136	70	170	240
2008	34	128	57	219	150	985	1135
2009	16	31	16	63	31	153	184
2010	12	35	29	76	10	134	144
2011	15	58	27	100	21	195	216
2012	21	63	32	116	9	196	205
2013	15	79	45	139	34	256	290
2014	10	54	31	95	21	152	173
2015	10	44	15	69	16	130	146
2016	8	25	12	45	11	80	91

Benue State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	192	236	138	566	271	728	999
1991	255	279	164	698	377	977	1354
1992	217	266	153	636	236	958	1194
1993	244	305	146	695	349	936	1285
1994	220	317	145	682	319	786	1105
1995	173	279	139	591	214	568	782
1996	187	301	115	603	300	661	961
1997	195	415	190	800	266	956	1222
1998	147	269	81	497	181	703	884
1999	215	417	121	753	287	1084	1371
2000	298	418	141	857	414	1233	1647
2001	383	548	154	1085	554	1710	2264
2002	28	67	43	138	78	270	348
2003	28	45	15	88	77	216	293
2004	55	102	27	184	128	382	510
2005	71	106	31	208	162	669	831
2006	33	55	3	91	62	388	450
2007	35	66	24	125	53	118	171
2008	81	222	91	394	279	969	1248
2009	53	212	55	320	165	734	899
2010	94	182	30	306	154	958	1112
2011	84	236	26	346	176	1031	1207
2012	52	195	31	278	90	801	891
2013	130	319	27	476	232	1400	1632
2014	91	190	9	290	169	973	1142
2015	93	248	47	388	176	1082	1258
2016	60	109	173	342	122	946	1068

Borno State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	282	357	326	965	374	1112	1486
1991	314	373	264	951	241	1116	1357
1992	200	252	186	638	239	763	1002
1993	156	189	151	496	156	558	714
1994	95	92	66	253	112	287	399
1995	55	69	83	207	69	150	219
1996	69	36	55	160	70	159	229
1997	49	42	20	111	40	49	89
1998	46	52	50	148	51	137	188
1999	68	59	68	195	98	288	386
2000	138	122	125	385	181	364	545
2001	159	147	131	437	249	466	715
2002	39	153	81	273	104	360	464
2003	26	49	37	112	48	168	216
2004	23	34	50	107	62	173	235
2005	49	48	15	112	92	277	369
2006	29	107	2	138	55	222	277
2007	47	127	27	201	138	357	495
2008	49	93	34	176	90	227	317
2009	50	94	28	172	123	570	693
2010	23	101	17	141	22	389	411
2011	42	99	24	165	70	593	663
2012	29	79	7	115	67	463	530
2013	15	43	20	78	49	313	362
2014	2	12	0	14	2	51	53
2015	1	8	0	9	2	55	57
2016	13	12	1	26	40	102	142

Cross River State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	166	316	110	592	230	553	783
1991	209	161	300	670	844	844	1688
1992	192	341	135	668	246	670	916
1993	205	349	171	725	255	631	886
1994	154	332	129	615	237	640	877
1995	129	253	98	480	174	483	657
1996	119	227	91	437	145	468	613
1997	146	261	80	487	169	301	470
1998	93	229	85	407	106	381	487
1999	167	261	58	486	205	574	779
2000	160	215	63	438	207	461	668
2001	178	204	73	455	253	502	755
2002	49	24	6	79	56	71	127
2003	36	88	50	174	124	274	398
2004	67	63	54	184	87	346	433
2005	50	64	29	143	88	188	276
2006	69	108	8	185	113	210	323
2007	21	73	36	130	43	392	435
2008	50	52	16	118	39	955	994
2009	42	100	54	196	70	535	605
2010	32	90	51	173	71	337	408
2011	31	109	36	176	105	366	471
2012	36	113	42	191	70	525	595
2013	49	82	38	169	115	299	414
2014	67	105	25	197	147	415	562
2015	48	74	16	138	113	350	463
2016	38	49	11	98	73	255	328

Delta State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	385	831	630	1846	511	1787	2298
1992	251	536	316	1103	329	1282	1611
1993	222	398	269	889	242	789	1031
1994	140	391	187	718	185	581	766
1995	247	707	379	1333	359	632	991
1996	138	411	157	706	188	660	848
1997	174	423	181	778	213	467	680
1998	210	426	168	804	250	701	951
1999	289	446	208	943	303	772	1075
2000	226	453	259	938	295	714	1009
2001	684	528	421	1633	1064	943	2007
2002	84	157	30	271	224	540	764
2003	37	91	47	175	65	286	351
2004	40	72	15	127	90	279	369
2005	31	44	47	122	83	268	351
2006	25	38	13	76	90	291	381
2007	15	32	21	68	25	142	167
2008	82	140	62	284	171	454	625
2009	88	216	126	430	172	975	1147
2010	83	167	67	317	134	1214	1348
2011	70	202	70	342	123	902	1025
2012	152	320	102	574	241	1015	1256
2013	157	294	69	520	315	1338	1653
2014	121	149	20	290	210	1046	1256
2015	80	102	18	200	151	761	912
2016	65	55	9	129	125	452	577

Ebonyi State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1997	15	8	5	28	16	18	34
1998	6	3	2	11	13	10	23
1999	43	57	19	119	54	103	157
2000	0	0	0	0	0	0	0
2001	49	42	59	150	63	137	200
2002	24	51	32	107	22	217	239
2003	28	44	13	85	41	105	146
2004	2	6	3	11	2	23	25
2005	12	28	8	48	25	143	168
2006	6	42	5	53	6	92	98
2007	49	97	33	179	130	465	595
2008	27	61	28	116	63	335	398
2009	23	29	32	84	46	198	244
2010	11	43	22	76	15	140	155
2011	8	36	9	53	16	223	239
2012	13	62	11	86	11	162	173
2013	21	81	26	128	30	230	260
2014	93	113	42	248	113	501	614
2015	102	144	41	287	180	556	736
2016	94	116	59	269	127	458	585

Edo State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	534	1009	633	2176	664	1830	2494
1991	50	106	27	183	38	114	152
1992	354	664	645	1663	596	1463	2059
1993	315	694	696	1705	508	1623	2131
1994	281	518	477	1276	357	978	1335
1995	243	570	409	1222	277	852	1129
1996	356	623	422	1401	357	915	1272
1997	224	515	427	1166	300	526	826
1998	247	405	443	1095	263	886	1149
1999	182	384	404	970	285	703	988
2000	223	351	509	1083	225	711	936
2001	231	241	295	767	213	834	1047
2002	65	98	78	241	144	500	644
2003	65	121	21	207	128	399	527
2004	45	65	46	156	82	293	375
2005	39	55	27	121	95	254	349
2006	67	115	32	214	190	540	730
2007	33	63	4	100	57	235	292
2008	113	188	86	387	247	869	1116
2009	117	362	151	630	290	2141	2431
2010	104	284	72	460	186	1523	1709
2011	134	289	92	515	361	1540	1901
2012	137	276	90	503	495	1465	1960
2013	103	130	25	258	290	686	976
2014	109	111	19	239	216	708	924
2015	103	148	23	274	184	992	1176
2016	79	162	27	268	122	820	942

Ekiti State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1997	23	25	18	66	24	27	51
1998	18	39	9	66	18	55	73
1999	26	56	32	114	27	109	136
2000	33	56	21	110	35	90	125
2001	54	94	44	192	58	180	238
2002	44	96	13	153	71	236	307
2003	54	84	10	148	116	253	369
2004	37	79	9	125	48	110	158
2005	25	55	15	95	48	201	249
2006	32	40	1	73	74	193	267
2007	56	97	23	176	91	358	449
2008	35	91	34	160	88	468	556
2009	32	105	13	150	80	337	417
2010	14	64	21	99	21	253	274
2011	12	65	26	103	23	287	310
2012	34	85	35	154	57	349	406
2013	32	99	26	157	42	350	392
2014	22	35	3	60	48	165	213
2015	17	37	1	55	24	180	204
2016	10	35	4	49	19	112	131

Enugu State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	201	280	174	655	288	606	894
1993	257	293	254	804	332	717	1049
1994	127	219	131	477	151	424	575
1995	105	173	104	382	128	293	421
1996	86	160	89	335	133	299	432
1997	56	61	34	151	103	76	179
1998	90	100	41	231	97	250	347
1999	98	182	134	414	115	353	468
2000	147	175	143	465	179	371	550
2001	272	282	239	793	290	564	854
2002	101	65	104	270	136	433	569
2003	20	21	9	50	43	76	119
2004	8	9	9	26	11	68	79
2005	36	57	21	114	145	397	542
2006	20	52	5	77	29	253	282
2007	130	296	119	545	284	1195	1479
2008	50	311	107	468	331	1927	2258
2009	26	109	52	187	72	385	457
2010	51	89	47	187	113	639	752
2011	61	121	43	225	107	851	958
2012	89	183	49	321	145	986	1131
2013	68	175	58	301	123	1154	1277
2014	72	165	26	263	178	817	995
2015	68	142	40	250	95	856	951
2016	66	138	34	238	118	715	833

Federal Capital Territory (FCT) – (Abuja)

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	52	75	50	177	68	306	374
1991	70	49	37	156	105	341	446
1992	86	74	96	256	127	501	628
1993	79	49	129	257	113	599	712
1994	10	7	12	29	15	53	68
1995	44	80	69	193	49	163	212
1996	18	7	34	59	19	108	127
1997	112	205	169	486	100	554	654
1998	134	162	203	499	127	423	550
1999	131	198	182	511	211	651	862
2000	94	128	54	276	173	867	1040
2001	8	11	12	31	5	28	33
2002	124	316	19	459	263	1248	1511
2003	118	267	50	435	369	1073	1442
2004	101	277	86	464	249	1027	1276
2005	106	224	166	496	236	1096	1332
2006	108	213	32	353	332	1171	1503
2007	24	64	35	123	77	225	302
2008	181	333	176	690	390	1086	1476
2009	158	486	323	967	368	2132	2500
2010	152	720	321	1193	396	3614	4010
2011	222	912	230	1364	465	2950	3415
2012	242	1049	231	1522	347	3395	3742
2013	259	1175	332	1766	446	3948	4394
2014	233	973	189	1395	335	2820	3155
2015	209	945	188	1342	328	2820	3148
2016	191	921	261	1373	253	2700	2953

Gombe State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1997	100	57	5	162	132	94	226
1998	69	55	30	154	87	296	383
1999	81	73	39	193	114	555	669
2000	120	144	54	318	199	1337	1536
2001	89	78	20	187	88	1321	1409
2002	35	84	2	121	84	522	606
2003	27	64	17	108	46	431	477
2004	22	33	17	72	45	284	329
2005	23	27	31	81	43	418	461
2006	23	79	1	103	66	358	424
2007	17	74	19	110	62	585	647
2008	37	106	44	187	97	2065	2162
2009	36	127	0	163	90	584	674
2010	49	172	0	221	83	320	403
2011	52	208	0	260	147	769	916
2012	55	200	0	255	79	568	647
2013	61	146	0	207	115	1020	1135
2014	53	124	2	179	107	779	886
2015	51	133	5	189	101	701	802
2016	51	113	4	168	158	578	736

Imo State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	262	422	187	871	321	802	1123
1991	190	340	168	698	240	716	956
1992	99	187	92	378	120	393	513
1993	165	255	129	549	213	503	716
1994	93	178	67	338	201	270	471
1995	90	149	62	301	97	246	343
1996	76	149	62	287	80	267	347
1997	41	52	28	121	20	56	76
1998	60	110	34	204	68	211	279
1999	54	95	29	178	85	176	261
2000	66	75	13	154	100	681	781
2001	73	92	7	172	103	1044	1147
2002	199	235	50	484	291	916	1207
2003	80	199	19	298	183	705	888
2004	74	138	30	242	87	437	524
2005	39	38	38	115	70	320	390
2006	78	122	25	225	187	364	551
2007	47	201	42	290	73	321	394
2008	29	122	47	198	129	662	791
2009	37	50	34	121	50	361	411
2010	55	190	91	336	82	576	658
2011	46	145	56	247	69	547	616
2012	67	252	84	403	87	897	984
2013	71	174	60	305	114	678	792
2014	63	144	34	241	103	672	775
2015	50	90	30	170	70	508	578
2016	34	73	12	119	51	401	452

Jigawa State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	60	39	20	119	122	98	220
1992	86	72	35	193	121	408	529
1993	141	66	25	232	158	493	651
1994	89	48	16	153	134	337	471
1995	112	38	9	159	140	291	431
1996	104	77	11	192	165	418	583
1997	118	78	6	202	178	91	269
1998	78	77	14	169	116	380	496
1999	89	95	57	241	118	334	452
2000	118	113	26	257	181	497	678
2001	206	135	10	351	296	953	1249
2002	138	72	29	239	253	610	863
2003	98	54	7	159	208	221	429
2004	114	22	46	182	187	293	480
2005	43	12	15	70	56	275	331
2006	66	113	50	229	81	152	233
2007	85	144	101	330	170	410	580
2008	74	121	46	241	126	895	1021
2009	46	92	23	161	86	281	367
2010	50	121	41	212	113	733	846
2011	64	208	38	310	156	1130	1286
2012	42	157	29	228	90	775	865
2013	40	91	17	148	99	573	672
2014	43	56	2	101	115	480	595
2015	38	109	2	149	79	505	584
2016	54	86	4	144	116	627	743

Kaduna State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	381	384	360	1125	550	1214	1764
1991	334	361	335	1030	489	1125	1614
1992	290	281	287	858	473	828	1301
1993	238	243	252	733	324	562	886
1994	312	323	291	926	420	874	1294
1995	287	301	287	875	348	860	1208
1996	152	140	96	388	365	432	797
1997	355	321	311	987	550	347	897
1998	192	188	165	545	274	494	768
1999	57	81	94	232	116	251	367
2000	116	133	110	359	255	359	614
2001	186	119	83	388	328	422	750
2002	82	201	0	283	184	611	795
2003	157	175	58	390	109	417	526
2004	79	143	189	411	61	391	452
2005	87	110	148	345	121	527	648
2006	60	131	14	205	117	471	588
2007	108	355	61	524	277	1011	1288
2008	177	523	303	1003	692	2017	2709
2009	193	259	87	539	496	1418	1914
2010	249	581	77	907	527	2969	3496
2011	247	620	93	960	494	3415	3909
2012	246	558	115	919	477	3366	3843
2013	303	600	143	1046	588	3663	4251
2014	263	249	13	525	539	2242	2781
2015	244	257	1	502	474	2025	2499
2016	270	420	25	715	505	2849	3354

Kano State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	563	746	608	1917	719	1811	2530
1991	599	758	638	1995	762	1804	2566
1992	540	611	496	1647	724	1494	2218
1993	521	608	492	1621	736	1544	2280
1994	290	458	397	1145	387	1023	1410
1995	310	385	374	1069	471	948	1419
1996	282	478	313	1073	350	969	1319
1997	339	600	394	1333	397	654	1051
1998	367	487	309	1163	461	959	1420
1999	408	573	436	1417	472	1320	1792
2000	326	452	325	1103	384	847	1231
2001	303	438	287	1028	365	877	1242
2002	434	445	199	1078	497	935	1432
2003	538	823	61	1422	719	1169	1888
2004	257	332	235	824	328	653	981
2005	37	42	8	87	140	336	476
2006	68	124	21	213	82	348	430
2007	173	227	129	529	356	632	988
2008	131	368	200	699	446	816	1262
2009	176	295	62	533	403	1111	1514
2010	113	345	146	604	301	1900	2201
2011	129	405	180	714	282	2501	2783
2012	87	368	123	578	158	2011	2169
2013	109	461	52	622	461	2050	2511
2014	163	219	22	404	358	1482	1840
2015	94	157	18	269	197	1235	1432
2016	104	267	19	390	190	1673	1863

Katsina State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	167	266	382	815	229	1068	1297
1991	147	195	205	547	193	938	1131
1992	167	224	75	466	223	753	976
1993	125	129	76	330	179	469	648
1994	103	90	56	249	158	348	506
1995	134	100	44	278	249	434	683
1996	148	96	56	300	150	365	515
1997	132	113	50	295	151	151	302
1998	61	69	54	184	80	207	287
1999	49	128	87	264	79	215	294
2000	195	127	74	396	328	828	1156
2001	298	146	60	504	445	1145	1590
2002	231	179	8	418	415	1067	1482
2003	318	215	8	541	502	1221	1723
2004	169	74	84	327	338	559	897
2005	76	53	18	147	153	396	549
2006	164	185	26	375	311	604	915
2007	169	164	50	383	295	666	961
2008	120	37	10	167	34	124	158
2009	98	106	27	231	302	422	724
2010	65	109	43	217	159	1163	1322
2011	75	185	28	288	122	1364	1486
2012	69	128	38	235	95	1178	1273
2013	99	221	20	340	150	1069	1219
2014	87	62	10	159	247	814	1061
2015	94	126	5	225	190	938	1128
2016	83	161	3	247	179	935	1114

Kebbi State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	20	24	6	50	31	96	127
1992	80	75	51	206	90	295	385
1993	37	49	16	102	58	237	295
1994	32	19	10	61	30	60	90
1995	8	12	7	27	8	41	49
1996	13	16	5	34	16	39	55
1997	24	18	28	70	13	27	40
1998	16	21	12	49	14	61	75
1999	15	33	7	55	11	45	56
2000	7	14	4	25	7	23	30
2001	29	23	2	54	32	86	118
2002	14	64	6	84	72	210	282
2003	51	159	82	292	55	320	375
2004	11	122	109	242	17	126	143
2005	33	72	18	123	59	196	255
2006	14	52	23	89	22	224	246
2007	16	63	47	126	25	261	286
2008	24	88	34	146	82	481	563
2009	35	83	67	185	66	578	644
2010	27	115	39	181	99	525	624
2011	43	147	53	243	147	650	797
2012	36	78	22	136	139	498	637
2013	53	110	29	192	114	652	766
2014	38	99	12	149	77	438	515
2015	39	87	17	143	97	573	670
2016	22	113	10	145	47	367	414

Kogi State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	28	37	63	128	38	297	335
1992	120	95	103	318	215	724	939
1993	254	72	93	419	389	1562	1951
1994	293	75	73	441	335	972	1307
1995	55	53	52	160	86	195	281
1996	88	120	64	272	119	364	483
1997	61	96	31	188	99	103	202
1998	97	100	29	226	196	419	615
1999	104	74	38	216	203	382	585
2000	124	91	43	258	212	340	552
2001	146	128	86	360	229	561	790
2002	94	109	11	214	247	678	925
2003	48	64	3	115	243	391	634
2004	47	72	32	151	216	495	711
2005	64	47	28	139	264	367	631
2006	94	125	11	230	221	562	783
2007	54	83	51	188	170	603	773
2008	52	137	61	250	165	1173	1338
2009	128	249	71	448	387	1271	1658
2010	164	342	120	626	415	2455	2870
2011	211	536	130	877	401	3795	4196
2012	162	398	97	657	318	2213	2531
2013	170	296	69	535	335	1777	2112
2014	134	107	13	254	304	1095	1399
2015	150	173	8	331	310	1450	1760
2016	113	127	27	267	223	1004	1227

Kwara State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	210	184	149	543	323	706	1029
1991	195	206	194	595	318	832	1150
1992	156	135	169	460	275	493	768
1993	155	146	194	495	241	626	867
1994	125	111	106	342	202	427	629
1995	61	73	65	199	86	227	313
1996	47	62	56	165	50	192	242
1997	92	134	62	288	147	139	286
1998	72	69	42	183	180	400	580
1999	39	42	24	105	104	172	276
2000	107	88	53	248	184	424	608
2001	86	50	49	185	95	246	341
2002	48	165	24	237	192	550	742
2003	37	97	1	135	87	280	367
2004	25	92	8	125	86	248	334
2005	18	61	37	116	46	174	220
2006	77	111	7	195	107	387	494
2007	40	53	10	103	113	418	531
2008	83	145	72	300	199	474	673
2009	84	206	39	329	206	1357	1563
2010	37	117	68	222	92	465	557
2011	76	217	53	346	170	921	1091
2012	53	121	41	215	161	560	721
2013	49	162	42	253	108	783	891
2014	49	117	33	199	130	675	805
2015	68	118	21	207	133	682	815
2016	57	121	19	197	110	658	768

Lagos State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	606	1159	1690	3455	758	2167	2925
1991	684	1264	1367	3315	752	1820	2572
1992	803	1315	1210	3328	933	1962	2895
1993	670	1238	1160	3068	822	1839	2661
1994	631	1476	1363	3470	772	2125	2897
1995	489	1395	1315	3199	756	1782	2538
1996	506	1282	1398	3186	653	1639	2292
1997	505	1529	1413	3447	559	1675	2234
1998	510	1571	1178	3259	574	2007	2581
1999	388	1172	916	2476	447	1509	1956
2000	329	961	935	2225	403	1229	1632
2001	677	1726	1531	3934	772	2397	3169
2002	891	2206	1621	4718	1266	3550	4816
2003	992	3008	1101	5101	1009	2901	3910
2004	695	2417	1274	4386	893	2589	3482
2005	453	1048	974	2475	666	2278	2944
2006	547	1944	315	2806	645	3169	3814
2007	227	393	30	650	332	728	1060
2008	364	100	39	503	90	519	609
2009	63	230	132	425	192	576	768
2010	82	332	138	552	892	1242	2134
2011	91	316	140	547	122	1074	1196
2012	89	318	119	526	146	1219	1365
2013	68	230	69	367	113	1030	1143
2014	61	188	72	321	110	731	841
2015	85	224	94	403	117	866	983
2016	90	247	104	441	165	971	1136

Nasarawa State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1997	75	61	24	160	111	84	195
1998	104	65	20	189	155	551	706
1999	72	15	6	93	118	230	348
2000	85	40	24	149	145	264	409
2001	182	26	6	214	241	416	657
2002	149	111	12	272	336	750	1086
2003	124	82	3	209	215	588	803
2004	82	95	21	198	184	464	648
2005	68	93	12	173	159	716	875
2006	31	73	3	107	112	391	503
2007	36	75	13	124	131	539	670
2008	69	208	89	366	264	687	951
2009	114	216	105	435	208	844	1052
2010	94	388	130	612	409	3251	3660
2011	93	371	76	540	240	2510	2750
2012	92	469	79	640	275	2142	2417
2013	191	862	105	1158	324	3136	3460
2014	181	664	33	878	314	2462	2776
2015	122	638	38	798	197	2069	2266
2016	102	175	253	530	192	1429	1621

Niger State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	232	221	136	589	355	915	1270
1991	315	206	103	624	506	1129	1635
1992	366	186	107	659	559	1044	1603
1993	355	193	99	647	560	1229	1789
1994	299	162	104	565	461	1066	1527
1995	247	171	71	489	379	611	990
1996	244	156	217	617	379	604	983
1997	209	155	109	473	325	176	501
1998	223	127	128	478	411	1082	1493
1999	219	135	56	410	389	808	1197
2000	191	157	69	417	283	717	1000
2001	213	161	36	410	303	640	943
2002	31	76	9	116	92	367	459
2003	49	90	137	276	168	492	660
2004	26	53	15	94	49	307	356
2005	53	140	41	234	116	551	667
2006	56	63	27	146	135	410	545
2007	81	224	59	364	144	815	959
2008	106	162	81	349	226	1589	1815
2009	88	213	80	381	216	999	1215
2010	84	222	47	353	248	1231	1479
2011	90	234	51	375	238	1061	1299
2012	108	253	73	434	254	1263	1517
2013	136	414	48	598	327	1618	1945
2014	112	441	49	602	227	1711	1938
2015	122	362	39	523	199	1387	1586
2016	111	391	33	535	234	1416	1650

Ogun State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	291	447	295	1033	319	978	1297
1991	357	541	411	1309	511	1165	1676
1992	423	675	489	1587	616	1964	2580
1993	414	605	439	1458	628	1471	2099
1994	318	463	290	1071	432	1028	1460
1995	251	461	230	942	403	937	1340
1996	377	580	345	1302	540	1058	1598
1997	310	495	364	1169	488	513	1001
1998	393	478	281	1152	659	1511	2170
1999	299	463	296	1058	585	1487	2072
2000	444	439	247	1130	634	1466	2100
2001	577	567	299	1443	919	1220	2139
2002	368	577	99	1044	611	1724	2335
2003	429	811	433	1673	852	1985	2837
2004	635	1450	1081	3166	844	2713	3557
2005	387	716	323	1426	553	1442	1995
2006	401	599	102	1102	722	1681	2403
2007	187	307	8	502	412	1012	1424
2008	373	392	272	1037	517	1106	1623
2009	143	391	168	702	292	1744	2036
2010	161	543	214	918	278	2303	2581
2011	172	525	170	867	304	2165	2469
2012	195	523	229	947	334	2293	2627
2013	167	328	88	583	309	2083	2392
2014	129	133	36	298	232	983	1215
2015	164	237	27	428	307	1499	1806
2016	136	210	41	387	279	1393	1672

Ondo State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	211	416	275	902	274	929	1203
1991	202	369	270	841	284	960	1244
1992	192	399	246	837	263	995	1258
1993	195	407	245	847	366	852	1218
1994	202	265	231	698	286	709	995
1995	190	270	179	639	258	599	857
1996	137	251	125	513	192	533	725
1997	177	258	136	571	299	396	695
1998	198	221	57	476	287	518	805
1999	148	198	128	474	203	473	676
2000	156	301	115	572	211	674	885
2001	223	263	160	646	353	782	1135
2002	51	100	242	393	181	311	492
2003	34	53	53	140	85	393	478
2004	47	75	36	158	142	490	632
2005	45	61	24	130	120	374	494
2006	54	95	19	168	145	540	685
2007	51	110	57	218	144	649	793
2008	58	106	45	209	123	365	488
2009	77	143	32	252	145	613	758
2010	64	104	32	200	140	698	838
2011	78	113	21	212	276	948	1224
2012	123	181	31	335	233	1325	1558
2013	113	185	16	314	190	1074	1264
2014	101	170	14	285	173	887	1060
2015	102	102	7	211	198	658	856
2016	129	122	4	255	238	901	1139

Osun State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	26	79	54	159	36	191	227
1992	148	242	124	514	224	774	998
1993	168	177	165	510	313	614	927
1994	105	145	90	340	121	377	498
1995	137	145	101	383	175	424	599
1996	106	163	58	327	144	532	676
1997	78	112	49	239	117	128	245
1998	112	87	41	240	149	268	417
1999	122	143	69	334	196	429	625
2000	121	96	54	271	198	820	1018
2001	187	193	95	475	345	568	913
2002	23	53	20	96	102	250	352
2003	23	57	13	93	78	291	369
2004	30	56	34	120	102	432	534
2005	60	63	75	198	108	475	583
2006	47	101	15	163	129	636	765
2007	44	107	44	195	113	715	828
2008	102	228	92	422	286	620	906
2009	76	136	50	262	133	835	968
2010	74	125	21	220	215	842	1057
2011	91	175	8	274	158	1227	1385
2012	97	167	25	289	196	1393	1589
2013	139	145	10	294	226	1179	1405
2014	118	142	6	266	190	1191	1381
2015	104	149	13	266	223	1043	1266
2016	73	158	14	245	164	949	1113

Oyo State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	509	727	542	1778	682	1926	2608
1991	466	802	499	1767	591	2048	2639
1992	350	468	325	1143	469	1366	1835
1993	362	404	245	1011	550	1255	1805
1994	266	320	209	795	362	749	1111
1995	251	302	221	774	332	666	998
1996	293	301	196	790	398	901	1299
1997	262	314	172	748	404	436	840
1998	304	330	166	800	450	827	1277
1999	202	287	141	630	305	671	976
2000	298	375	263	936	361	849	1210
2001	315	464	443	1222	393	874	1267
2002	153	312	36	501	439	1142	1581
2003	54	183	18	255	97	806	903
2004	96	109	29	234	198	662	860
2005	72	37	93	202	229	504	733
2006	69	76	0	145	140	389	529
2007	52	70	82	204	127	866	993
2008	77	140	62	279	168	504	672
2009	70	98	43	211	146	712	858
2010	118	165	16	299	213	1348	1561
2011	137	192	11	340	229	1324	1553
2012	142	172	21	335	278	1450	1728
2013	190	142	4	336	368	1491	1859
2014	145	121	6	272	277	1137	1414
2015	128	134	8	270	222	1229	1451
2016	151	162	8	321	311	1267	1578

Plateau State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	248	184	139	571	352	859	1211
1991	362	198	131	691	553	1108	1661
1992	274	164	124	562	374	831	1205
1993	257	157	99	513	355	729	1084
1994	161	111	83	355	214	483	697
1995	214	149	100	463	288	440	728
1996	205	175	106	486	216	481	697
1997	78	100	68	246	96	184	280
1998	90	126	83	299	111	246	357
1999	109	86	39	234	140	251	391
2000	111	100	90	301	911	380	1291
2001	145	181	79	405	190	546	736
2002	46	106	43	195	102	497	599
2003	26	66	17	109	49	253	302
2004	25	71	6	102	94	229	323
2005	32	103	33	168	79	319	398
2006	34	128	30	192	62	410	472
2007	38	162	110	310	84	513	597
2008	48	156	75	279	209	702	911
2009	27	120	82	229	98	308	406
2010	48	134	12	194	67	534	601
2011	41	163	37	241	126	770	896
2012	33	167	24	224	77	628	705
2013	68	232	24	324	109	902	1011
2014	63	160	22	245	106	824	930
2015	50	168	18	236	77	823	900
2016	38	77	129	244	74	674	748

Rivers State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	87	235	164	486	106	510	616
1991	149	289	239	677	213	618	831
1992	172	343	253	768	234	904	1138
1993	151	208	164	523	232	478	710
1994	105	202	198	505	133	495	628
1995	97	262	207	566	113	360	473
1996	106	279	171	556	132	408	540
1997	136	431	249	816	168	578	746
1998	152	437	200	789	179	886	1065
1999	102	274	133	509	125	498	623
2000	84	217	92	393	111	402	513
2001	126	311	199	636	184	729	913
2002	79	80	104	263	87	177	264
2003	6	28	5	39	13	48	61
2004	25	52	87	164	40	172	212
2005	28	28	30	86	38	100	138
2006	11	35	17	63	30	123	153
2007	29	58	22	109	54	218	272
2008	37	68	28	133	64	325	389
2009	23	81	51	155	34	523	557
2010	30	72	69	171	68	399	467
2011	35	86	41	162	115	373	488
2012	28	93	62	183	167	579	746
2013	46	125	75	246	82	626	708
2014	38	67	32	137	67	353	420
2015	35	37	24	96	69	261	330
2016	28	56	27	111	45	227	272

Sokoto State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	329	241	121	691	427	1124	1551
1991	295	225	116	636	464	1182	1646
1992	172	157	110	439	282	837	1119
1993	109	95	38	242	200	638	838
1994	119	116	59	294	388	467	855
1995	80	102	28	210	327	465	792
1996	60	111	39	210	160	265	425
1997	122	78	23	223	144	143	287
1998	47	35	7	89	61	152	213
1999	78	67	10	155	99	178	277
2000	50	45	6	101	55	318	373
2001	21	13	5	39	35	50	85
2002	15	43	2	60	20	99	119
2003	19	30	35	84	8	47	55
2004	19	42	29	90	33	153	186
2005	15	44	10	69	26	166	192
2006	15	37	19	71	50	299	349
2007	16	53	14	83	45	234	279
2008	30	54	20	104	43	225	268
2009	41	61	82	184	80	372	452
2010	13	68	29	110	89	231	320
2011	26	43	12	81	55	235	290
2012	20	35	8	63	33	166	199
2013	20	102	7	129	41	258	299
2014	35	111	12	158	108	341	449
2015	44	113	7	164	102	381	483
2016	26	86	10	122	73	464	537

Taraba State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	18	24	4	46	22	100	122
1992	69	50	17	136	100	174	274
1993	60	37	29	126	78	176	254
1994	59	59	1	119	74	199	273
1995	28	11	3	42	33	65	98
1996	96	38	13	147	79	133	212
1997	10	19	4	33	16	41	57
1998	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0
2000	116	107	27	250	105	382	487
2001	0	0	0	0	0	0	0
2002	34	65	13	112	69	282	351
2003	36	32	16	84	65	175	240
2004	17	31	18	66	47	214	261
2005	17	37	22	76	33	133	166
2006	23	68	45	136	28	278	306
2007	19	94	13	126	35	230	265
2008	29	70	28	127	68	539	607
2009	18	99	3	120	42	300	342
2010	15	80	12	107	15	271	286
2011	28	287	1	316	44	791	835
2012	27	120	1	148	89	394	483
2013	18	57	0	75	30	277	307
2014	11	72	0	83	27	313	340
2015	12	92	2	106	14	292	306
2016	30	125	1	156	52	499	551

Yobe State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	24	13	8	45	25	37	62
1992	55	38	32	125	74	206	280
1993	55	23	21	99	109	231	340
1994	60	66	35	161	83	215	298
1995	74	73	45	192	100	227	327
1996	82	52	83	217	87	681	768
1997	47	45	25	117	96	142	238
1998	62	41	16	119	94	303	397
1999	55	50	20	125	65	232	297
2000	102	41	14	157	180	212	392
2001	139	104	20	263	226	492	718
2002	46	120	28	194	95	499	594
2003	46	155	34	235	79	386	465
2004	34	129	16	179	120	489	609
2005	43	90	47	180	78	330	408
2006	30	48	3	81	82	343	425
2007	16	70	36	122	71	333	404
2008	54	135	57	246	160	635	795
2009	42	74	45	161	77	415	492
2010	7	16	4	27	16	117	133
2011	8	18	3	29	25	126	151
2012	27	88	6	121	70	481	551
2013	21	17	5	43	83	264	347
2014	24	34	12	70	127	382	509
2015	17	20	16	53	114	332	446
2016	50	47	4	101	114	661	775

Zamfara State

Year (a)	Fatal Cases (b)	Serious Cases (c)	Minor Cases (d)	Total Cases (e) = (b)+(c)+(d)	Persons Killed (f)	Persons Injured (g)	Total Casualty (h) = (f)+(g)
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1997	26	33	2	61	32	75	107
1998	0	0	0	0	0	0	0
1999	43	21	9	73	73	202	275
2000	0	0	0	0	0	0	0
2001	45	38	30	113	39	48	87
2002	18	35	3	56	49	107	156
2003	9	12	0	21	16	65	81
2004	8	26	48	82	27	122	149
2005	23	45	18	86	61	164	225
2006	39	58	3	100	87	426	513
2007	53	143	18	214	127	492	619
2008	34	104	41	179	97	713	810
2009	26	70	22	118	71	495	566
2010	24	108	10	142	44	561	605
2011	48	183	2	233	103	884	987
2012	65	221	21	307	152	1095	1247
2013	83	239	5	327	177	1039	1216
2014	72	189	5	266	107	809	916
2015	53	142	8	203	148	773	921
2016	43	112	9	164	90	681	771

Appendix B

- Ethical review approval.
- General health and safety risk assessment.

Ethical review approval:

Dear Professor Miles R. Tight,

Re: “Road Transport Safety in Abuja, Nigeria: An analysis of Road Traffic Crashes and Traffic Conflicts Using Traffic Conflict Techniques.”

Application for Ethical Review ERN_18-1194

Thank you for your application for ethical review for the above project, which was reviewed by the Science, Technology, Engineering and Mathematics Ethical Review Committee.

On behalf of the Committee, I confirm that this study now has full ethical approval on the proviso the following condition is met:

- Please ensure that the school’s health and safety committee approve the work prior to its commencement.

I would like to remind you that any substantive changes to the nature of the study as described in the Application for Ethical Review, and/or any adverse events occurring during the study should be promptly bought to the Committee’s attention by the Principal Investigator and may necessitate further ethical review.

Please also ensure that the relevant requirements within the University’s Code of Practice for Research and the information and guidance provided on the University’s ethics webpages (available at https://intranet.birmingham.ac.uk/finance/accounting/Research-Support-Group/Research-Ethics/Links-and-Resources.aspx) are adhered to and referred to in any future applications for ethical review. It is now a requirement on the revised application form (https://intranet.birmingham.ac.uk/finance/accounting/Research-Support-Group/Research-Ethics/Ethical-Review-Forms.aspx) to confirm that this guidance has been consulted and is understood, and that it has been taken into account when completing your application for ethical review.

Please be aware that whilst Health and Safety (H&S) issues may be considered during the ethical review process, you are still required to follow the University’s guidance on H&S and to ensure that H&S risk assessments have been carried out as appropriate. For further information about this, please contact your School H&S representative or the University’s H&S Unit at healthandsafety@contacts.bham.ac.uk.

Kind regards,

Ms Sam Waldron
Deputy Research Ethics Officer
Research Support Group

Aston Webb Building
University of Birmingham
Edgbaston B15 2TT

Tel: [redacted]
Email: [redacted]

Web: https://intranet.birmingham.ac.uk/finance/RSS/Research-Support-Group/Research-Ethics/Research-Integrity-at-the-University-of-Birmingham.aspx

Please remember to submit a new Self-Assessment Form for each new project.

Click Ethical Review Process for further details regarding the University's Ethical Review process, or emailethics-queries@contacts.bham.ac.uk with any queries.

Click Research Governance for further details regarding the University's Research Governance and Clinical Trials Insurance processes, or email researchgovernance@contacts.bham.ac.uk with any queries

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General Health and safety risk assessment:

GENERAL HEALTH AND SAFETY RISK ASSESSMENT FORM

Site: Abuja, Nigeria Department: Civil Engineering Activity: Traffic Conflict Observation and Traffic Flow Count

Risk Assessor: Uchenna Nnabuihe Uhegbu Date of Assessment: 04/10/2019 Date of Assessment Review: 04/10/2019

Academic/Managers Name: Professor Miles R. Tight Academic/Managers Signature:

E - Employee / S – Student / V – Visitor / C – Contractor

Hazards Identified	Persons at Risk (Numbers) E	S	V	C	Control measures already in place	Grading of Risk with control measures in place (Severity x Likelihood)	Are these adequate YES / NO	What further action is necessary to control the risk?	Grading of Risk after further action (Severity x Likelihood)	To be completed by (date)	Responsible Person
1. Contact with insects		S			On Arrival in Nigeria, the Student will visit a pharmacy and take the required dose of anti-malaria medicines.	1	YES	Use of Mosquito nets and pesticides in the accommodation of the research student.	1	01/11/18	Student
2. Transportation		S			Private vehicle(s) will be used to and from the site of the traffic observation.	1	YES	Family members to have research student's contact and Itinerary, as well as know where research student is, and the time due back.	1	07/12/18	Student
3. Stress		S			No accommodation stress, as the student has a family in Abuja, Nigeria.	1	YES			01/11/18	Student

	E	S	V	C							
4. Climatic extremes		S			No issues of sunburns and/or hyperthermia, as the student is already used to the hot weather in Nigeria. However, the student will also use hats, long sleeves and sunshades while in the field to prevent any sunburns.	1	YES	Enough water supplies while carrying out the traffic count, under the scorching sun.	1	07/12/18	Student
5. Stress		S			Civil Unrest, unfriendly environment and Violence from touts, due to the build-up to general elections scheduled for February 2019, will be quelled with the assistance and presence of 3 officers of The Federal Road Safety Corps (FRSC).	2	YES	On reporting to the site of field observation, the National Union of Road Transport Workers (NURTW) will be consulted to assist in quelling any arising disturbance from the touts.	1	07/12/18	Student
6. Transportation					In order to prevent any risk of being run over by vehicles or causing distraction to drivers and other road users, the student will blend into the natural background to become inconspicuous, so as to prevent influencing of the traffic behaviour.	3	YES	The student will be accompanied by officers of The Federal Road Safety Corps (FRSC), thus eliminating any arising distractions.	2	07/12/18	Student

Likelihood score	1	2	3	4	5
Frequency	Rare	Unlikely	Possible	Likely	Almost certain
Broad descriptor	This will probably never happen/occur	Do not expect it to happen/occur but it is possible it may do so	Might happen or occur occasionally	Will probably happen/occur but it is not a persisting issue	Will undoubtedly happen/occur, possibly frequently
Time-framed descriptor	Not expected to occur for years	Expected to occur at least annually	Expected to occur at least monthly	Expected to occur at least weekly	Expected to occur at least daily
Probability Will it happen or not?	<0.1 per cent	0.1–1 per cent	1.1–10 per cent	11–50 per cent	>50 per cent

	Consequence / Severity score (severity levels) and examples of descriptors				
	1	2	3	4	5
Domains	Negligible	Minor	Moderate	Major	Catastrophic
Impact on the safety of staff, students or public (physical / psychological harm)	Minimal injury not requiring first aid or requiring no/minimal intervention or treatment. No time off work	Minor injury or illness, first aid treatment needed or requiring minor intervention. Requiring time off work for <3 days	Moderate injury requiring professional intervention Requiring time off work for 4-14 days RIDDOR / MHRA / agency reportable incident	Major injury leading to long-term incapacity/ disability (loss of limb) Requiring time off work for >14 days	Incident leading to death Multiple permanent injuries or irreversible health effects

The overall ***level of risk*** is then calculated by multiplying the two scores together.

Risk Level = Consequence / Severity x Likelihood (C x L)

	Likelihood				
Likelihood score	1	2	3	4	5
	Rare	Unlikely	Possible	Likely	Almost certain
5 Catastrophic	5	10	15	20	25
4 Major	4	8	12	16	20
3 Moderate	3	6	9	12	15
2 Minor	2	4	6	8	10
1 Negligible	1	2	3	4	5

Appendix C

- Consent form for questionnaire.
- Participant Information Leaflet for questionnaire.
- Questionnaire.
- Consent form for interview.
- Participant information leaflet for interview.
- Interview questions.
- Interview response letter from the Federal Road Safety Corps (FRSC).
- Interview response letter from the Federal Ministry of Transportation.

Consent form for questionnaire:

<u>**CONSENT FORM**</u>

<u>**Title of the proposed study:**</u>

Road Transport Safety in Abuja, Nigeria: An analysis of Road Traffic Crashes and Traffic Conflicts Using Traffic Conflict Techniques.

<u>**Fair Processing Statement:**</u>

This information is being collected by Uchenna Uhegbu, a PhD Candidate of the Department of Civil Engineering in the University of Birmingham, as part of a research project concerned with identifying and assessing the causes of increasing Road Traffic Crashes (RTCs) in Abuja, Nigeria, using surrogate safety indicators. The data which you supply and that which may be collected as part of the research project will be entered into a filing system or database and will only be accessed by authorised personnel involved in this study. The information will be retained by the University of Birmingham and will only be used for the purpose of research, and statistical and audit purposes. By supplying this information you are consenting to the University storing your information for the purposes stated above. The information will be processed by the University of Birmingham in accordance with the provisions of the UK Data Protection Act of 2018. No identifiable personal data will be published.

<u>**Statements of Understanding/Consent:**</u>

I confirm that I have read and understand the participant information leaflet for this study. I have had the opportunity to ask questions if necessary and have had these answered satisfactorily.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reasons. You can withdraw your data by January 1, 2019, by contacting the researcher on If I withdraw, my data will be removed from the study and will be destroyed.

I understand that my personal data will be processed for the purposes detailed above, in accordance with the UK Data Protection Act of 2018.

☐ ***I have read this consent form and based upon the above, I consent to taking part in this study.***

<u>**Name of researcher, Signature and Date:**</u>

Name of Researcher/ Individual Obtaining Consent: ……….………………………………...........

Date: - ……………………………………   Signature: - ………………………….

N/B: A copy of this "consent form" and "the participant information leaflet" signed and dated would be administered to each participant and retained by the researcher which will be securely filed.

Participant Information Leaflet for questionnaire:

Road Transport Safety in Abuja, Nigeria: An analysis of Road Traffic Crashes and Traffic Conflicts Using Traffic Conflict Techniques (Surrogate safety indicators).

Investigators: Uchenna Uhegbu, Professor Miles Tight and Dr. Michael Burrow
Department of Civil Engineering, University of Birmingham.

Dear Participant,

Kindly read through this participant information leaflet. For the purpose of this study, if you have any questions or need further clarification, do not hesitate to ask the researcher or contact him on a later date at:

Invitation

You have been invited to take part in this PhD research project. You have been selected simply by random selection, because you are a resident of the Federal Capital Territory (FCT). Your participation in this study will not affect you or your rights in any way. If you decide to take part, it is important to understand the reason for conducting the research and what it involves. You will be requested to complete a paper-based questionnaire which will last an estimated 20 minutes. Your answers to the questionnaire will be used in the study. You are free to skip any questions you are not comfortable answering. It is important to note that participation is voluntary, therefore, you are free to withdraw at any time, should you wish to do so. Every participant has a unique ID Code assigned to the questionnaires. These Codes are located at the top left corner of the questionnaire. Should you wish to successfully withdraw from the study, your assigned ID code must be quoted to the researcher. You can withdraw your data by January 1, 2019, by contacting the researcher on

Kindly take time to carefully read the following information as well as in deciding if you wish to continue or not. Thank you for reading this.

Purpose of the Study

This research project is concerned with identifying and assessing the major causes of increasing Road Traffic Crashes (RTCs) in Abuja, Nigeria, using surrogate safety indicators. Surrogate safety indicators are indirect means of measuring road traffic safety. They serve as alternatives to accident records based safety analyses.

Reward/Reimbursement/Expenses

Participation in the study is voluntary, and will involve no form of payments. While there is no immediate reward for participating in the study, it is however believed that the findings and recommendations of this study will have a beneficial impact in drastically reducing the causes of road traffic crashes in Abuja, and in improving the overall safety of road transportation in Nigeria.

Confidentiality/Anonymity and Data Security

Your responses will be treated as anonymous and confidential and will be retained by the University of Birmingham. It will only be used for the purpose of research, and statistical and audit purposes. You will not be personally identified in any reports or publications on completion of this study. Your responses will not be shared with any third parties, however, a final report of the study will be presented to the Federal Road Safety Corps and the sponsors of the research, the Petroleum Technology Development Fund (PTDF). By supplying this information you are consenting to the University of Birmingham storing your information for the purposes stated earlier.

Results of the Study

Your responses will be used in this study and will serve only academic purposes.

Research Funding

This study is sponsored by the Petroleum Technology Development Fund (PTDF) Nigeria, and the School of Engineering, University of Birmingham.

Researcher's Contact Details

Uchenna Nnabuihe Uhegbu

Doctoral Researcher

[redacted]

Supervisors' Contact Details

Professor Miles Tight

Main Supervisor

[redacted]

Dr. Michael Burrow

Second Supervisor

[redacted]

University of Birmingham

Edgbaston

Birmingham

B15 2TT, UK

Thank you for reading this participant information leaflet.

Questionnaire:

Road Transport Safety in Abuja, Nigeria: An analysis of Road Traffic Crashes and Traffic Conflicts Using Traffic Conflict Techniques (Surrogate safety indicators)

Investigators: Uchenna Uhegbu, Professor Miles Tight and Dr. Michael Burrow
Department of Civil Engineering, University of Birmingham

Before completing this questionnaire, carefully read the participant information leaflet and consent form

☐ **I have read the information sheet and consent to taking part.**

Section A: Personal Data

1. Gender: ☐ Male ☐ Female

2. What is your marital status?

☐ Single ☐ Married ☐ Widowed ☐ Divorced ☐ Separated

3. Age:

☐ Below 18 ☐ 18 – 29 ☐ 30 – 40

☐ 41 – 50 ☐ 51 – 60 ☐ Above 60

4. Highest education received:

☐ No Education ☐ Primary school ☐ Secondary school

☐ Undergraduate ☐ Postgraduate

5. Are you in good health?

☐ Yes ☐ No

6. How long have you been a driver?

☐ 0 – 10 years ☐ 11 – 20 years ☐ 21 – 30 years ☐ 31 – 40 years ☐ above 40 years

Section B: Road Traffic Crashes

7. How bothered are you about road accidents?

☐ Not Bothered ☐ Partly Bothered ☐ Very Bothered

8. I am worried about road accidents in Abuja

☐ Strongly disagree ☐ Disagree ☐ Neither agree nor disagree

☐ Agree ☐ Strongly agree

9. In the last 6 months, have you been involved in an accident?

☐ Yes ☐ No

10. In the last 6 months, how many traffic accidents, without injuries, have you been involved in?

☐ None ☐ One ☐ Two ☐ Three ☐ Four ☐ More than Four

11. In the last 6 months, how many traffic accidents, with injuries, have you been involved in?

☐ None ☐ One ☐ Two ☐ Three ☐ Four ☐ More than Four

Skip to question 13, if you have not been involved in any road accident in the last 6 months.

12. From your point of view, who was responsible for that accident?

☐ Driver ☐ Pedestrian ☐ Driver and Pedestrian ☐ No one

13. What do you think are the major causes of road accidents in Abuja?

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

14. When do most traffic accidents in Abuja happen?

☐ Morning ☐ Afternoon ☐ Evening ☐ Night

15. What day of the week do you think most traffic accidents take place?

☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday

☐ Saturday ☐ Sunday

16. Is weather an important factor causing traffic accidents?

☐ Yes ☐ No

Section C: Driver Behaviour

17. Do you own the main vehicle you drive?

☐ Yes ☐ No

18. How old is the vehicle you mostly use?

☐ Less than 1 year ☐ 1 to 4 years ☐ 5 to 8 Years ☐ Above 8 Years

19. What is your vehicle mostly used for?

☐ Commute to work ☐ Commercial use ☐ Social use ☐ Private business

20. How many kilometres do you drive daily?

☐ Less than 40 Km ☐ 41 – 50 Km ☐ 51 – 60 Km ☐ 61 – 70 Km

☐ 71 – 80 Km ☐ 81 – 90 Km ☐ 91 – 100 Km ☐ Above 100 Km

21. Do you regularly use your seatbelt?

☐ Yes ☐ No

22. In the last week, how regularly did you use your seatbelt while driving?

☐ Always ☐ Sometimes ☐ Never

23. In the last week, how regularly did you use your seatbelt while driven by someone?

☐ Always ☐ Sometimes ☐ Never

24. Do you use your phone while driving?

☐ Always ☐ Sometimes ☐ Never

25. In the last week, how many times did you use your phone while driving?

☐ Always ☐ Sometimes ☐ Never

26. Do you drive with a child in your car?

☐ Yes ☐ No

27. Do you have a child car seat?

☐ Yes ☐ No

28. In the last week, how many times have you driven with your children while using the child car seat?

☐ None ☐ One ☐ Two ☐ Three ☐ Four ☐ Five ☐ More than Five

29. Do you take alcohol?

☐ Yes ☐ No

30. In the last month, how many times did you drink alcohol and drive?

☐ None ☐ One ☐ Two ☐ Three ☐ Four ☐ More than four

31. Over the last month, which of these (if any) forms of driving behaviours did you commit? (Kindly tick all appropriate boxes)

☐ Over Speeding

☐ Not using indicators

☐ Tailgating

☐ Driving without seatbelts

☐ Use of Phone while driving

☐ Drinking and driving

☐ Wrong-way driving (driving against traffic)

☐ Driving through a red traffic light

☐ Other (Please indicate) …………………………….

32. Which (if any) unsafe driving behaviours do you encounter most often on the road? (Kindly tick all appropriate boxes)

☐ Over Speeding

☐ Not using indicators

☐ Tailgating

☐ Driving without seatbelts

☐ Use of Phone while driving

☐ Drinking and driving

☐ Wrong-way driving (driving against traffic)

☐ Driving through a red traffic light

☐ Other (Please indicate) ……………………………………

33. As a driver, I am sometimes very angry with other drivers?

☐ Agree ☐ Disagree

34. In the last Month, have you been subjected to rage from other drivers?

☐ Yes ☐ No

Part 4: Road safety

35. What do you suggest the Federal Road Safety Corps (FRSC) should do to reduce road accidents?

………

………

………

………

36. When was the last road safety enlightenment campaign you heard of?

☐ Never heard of any ☐ Less than 6 Months Ago

☐ 6 to 12 Months Ago ☐ Over 12 Months ago

37. What is the main source of road safety enlightenment campaign you are interested in?

☐ Newspaper ☐ Radio ☐ Television ☐ Social Media ☐ Other (indicate)…………….

38. How sufficient are the amount of road safety officials on the roads?

☐ Sufficient enough ☐ Not sufficient

Skip to question 42, if you have not been stopped by the road safety in the last 6 months.

39. In the last 6 months, how many times have you been stopped by the road safety while driving?

☐ None ☐ Once ☐ Twice ☐ Thrice ☐ More than Thrice

40. In the last 6 months, what were the reasons the road safety gave for stopping you?

(Kindly tick all appropriate boxes)

☐ Over Speeding

☐ Not using indicators

☐ Tailgating

☐ Driving without seatbelts

- [ ] Use of Phone while driving
- [ ] Drinking and driving
- [ ] Wrong-way driving (driving against traffic)
- [ ] Driving through traffic lights
- [ ] Other (Please indicate) ……………………………………

41. Did you change your driving behaviour as a result of the road safety stopping you?

- [ ] Yes
- [ ] No

42. Do you think the road safety judiciously enforces penalties for traffic violations?

- [ ] Yes
- [ ] No

43. In the last 6 months, have you officially or unofficially paid for violating traffic rules?

- [ ] Yes
- [ ] No

44. If you saw a road user breaking traffic rules, would you take action?

- [ ] Yes
- [ ] No

45. Will you report the offence to the road safety?

- [ ] Yes
- [ ] No

46. Any suggestions to improve road safety in Abuja?

……

……

……

……

Thank you for your help with this study.

Consent form for interview:

CONSENT FORM

Title of the proposed study:

Road Transport Safety in Abuja, Nigeria: An analysis of Road Traffic Crashes and Traffic Conflicts Using Traffic Conflict Techniques.

Fair Processing Statement:

This interview is conducted by Uchenna Uhegbu, a PhD Candidate of the Department of Civil Engineering in the University of Birmingham, as part of a research project concerned with identifying and assessing the causes of increasing Road Traffic Crashes (RTCs) in Abuja, Nigeria, using Traffic Conflict Techniques (TCT). The conversation will take about 30 minutes. The responses to the interview questions as part of the research project will be recorded and will only be accessed by authorised personnel involved in this study. The answers will be retained by the University of Birmingham and will only be used for the purpose of research, statistical and audit purposes only. By agreeing to hold the interview, you are consenting to the University storing your information for the purposes stated above. The information will be processed by the University of Birmingham in accordance with the provisions of the UK Data Protection Act of 2018.

Participant consent:

1. I understand the aim and objective of this study and I can refuse to answer any particular question.

2. I have been provided with a copy of this interview consent form.

3. I have the right to ask questions with respect to the study, and receive answers from the researcher.

4. I am free to withdraw from the study for any given reason, by January 1, 2019, by contacting the researcher on

5. If I withdraw, my data will be removed from the study and will be destroyed

6. The conversation will be recorded and transcribed and will be stored until the completion of study.

Name of Participant: ………………………………..……….……………………………...........

Date: - ……………………………………   Signature: - ………………………….

Name of Researcher/ Individual Obtaining Consent: ……….……………………………...........

Date: - ……………………………………   Signature: - ………………………….

Participant information leaflet for interview:

Road Transport Safety in Abuja, Nigeria: An analysis of Road Traffic Crashes and Traffic Conflicts Using Traffic Conflict Techniques (Surrogate safety indicators).

Investigators: Uchenna Uhegbu, Professor Miles Tight and Dr. Michael Burrow
Department of Civil Engineering, University of Birmingham.

Dear Participant,

Kindly read through this participant information leaflet. For the purpose of this study, if you have any questions or need further clarification, do not hesitate to ask the researcher or contact him on a later date at: [redacted]

Invitation

You have been invited to take part in this PhD research project. It is important to note that participation is voluntary, therefore, you are free to withdraw at any time, should you wish to do so. You can withdraw your data by January 1, 2019, by contacting the researcher on [redacted] You have been selected simply because you are among the best people to provide the information needed for this study, since you are a key player in Nigeria's transportation industry. Your participation in this study will not affect you or your rights in any way. If you decide to take part, it is important to understand the reason for conducting the research and what it involves. You will be requested to answer some interview questions which will last an estimated 30 minutes. Your answers to these questions will be used in the study. You are free to skip any questions you are not comfortable answering. Kindly take time to carefully read the following information as well as in deciding if you wish to continue or not. Thank you for reading this.

Purpose of the Study

This research project is concerned with identifying and assessing the major causes of increasing Road Traffic Crashes (RTCs) in Abuja, Nigeria, using traffic conflict techniques (surrogate safety indicators). Surrogate safety indicators are indirect means of measuring road traffic safety. They serve as alternatives to accident records based safety analyses.

Reward/Reimbursement/Expenses

Participation in the study is voluntary, and will involve no form of payments. While there is no immediate reward for participating in the study, it is however believed that the findings and recommendations of this study will have a beneficial impact in drastically reducing the causes of road traffic crashes in Abuja, and in improving the overall safety of road transportation in Nigeria.

Confidentiality/Anonymity and Data Security

Your responses will not be treated as anonymous and/or confidential and will be retained by the University of Birmingham. Your responses will be used for the purpose of research, and statistical and audit purposes only. You will be cited in any reports or publications resulting from this study and a PhD thesis on completion of the research programme. A final report of the study will be presented to the Federal Road Safety Corps and the sponsors of the research, the Petroleum Technology Development Fund (PTDF). By supplying this information you are consenting to the University of Birmingham storing your information for the purposes stated earlier.

Results of the Study

Your responses will be used in this study and will serve only academic purposes.

Research Funding

This study is sponsored by the Petroleum Technology Development Fund (PTDF) Nigeria, and the School of Engineering, University of Birmingham.

Researcher's Contact Details

Uchenna Nnabuihe Uhegbu

Doctoral Researcher

Supervisors' Contact Details

Professor Miles Tight

Main Supervisor

Dr. Michael Burrow

Second Supervisor

University of Birmingham

Edgbaston

Birmingham

B15 2TT, UK

Thank you for reading this participant information leaflet.

Interview Questions:

<u>Interview Questions</u>

1. What are the causes of traffic accidents in Abuja and generally in Nigeria?

    - Have you been involved in any accident?
    - If yes, what were the cause(s)?

2. How many traffic officers are working in the field of traffic law enforcement?

    - How much experience do they have?
    - What type of training courses do they have?

3. Describe the traffic safety campaigns (if any) carried out in Nigeria over the last 12 months.

    - How effective have these campaigns been?
    - How can we engage in more traffic safety awareness programs?

4. Does Nigeria have a working traffic safety law?

    - What are the difficulties faced with respect to enforcing traffic safety laws?
    - How can we improve the enforcement of these traffic laws in Abuja?

5. Do you have any recommendations for traffic accidents risk reduction?

    - What precautions should be taken to ensure traffic safety in Abuja's roads?
    - Which of these recommendations is the most important?

Interview response letter from the Federal Road Safety Corps (FRSC):

FEDERAL ROAD SAFETY CORPS

DEPARTMENT OF POLICY, RESEARCH & STATISTICS

NATIONAL HEADQUARTERS
4 Maputo Street
Zone 3, Wuse District
P.M.B. 125, Wuse, Abuja-Nigeria.
Website: www.frsc.gov.ng
E-mail: prs@frsc.gov.ng
Tel: [redacted]

FRSC/HQ/PRS/617/VOL.I/32

27 Nov., 2018

Uchenna Nabuike Uhegbu
Doctoral Researcher,
University of Birmingham.

RE: ROAD TRANSPORT SAFETY IN ABUJA, NIGERIA: ANALYSIS OF ROAD TRAFFIC CRASHES AND TRAFFIC CONFLICT USING TRAFFIC CONFLICT TECHNIQUES (SURROGATE SAFETY INDICATORS)

The above subject refers, please.

2. Corps Marshal has approved the release of the answers to your questionnaire for the above study.

3. Accept the assurances of our highest regards.

[redacted]

ACM Kayode J. Fanola, mni
Assistant Corps Marshal
ACM Policy, Research and Statistics
For: Corps Marshal

Interview response letter from the Federal Ministry of Transportation:

FEDERAL MINISTRY OF TRANSPORTATION

ROAD TRANSPORT AND MASS TRANSIT ADMINISTRATION DEPARTMENT
BUKAR DIPCHARIMA HOUSE
Central Business District, Off 3rd Avenue, P.M.B. 0336, Abuja.

Tel:
Fax:

Ref: RT/MTA/325/18/1/6
Date: 13th December, 2018.

The Supervisor,
Professor Miles Tight, University of Birmingham,
Edgbaston, Birmingham, B15 2TT,UK.

RE: ROAD TRANSPORT SAFETY IN ABUJA, NIGERIA: AN ANALYSIS OF ROAD TRAFFIC CRASHES AND TRAFFIC CONFLICTS USING TRAFFIC CONFLICT TECHNIQUES (SURROGATE SAFETY INDICATORS)

I am directed to acknowledge receipt of your letter on the above subject and inform you that the Federal Ministry of Transportation Nigeria (FMoT) is willing to participate in the Research Project.

2. I am to further inform you that the Ministry plays a strategic and pivotal role in the Road Safety Policy Development and is a Member of key institutional management for Road Safety within Nigeria as well as internationally. It also partners with various Stakeholders towards the realization of the objectives of the United Nations Decade of Action on road safety.

3. It would therefore be apposite for you to link up with the Department responsible for Road Safety issues in the Ministry. For this purpose, you may wish to contact:

(i) **Anthonia** A Ekpa, PhD, [redacted]
(ii) **Usenekong Akpan,** [redacted]

4. While appreciating your efforts towards reducing road crashes in Nigeria, please accept the warm regards of the Honourable Minister.

[redacted]

Anthonia A. Ekpa, PhD
Director, Road Transport & Mass Transit Administration
For: Honourable Minister.

Appendix D

- Sample DOCTOR Observation sheet.
- TTC Estimation.

Sample DOCTOR Observation form:

DOCTOR OBSERVATION SHEET | no:

OBSERVER

WEATHER: sun ☐ cloudy ☐ rain ☐

ROAD: dry ☐ wet ☐

DATE:

LOCATION:

MUNICIPALITY:

OBSERVATION-PERIOD:

SEVERITY OF CONFLICT

1	2	3	4	5

slight — severe

MIN. TTC

0 0,5s 1,0s 1,5s 2,0s >

TIME CONFLICT

PET

0 0,5s 1,0s >

EXTENT OF CONSEQUENCES

☐ ☐ ☐ ☐

small — great

CONFLICTTYPE ⟶ or ⟵

roadusers	Nr. 1	Nr. 2	Nr. 3
car	☐	☐	
lorry, bus	☐	☐	
moped	☐	☐	
bicycle	☐	☐	
pedestrian	☐	☐	
other	☐	☐	

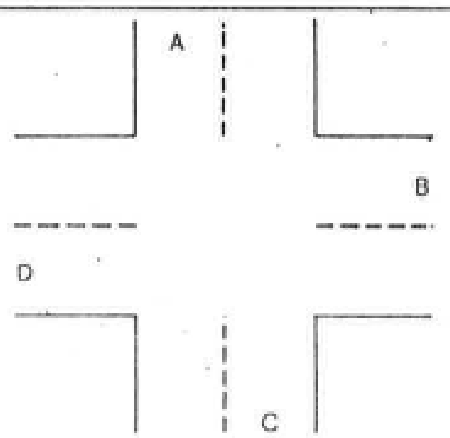
SPEED

0 - 15 km/hr	☐	☐
15 - 30 km/hr	☐	☐
30 - 50 km/hr	☐	☐
50 - 70 km/hr	☐	☐
70 - 100 km/hr	☐	☐
> 100 km/hr	☐	☐

AVOIDING ACTIONS

no reaction	☐	☐
controlled	☐	☐
uncontrolled	☐	☐
braking	☐	☐
accelerating	☐	☐
swerving	☐	☐

MANOEUVRE AND PARTICIPANTS



* PLACE OBSERVER

REMARKS:

TTC Estimation

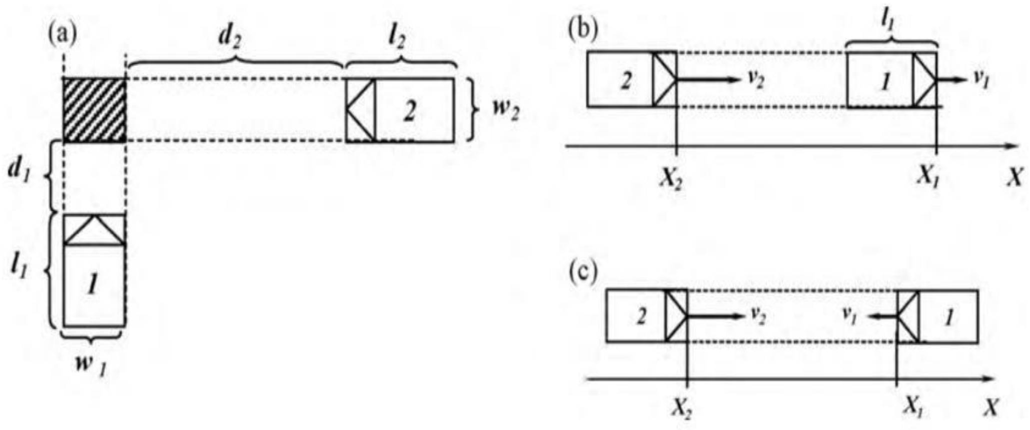


Figure D1: Estimation of Time – To – Collision (TTC) (Laureshyn et al., 2010).

The time – to – Collison (TTC) is the time required for the collision of two road users, when there are no changes in their speed and they maintain same paths without an evasive manoeuvre. The lowest value that is reached during the approach process is given by TTC min.

The general assumption in the estimation of TTC is that "*road users' trajectories cross at a right angle or are parallel*". This is shown in Figure D1 above.

The TTC for a right – angle collision course (Figure D1a), according to van der Horst, (1990), is estimated by:

$$\begin{aligned} \mathrm{TTC} &= \frac{d_2}{v_2}, \quad \text{if } \frac{d_1}{v_1} < \frac{d_2}{v_2} < \frac{d_1 + l_1 + w_2}{v_1} \\ \mathrm{TTC} &= \frac{d_1}{v_1}, \quad \text{if } \frac{d_2}{v_2} < \frac{d_1}{v_1} < \frac{d_2 + l_2 + w_1}{v_2} \end{aligned},$$

From Figure D1(a): l_1, l_2 and w_1, w_2 are the lengths and widths of vehicles 1 and 2, respectively; d_1 and d_2 are distances from the fronts of vehicles 1 and 2, respectively, to the area of intersection, and v_1 *and* v_2 are the vehicle speeds for vehicles 1 and 2 respectively (Laureshyn et al., 2010).

According to Minderhoud and Bovy, (2001), the TTC for a rear – end collision [Figure D1 (b)] is:

$$\mathrm{TTC} = \frac{X_1 - X_2 - l_1}{v_1 - v_2}, \quad \text{if } v_2 > v_1,$$

And for a head – on collision [Figure D1 (c)] is:

$$\mathrm{TTC} = \frac{X_1 - X_2}{v_1 + v_2}.$$

Where x_1 and x_2 are the vehicle positions.

Based on the assumption that vehicles are rectangular in form, and that different collision types exist, all possible 32 collision scenarios need to be analysed (Laureshyn et al., 2010).

Appendix E

- Questionnaire analysis

Questionnaire analysis:

Table E1: Chi-Square of how bothered respondents are about road accidents and gender

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	14.955[a]	1	.000		
Continuity Correction[b]	13.704	1	.000		
Likelihood Ratio	14.164	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	321				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 16.30.					
b. Computed only for a 2x2 table					

Table E2: Chi-Square of how bothered respondents are about road accidents and marital status

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	54.193[a]	4	.000
Likelihood Ratio	49.180	4	.000
N of Valid Cases	321		
a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is .15.			

Table E3: Chi-Square of how bothered respondents are about road accidents and age

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	25.690[a]	5	.000
Likelihood Ratio	24.970	5	.000
N of Valid Cases	321		
a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is 1.05.			

Table E4: Chi-Square of how bothered respondents are about road accidents and highest education received

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	116.100[a]	4	.000
Likelihood Ratio	98.383	4	.000
N of Valid Cases	321		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 1.20.			

Table E5: Chi-Square of how bothered respondents are about road accidents and driving experience

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.906[a]	4	.008
Likelihood Ratio	16.208	4	.003
N of Valid Cases	321		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 2.09.			

Table E6: Cross tabulation of gender and if respondents have been involved in a road accident in the last 6 months

Gender * In the last 6 months, have you been involved in an accident Cross tabulation					
			In the last 6 months, have you been involved in an accident		Total
			Yes	No	
Gender	Male	Count	69	143	212
		% within Gender	32.5%	67.5%	100.0%
	Female	Count	26	83	109
		% within Gender	23.9%	76.1%	100.0%
Total		Count	95	226	321
		% within Gender	29.6%	70.4%	100.0%

Table E7: Cross tabulation of marital status and if respondents have been involved in a road accident in the last 6 months

Marital Status * In the last 6 months, have you been involved in an accident Cross tabulation

			In the last 6 months, have you been involved in an accident		Total
			Yes	No	
Marital Status	Single	Count	27	65	92
		% within Marital Status	29.3%	70.7%	100.0%
	Married	Count	67	119	186
		% within Marital Status	36.0%	64.0%	100.0%
	Widowed	Count	1	26	27
		% within Marital Status	3.7%	96.3%	100.0%
	Divorced	Count	0	1	1
		% within Marital Status	0.0%	100.0%	100.0%
	Separated	Count	0	15	15
		% within Marital Status	0.0%	100.0%	100.0%
Total		Count	95	226	321
		% within Marital Status	29.6%	70.4%	100.0%

Table E8: Cross tabulation of age and if respondents have been involved in a road accident in the last 6 months

Age Group * In the last 6 months, have you been involved in an accident Cross tabulation

			In the last 6 months, have you been involved in an accident		Total
			Yes	No	
Age Group	<18	Count	0	7	7
		% within Age Group	0.0%	100.0%	100.0%
	18 - 29	Count	33	33	66
		% within Age Group	50.0%	50.0%	100.0%
	30 - 40	Count	44	47	91
		% within Age Group	48.4%	51.6%	100.0%
	41 - 50	Count	18	103	121
		% within Age Group	14.9%	85.1%	100.0%
	51 - 60	Count	0	14	14
		% within Age Group	0.0%	100.0%	100.0%
	>60	Count	0	22	22
		% within Age Group	0.0%	100.0%	100.0%
Total		Count	95	226	321
		% within Age Group	29.6%	70.4%	100.0%

Table E9: Cross tabulation of highest education received and if respondents have been involved in a road accident in the last 6 months

Highest Education Received * In the last 6 months, have you been involved in an accident Cross tabulation					
			In the last 6 months, have you been involved in an accident		Total
			Yes	No	
Highest Education Received	No Education	Count	2	6	8
		% within Highest Education Received	25.0%	75.0%	100.0%
	Primary School	Count	2	17	19
		% within Highest Education Received	10.5%	89.5%	100.0%
	Secondary School	Count	37	64	101
		% within Highest Education Received	36.6%	63.4%	100.0%
	Undergraduate	Count	48	103	151
		% within Highest Education Received	31.8%	68.2%	100.0%
	Postgraduate	Count	6	36	42
		% within Highest Education Received	14.3%	85.7%	100.0%
Total		Count	95	226	321
		% within Highest Education Received	29.6%	70.4%	100.0%

Table E10: Cross tabulation of driving experience and if respondents have been involved in a road accident in the last 6 months

How Long Have You Been A Driver * In the last 6 months, have you been involved in an accident Cross tabulation					
			In the last 6 months, have you been involved in an accident		Total
			Yes	No	
How Long Have You Been A Driver	0 - 10	Count	47	56	103
		% within How Long Have You Been A Driver	45.6%	54.4%	100.0%
	11 - 20	Count	24	28	52
		% within How Long Have You Been A Driver	46.2%	53.8%	100.0%
	21 - 30	Count	24	113	137
		% within How Long Have You Been A Driver	17.5%	82.5%	100.0%
	31 - 40	Count	0	15	15
		% within How Long Have You Been A Driver	0.0%	100.0%	100.0%
	Above 40	Count	0	14	14
		% within How Long Have You Been A Driver	0.0%	100.0%	100.0%
Total		Count	95	226	321
		% within How Long Have You Been A Driver	29.6%	70.4%	100.0%

Table E11: Chi-Square if respondents have been involved in an accident in the last 6 months and marital status

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.102[a]	4	.001
Likelihood Ratio	26.911	4	.000
N of Valid Cases	321		

a. 3 cells (30.0%) have expected count less than 5. The minimum expected count is .30.

Table E12: Chi-Square if respondents have been involved in an accident in the last 6 months and age

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	59.210[a]	5	.000
Likelihood Ratio	70.624	5	.000
N of Valid Cases	321		
a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is 2.07.			

Table E13: Chi-Square if respondents have been involved in an accident in the last 6 months and highest education received

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.871[a]	4	.028
Likelihood Ratio	12.174	4	.016
N of Valid Cases	321		
a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 2.37.			

Table E14: Chi-Square if respondents have been involved in an accident in the last 6 months and driving experience

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	41.335[a]	4	.000
Likelihood Ratio	49.028	4	.000
N of Valid Cases	321		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 4.14.			

Table E15: Chi-Square if respondents have been involved in an accident in the last 6 months and gender

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.611[a]	1	.106		
Continuity Correction[b]	2.211	1	.137		
Likelihood Ratio	2.669	1	.102		
Fisher's Exact Test				.122	.067
N of Valid Cases	321				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 32.26.

b. Computed only for a 2x2 table

Table E16: Cross tabulation of gender and if respondents have been involved in an accident in the last 6 months that resulted in injuries

Gender * In the last 6 months, have you been involved in a traffic accident that resulted in injuries. Cross tabulation

			In the last 6 months, how many traffic accidents, with injuries, have you been involved in		Total
			No	Yes	
Gender	Male	Count	177	35	212
		% within Gender	83.5%	16.5%	100.0%
	Female	Count	100	9	109
		% within Gender	91.7%	8.3%	100.0%
Total		Count	277	44	321
		% within Gender	86.3%	13.7%	100.0%

Table E17: Cross tabulation of marital status and if respondents have been involved in an accident in the last 6 months that resulted in injuries

Marital Status * In the last 6 months, have you been involved in a traffic accident that resulted in injuries.
Cross tabulation

			In the last 6 months, how many traffic accidents, with injuries, have you been involved in		Total
			No	Yes	
Marital Status	Single	Count	83	9	92
		% within Marital Status	90.2%	9.8%	100.0%
	Married	Count	152	34	186
		% within Marital Status	81.7%	18.3%	100.0%
	Widowed	Count	26	1	27
		% within Marital Status	96.3%	3.7%	100.0%
	Divorced	Count	1	0	1
		% within Marital Status	100.0%	0.0%	100.0%
	Separated	Count	15	0	15
		% within Marital Status	100.0%	0.0%	100.0%
Total		Count	277	44	321
		% within Marital Status	86.3%	13.7%	100.0%

Table E18: Cross tabulation of age group and if respondents have been involved in an accident in the last 6 months that resulted in injuries

Age Group * In the last 6 months, have you been involved in a traffic accident that resulted in injuries. Cross tabulation

			In the last 6 months, how many traffic accidents, with injuries, have you been involved in		Total
			No	Yes	
Age Group	<18	Count	7	0	7
		% within Age Group	100.0%	0.0%	100.0%
	18 - 29	Count	55	11	66
		% within Age Group	83.3%	16.7%	100.0%
	30 - 40	Count	67	24	91
		% within Age Group	73.6%	26.4%	100.0%
	41 - 50	Count	112	9	121
		% within Age Group	92.6%	7.4%	100.0%
	51 - 60	Count	14	0	14
		% within Age Group	100.0%	0.0%	100.0%
	>60	Count	22	0	22
		% within Age Group	100.0%	0.0%	100.0%
Total		Count	277	44	321
		% within Age Group	86.3%	13.7%	100.0%

Table E19: Cross tabulation of highest education received and if respondents have been involved in an accident in the last 6 months that resulted in injuries

Highest Education Received * In the last 6 months, have you been involved in a traffic accident that resulted in injuries. Cross tabulation					
			In the last 6 months, have you been involved in road accidents that resulted to injuries		Total
			No	Yes	
Highest Education Received	No Education	Count	7	1	8
		% within Highest Education Received	87.5%	12.5%	100.0%
	Primary School	Count	18	1	19
		% within Highest Education Received	94.7%	5.3%	100.0%
	Secondary School	Count	78	23	101
		% within Highest Education Received	77.2%	22.8%	100.0%
	Undergraduate	Count	133	18	151
		% within Highest Education Received	88.1%	11.9%	100.0%
	Postgraduate	Count	41	1	42
		% within Highest Education Received	97.6%	2.4%	100.0%
Total		Count	277	44	321
		% within Highest Education Received	86.3%	13.7%	100.0%

Table E20: Cross tabulation of driving experience and if respondents have been involved in an accident in the last 6 months that resulted in injuries

How Long Have You Been A Driver * In the last 6 months, have you been involved in traffic accidents that resulted to injuries. Cross tabulation

			In the last 6 months, , have you been involved in traffic accidents that resulted to injuries		Total
			No	Yes	
How Long Have You Been A Driver	0 - 10	Count	83	20	103
		% within How Long Have You Been A Driver	80.6%	19.4%	100.0%
	11 - 20	Count	39	13	52
		% within How Long Have You Been A Driver	75.0%	25.0%	100.0%
	21 - 30	Count	126	11	137
		% within How Long Have You Been A Driver	92.0%	8.0%	100.0%
	31 - 40	Count	15	0	15
		% within How Long Have You Been A Driver	100.0%	0.0%	100.0%
	Above 40	Count	14	0	14
		% within How Long Have You Been A Driver	100.0%	0.0%	100.0%
Total		Count	277	44	321
		% within How Long Have You Been A Driver	86.3%	13.7%	100.0%

Table E21: Chi-Square if respondents have been involved in an accident in the last 6 months that resulted in injuries and gender of respondents

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.145[a]	1	.042		
Continuity Correction[b]	3.477	1	.062		
Likelihood Ratio	4.460	1	.035		
Fisher's Exact Test				.058	.028
N of Valid Cases	321				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.94.

b. Computed only for a 2x2 table

Table E22: Chi-Square if respondents have been involved in an accident in the last 6 months that resulted in injuries and age of respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23.683[a]	5	.000
Likelihood Ratio	27.988	5	.000
N of Valid Cases	321		
a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is .96.			

Table E23: Chi-Square if respondents have been involved in an accident in the last 6 months that resulted in injuries and highest education received

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	13.135[a]	4	.011
Likelihood Ratio	14.529	4	.006
N of Valid Cases	321		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 1.10.			

Table E24: Chi-Square if respondents have been involved in an accident in the last 6 months that resulted in injuries and driving experience of respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.786[a]	4	.002
Likelihood Ratio	20.093	4	.000
N of Valid Cases	321		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 1.92.			

Table E25: Chi-Square if respondents have been involved in an accident in the last 6 months that resulted in injuries and marital status

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.311[a]	4	.054
Likelihood Ratio	12.140	4	.016
N of Valid Cases	321		
a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is .14.			

Table E26: Cross tabulation of gender and when most traffic accidents happen in Abuja

Gender * When do most traffic accidents in Abuja happen Cross tabulation							
			When do most traffic accidents in Abuja happen				Total
			Morning	Afternoon	Evening	Night	
Gender	Male	Count	8	19	57	128	212
		% within Gender	3.8%	9.0%	26.9%	60.4%	100.0%
	Female	Count	15	33	20	41	109
		% within Gender	13.8%	30.3%	18.3%	37.6%	100.0%
Total		Count	23	52	77	169	321
		% within Gender	7.2%	16.2%	24.0%	52.6%	100.0%

Table E27: Cross tabulation of marital status and when most traffic accidents happen in Abuja

What is your marital status * When do most traffic accidents in Abuja happen Cross tabulation							
			When do most traffic accidents in Abuja happen				Total
			Morning	Afternoon	Evening	Night	
What is your marital status	Single	Count	14	15	13	50	92
		% within What is your marital status	15.2%	16.3%	14.1%	54.3%	100.0%
	Married	Count	6	33	55	92	186
		% within What is your marital status	3.2%	17.7%	29.6%	49.5%	100.0%
	Widowed	Count	2	2	8	15	27
		% within What is your marital status	7.4%	7.4%	29.6%	55.6%	100.0%
	Separated	Count	1	2	1	12	16
		% within What is your marital status	6.3%	12.5%	6.3%	75.0%	100.0%
Total		Count	23	52	77	169	321
		% within What is your marital status	7.2%	16.2%	24.0%	52.6%	100.0%

Table E28: Cross tabulation of age and when most traffic accidents happen in Abuja

Age * When do most traffic accidents in Abuja happen Cross tabulation							
			When do most traffic accidents in Abuja happen				Total
			Morning	Afternoon	Evening	Night	
Age	< 18	Count	6	0	0	1	7
		% within Age	85.7%	0.0%	0.0%	14.3%	100.0%
	18 - 29	Count	6	10	24	26	66
		% within Age	9.1%	15.2%	36.4%	39.4%	100.0%
	30 - 40	Count	3	26	14	48	91
		% within Age	3.3%	28.6%	15.4%	52.7%	100.0%
	41 - 50	Count	3	11	36	71	121
		% within Age	2.5%	9.1%	29.8%	58.7%	100.0%
	51 - 60	Count	5	0	1	8	14
		% within Age	35.7%	0.0%	7.1%	57.1%	100.0%
	> 60	Count	0	5	2	15	22
		% within Age	0.0%	22.7%	9.1%	68.2%	100.0%
Total		Count	23	52	77	169	321
		% within Age	7.2%	16.2%	24.0%	52.6%	100.0%

Table E29: Cross tabulation of highest education received and when most traffic accidents happen in Abuja

Highest Education Received * When do most traffic accidents in Abuja happen Cross tabulation							
			When do most traffic accidents in Abuja happen				Total
			Morning	Afternoon	Evening	Night	
Highest Education Received	No Education	Count	1	1	1	5	8
		% within Highest Education Received	12.5%	12.5%	12.5%	62.5 %	100.0%
	Primary School	Count	2	3	3	11	19
		% within Highest Education Received	10.5%	15.8%	15.8%	57.9 %	100.0%
	Secondary School	Count	8	17	27	49	101
		% within Highest Education Received	7.9%	16.8%	26.7%	48.5 %	100.0%
	Undergraduate	Count	8	24	41	78	151
		% within Highest Education Received	5.3%	15.9%	27.2%	51.7 %	100.0%
	Post Graduate	Count	4	7	5	26	42
		% within Highest Education Received	9.5%	16.7%	11.9%	61.9 %	100.0%
Total		Count	23	52	77	169	321
		% within Highest Education Received	7.2%	16.2%	24.0%	52.6 %	100.0%

Table E30: Cross tabulation of driving experience and when most traffic accident happen in Abuja

How Long Have You Been A Driver * When do most traffic accidents in Abuja happen Cross tabulation							
			When do most traffic accidents in Abuja happen				Total
			Morning	Afternoon	Evening	Night	
How Long Have You Been A Driver	0 - 10	Count	12	21	26	44	103
		% within How Long Have You Been A Driver	11.7%	20.4%	25.2%	42.7%	100.0%
	11 - 20	Count	2	11	13	26	52
		% within How Long Have You Been A Driver	3.8%	21.2%	25.0%	50.0%	100.0%
	21 - 30	Count	6	16	36	79	137
		% within How Long Have You Been A Driver	4.4%	11.7%	26.3%	57.7%	100.0%
	31 - 40	Count	3	2	0	10	15
		% within How Long Have You Been A Driver	20.0%	13.3%	0.0%	66.7%	100.0%
	Above 40	Count	0	2	2	10	14
		% within How Long Have You Been A Driver	0.0%	14.3%	14.3%	71.4%	100.0%
Total		Count	23	52	77	169	321
		% within How Long Have You Been A Driver	7.2%	16.2%	24.0%	52.6%	100.0%

Table E31: Chi-Square of when most traffic accident happen in Abuja and gender of respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	39.481[a]	3	.000
Likelihood Ratio	37.885	3	.000
N of Valid Cases	321		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.81.			

Table E32: Chi-Square of when most traffic accident happen in Abuja and marital status of respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	24.642[a]	9	.003
Likelihood Ratio	25.147	9	.003
N of Valid Cases	321		
a. 5 cells (31.3%) have expected count less than 5. The minimum expected count is 1.15.			

Table E33: Chi-Square of when most traffic accidents happen in Abuja and age of respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	120.253[a]	15	.000
Likelihood Ratio	80.213	15	.000
N of Valid Cases	321		
a. 10 cells (41.7%) have expected count less than 5. The minimum expected count is .50.			

Table E34: Chi-Square of when most traffic accidents happen in Abuja and driving experience of respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22.054[a]	12	.037
Likelihood Ratio	25.554	12	.012
N of Valid Cases	321		
a. 7 cells (35.0%) have expected count less than 5. The minimum expected count is 1.00.			

Table E35: Chi-Square of when most traffic accidents happen in Abuja and highest level of education received by respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.630[a]	12	.813
Likelihood Ratio	8.258	12	.765
N of Valid Cases	321		
a. 8 cells (40.0%) have expected count less than 5. The minimum expected count is .57.			

Table E36: Cross tabulation of gender and if respondents use their seatbelt regularly

Gender * Do you regularly use your seatbelt Cross tabulation					
			Do you regularly use your seatbelt		Total
			NO	YES	
Gender	Male	Count	142	70	212
		% within Gender	67.0%	33.0%	100.0%
	Female	Count	64	45	109
		% within Gender	58.7%	41.3%	100.0%
Total		Count	206	115	321
		% within Gender	64.2%	35.8%	100.0%

Table E37: Cross tabulation of marital status and if respondents use their seatbelts regularly

What is your marital status * Do you regularly use your seatbelt Cross tabulation					
			Do you regularly use your seatbelt		Total
			NO	YES	
What is your marital status	Divorced	Count	3	2	5
		% within What is your marital status	60.0%	40.0%	100.0%
	Married	Count	124	62	186
		% within What is your marital status	66.7%	33.3%	100.0%
	Separated	Count	3	8	11
		% within What is your marital status	27.3%	72.7%	100.0%
	Single	Count	66	26	92
		% within What is your marital status	71.7%	28.3%	100.0%
	Widowed	Count	10	17	27
		% within What is your marital status	37.0%	63.0%	100.0%
Total		Count	206	115	321
		% within What is your marital status	64.2%	35.8%	100.0%

Table E38: Cross tabulation of age and if respondents use their seatbelts regularly

Age * Do you regularly use your seatbelt Cross tabulation					
			Do you regularly use your seatbelt		Total
			NO	YES	
Age	< 18	Count	3	4	7
		% within Age	42.9%	57.1%	100.0%
	18 - 29	Count	46	20	66
		% within Age	69.7%	30.3%	100.0%
	30 - 40	Count	65	26	91
		% within Age	71.4%	28.6%	100.0%
	41 - 50	Count	81	40	121
		% within Age	66.9%	33.1%	100.0%
	51 - 60	Count	4	10	14
		% within Age	28.6%	71.4%	100.0%
	> 60	Count	7	15	22
		% within Age	31.8%	68.2%	100.0%
Total		Count	206	115	321
		% within Age	64.2%	35.8%	100.0%

Table E39: Cross tabulation of highest education received and if respondents use their seatbelts regularly

Highest Education Received * Do you regularly use your seatbelt Cross tabulation					
			Do you regularly use your seatbelt		Total
			NO	YES	
Highest Education Received	No Education	Count	6	2	8
		% within Highest Education Received	75.0%	25.0%	100.0%
	Primary School	Count	15	4	19
		% within Highest Education Received	78.9%	21.1%	100.0%
	Secondary School	Count	70	31	101
		% within Highest Education Received	69.3%	30.7%	100.0%
	Undergraduate	Count	101	50	151
		% within Highest Education Received	66.9%	33.1%	100.0%
	Post Graduate	Count	14	28	42
		% within Highest Education Received	33.3%	66.7%	100.0%
Total		Count	206	115	321
		% within Highest Education Received	64.2%	35.8%	100.0%

Table E40: Cross tabulation of driving experience and if respondents use their seatbelts regularly

How Long Have You Been A Driver * Do you regularly use your seatbelt Cross tabulation					
			Do you regularly use your seatbelt		Total
			NO	YES	
How Long Have You Been A Driver	0 - 10	Count	72	31	103
		% within How Long Have You Been A Driver	69.9%	30.1%	100.0%
	11 - 20	Count	36	16	52
		% within How Long Have You Been A Driver	69.2%	30.8%	100.0%
	21 - 30	Count	88	49	137
		% within How Long Have You Been A Driver	64.2%	35.8%	100.0%
	31 - 40	Count	10	5	15
		% within How Long Have You Been A Driver	66.7%	33.3%	100.0%
	Above 40	Count	0	14	14
		% within How Long Have You Been A Driver	0.0%	100.0%	100.0%
Total		Count	206	115	321
		% within How Long Have You Been A Driver	64.2%	35.8%	100.0%

Table E41: Chi-Square of if respondents use their seatbelts regularly and marital status of respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	17.994[a]	4	.001
Likelihood Ratio	17.294	4	.002
N of Valid Cases	321		

a. 3 cells (30.0%) have expected count less than 5. The minimum expected count is 1.79.

Table E42: Chi-Square of if respondents use their seatbelts regularly and age of respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22.482[a]	5	.000
Likelihood Ratio	21.587	5	.001
N of Valid Cases	321		
a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is 2.51.			

Table E43: Chi-Square of if respondents use their seatbelts regularly and highest education received by respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	21.228[a]	4	.000
Likelihood Ratio	20.505	4	.000
N of Valid Cases	321		
a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 2.87.			

Table E44: Chi-Square of if respondents use their seatbelts regularly and driving experience

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	27.167[a]	4	.000
Likelihood Ratio	30.885	4	.000
N of Valid Cases	321		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.02.			

Table E45: Chi-Square of if respondents use their seatbelts regularly and gender

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.139[a]	1	.144		
Continuity Correction[b]	1.795	1	.180		
Likelihood Ratio	2.120	1	.145		
Fisher's Exact Test				.176	.091
N of Valid Cases	321				
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 39.05.					
b. Computed only for a 2x2 table					

Table E46: Cross tabulation of marital status and if respondents engaged in drink driving in the last month

Marital Status * how many times did you engage in drink driving in the last month Cross tabulation

			How many times did you engage in drink driving in the last month			Total
			None	1	2	
Marital Status	Single	Count	29	17	3	49
		% within Marital Status	59.2%	34.7%	6.1%	100.0%
		% of Total	15.5%	9.1%	1.6%	26.2%
	Married	Count	65	13	22	100
		% within Marital Status	65.0%	13.0%	22.0%	100.0%
		% of Total	34.8%	7.0%	11.8%	53.5%
	Widowed	Count	14	1	7	22
		% within Marital Status	63.6%	4.5%	31.8%	100.0%
		% of Total	7.5%	0.5%	3.7%	11.8%
	Separated	Count	9	2	5	16
		% within Marital Status	56.3%	12.5%	31.3%	100.0%
		% of Total	4.8%	1.1%	2.7%	8.6%
Total		Count	117	33	37	187
		% within Marital Status	62.6%	17.6%	19.8%	100.0%
		% of Total	62.6%	17.6%	19.8%	100.0%

Table E47: Cross tabulation of age and if respondents engaged in drink driving in the last month

Age * how many times did you engage in drink driving in the last month Cross tabulation						
			How many times did you engage in drink driving in the last month			Total
			None	1	2	
Age	18-29	Count	17	6	6	29
		% within Age	58.6%	20.7%	20.7%	100.0%
		% of Total	9.1%	3.2%	3.2%	15.5%
	30-40	Count	27	11	7	45
		% within Age	60.0%	24.4%	15.6%	100.0%
		% of Total	14.4%	5.9%	3.7%	24.1%
	41-50	Count	54	13	13	80
		% within Age	67.5%	16.3%	16.3%	100.0%
		% of Total	28.9%	7.0%	7.0%	42.8%
	51-60	Count	7	1	4	12
		% within Age	58.3%	8.3%	33.3%	100.0%
		% of Total	3.7%	0.5%	2.1%	6.4%
	Above 60	Count	12	2	7	21
		% within Age	57.1%	9.5%	33.3%	100.0%
		% of Total	6.4%	1.1%	3.7%	11.2%
Total		Count	117	33	37	187
		% within Age	62.6%	17.6%	19.8%	100.0%
		% of Total	62.6%	17.6%	19.8%	100.0%

Table E48: Cross tabulation of highest education received and if respondents engaged in drink driving in the last month

Highest Education Received * how many times did you engage in drink driving in the last month Cross tabulation						
			How many times did you engage in drink driving in the last month			Total
			None	1	2	
Highest Education Received	No Education	Count	1	1	1	3
		% within Highest Education Received	33.3%	33.3%	33.3%	100.0%
		% of Total	0.5%	0.5%	0.5%	1.6%
	Primary School	Count	3	2	0	5
		% within Highest Education Received	60.0%	40.0%	0.0%	100.0%
		% of Total	1.6%	1.1%	0.0%	2.7%
	Secondary School	Count	34	15	13	62
		% within Highest Education Received	54.8%	24.2%	21.0%	100.0%
		% of Total	18.2%	8.0%	7.0%	33.2%
	Undergraduate	Count	54	11	14	79
		% within Highest Education Received	68.4%	13.9%	17.7%	100.0%
		% of Total	28.9%	5.9%	7.5%	42.2%
	Postgraduate	Count	25	4	9	38
		% within Highest Education Received	65.8%	10.5%	23.7%	100.0%
		% of Total	13.4%	2.1%	4.8%	20.3%
Total		Count	117	33	37	187
		% within Highest Education Received	62.6%	17.6%	19.8%	100.0%
		% of Total	62.6%	17.6%	19.8%	100.0%

Table E49: Cross tabulation of driver experience and if respondents engaged in drink driving in the last month

How long have you been a driver * how many times did you engage in drink driving in the last month Cross tabulation						
			How many times did you engage in drink driving in the last month			Total
			None	1	2	
How long have you been a driver	0-10	Count	20	9	10	39
		% within How long have you been a driver	51.3%	23.1%	25.6%	100.0%
		% of Total	10.7%	4.8%	5.3%	20.9%
	11-20	Count	21	7	4	32
		% within How long have you been a driver	65.6%	21.9%	12.5%	100.0%
		% of Total	11.2%	3.7%	2.1%	17.1%
	21-30	Count	60	14	13	87
		% within How long have you been a driver	69.0%	16.1%	14.9%	100.0%
		% of Total	32.1%	7.5%	7.0%	46.5%
	31-40	Count	10	1	4	15
		% within How long have you been a driver	66.7%	6.7%	26.7%	100.0%
		% of Total	5.3%	0.5%	2.1%	8.0%
	Above 40	Count	6	2	6	14
		% within How long have you been a driver	42.9%	14.3%	42.9%	100.0%
		% of Total	3.2%	1.1%	3.2%	7.5%
Total		Count	117	33	37	187
		% within How long have you been a driver	62.6%	17.6%	19.8%	100.0%
		% of Total	62.6%	17.6%	19.8%	100.0%

Table E50: Chi-Square of marital status and if respondents engaged in drink driving in the last month

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.507[a]	6	.003
Likelihood Ratio	20.090	6	.003
Linear-by-Linear Association	1.866	1	.172
N of Valid Cases	187		
a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is 2.82.			

Table E51: Chi-Square of age and if respondents engaged in drink driving in the last month

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.343[a]	8	.500
Likelihood Ratio	7.051	8	.531
Linear-by-Linear Association	.411	1	.522
N of Valid Cases	187		
a. 4 cells (26.7%) have expected count less than 5. The minimum expected count is 2.12.			

Table E52: Chi-Square of highest education received and if respondents engaged in drink driving in the last month

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.318[a]	8	.403
Likelihood Ratio	8.957	8	.346
Linear-by-Linear Association	.619	1	.431
N of Valid Cases	187		
a. 6 cells (40.0%) have expected count less than 5. The minimum expected count is .53.			

Table E53: Chi-Square of gender and if respondents engaged in drink driving in the last month

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.125[a]	2	.346
Likelihood Ratio	2.271	2	.321
Linear-by-Linear Association	.004	1	.947
N of Valid Cases	187		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.35.			

Table E54: Chi-Square of driver experience and if respondents engaged in drink driving in the last month

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.221[a]	8	.189
Likelihood Ratio	10.795	8	.214
Linear-by-Linear Association	.036	1	.849
N of Valid Cases	187		
a. 4 cells (26.7%) have expected count less than 5. The minimum expected count is 2.47.			

Table E55: Cross tabulation of gender and if respondents drive with a child in their car

Gender * Do you drive with a child in your car Cross tabulation					
			Do you drive with a child in your car		Total
			No	Yes	
Gender	Male	Count	113	21	134
		% within Gender	84.3%	15.7%	100.0%
	Female	Count	22	31	53
		% within Gender	41.5%	58.5%	100.0%
Total		Count	135	52	187
		% within Gender	72.2%	27.8%	100.0%

Table E56: Cross tabulation of marital status and if respondents drive with a child in their car

What is your marital status * Do you drive with a child in your car Cross tabulation					
			Do you drive with a child in your car		Total
			No	Yes	
What is your marital status	Divorced	Count	5	0	5
		% within What is your marital status	100.0%	0.0%	100.0%
	Married	Count	61	39	100
		% within What is your marital status	61.0%	39.0%	100.0%
	Separated	Count	9	2	11
		% within What is your marital status	81.8%	18.2%	100.0%
	Single	Count	38	11	49
		% within What is your marital status	77.6%	22.4%	100.0%
	Widowed	Count	22	0	22
		% within What is your marital status	100.0%	0.0%	100.0%
Total		Count	135	52	187
		% within What is your marital status	72.2%	27.8%	100.0%

Table E57: Cross tabulation of age group and if respondents drive with a child in their car

Age * Do you drive with a child in your car Cross tabulation					
			Do you drive with a child in your car		Total
			No	Yes	
Age	18 - 29	Count	14	15	29
		% within Age	48.3%	51.7%	100.0%
	30 - 40	Count	20	25	45
		% within Age	44.4%	55.6%	100.0%
	41 - 50	Count	68	12	80
		% within Age	85.0%	15.0%	100.0%
	51 - 60	Count	12	0	12
		% within Age	100.0%	0.0%	100.0%
	> 60	Count	21	0	21
		% within Age	100.0%	0.0%	100.0%
Total		Count	135	52	187
		% within Age	72.2%	27.8%	100.0%

Table E58: Cross tabulation of highest education received and if respondents drive with a child in their car

Highest Education Received * Do you drive with a child in your car Cross tabulation					
			Do you drive with a child in your car		Total
			No	Yes	
Highest Education Received	No Education	Count	3	0	3
		% within Highest Education Received	100.0%	0.0%	100.0%
	Primary School	Count	3	2	5
		% within Highest Education Received	60.0%	40.0%	100.0%
	Secondary School	Count	38	24	62
		% within Highest Education Received	61.3%	38.7%	100.0%
	Undergraduate	Count	55	24	79
		% within Highest Education Received	69.6%	30.4%	100.0%
	Post Graduate	Count	36	2	38
		% within Highest Education Received	94.7%	5.3%	100.0%
Total		Count	135	52	187
		% within Highest Education Received	72.2%	27.8%	100.0%

Table E59: Cross tabulation of driving experience and if respondents drive with a child in their car

How Long Have You Been A Driver * Do you drive with a child in your car Cross tabulation					
			Do you drive with a child in your car		Total
			No	Yes	
How Long Have You Been A Driver	0 - 10	Count	19	20	39
		% within How Long Have You Been A Driver	48.7%	51.3%	100.0%
	11 - 20	Count	13	19	32
		% within How Long Have You Been A Driver	40.6%	59.4%	100.0%
	21 - 30	Count	74	13	87
		% within How Long Have You Been A Driver	85.1%	14.9%	100.0%
	31 - 40	Count	15	0	15
		% within How Long Have You Been A Driver	100.0%	0.0%	100.0%
	Above 40	Count	14	0	14
		% within How Long Have You Been A Driver	100.0%	0.0%	100.0%
Total		Count	135	52	187
		% within How Long Have You Been A Driver	72.2%	27.8%	100.0%

Table E60: Chi-Square of if respondents drive with a child in their car and gender

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	34.686[a]	1	.000		
Continuity Correction[b]	32.586	1	.000		
Likelihood Ratio	32.782	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	187				
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.74.					
b. Computed only for a 2x2 table					

Table E61: Chi-Square of if respondents drive with a child in their car and marital status

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	17.849[a]	4	.001
Likelihood Ratio	24.712	4	.000
N of Valid Cases	187		
a. 3 cells (30.0%) have expected count less than 5. The minimum expected count is 1.39.			

Table E62: Chi-Square of if respondents drive with a child in their car and age

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	44.770[a]	4	.000
Likelihood Ratio	51.453	4	.000
N of Valid Cases	187		
a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 3.34.			

Table E63: Chi-Square of if respondents drive with a child in their car and driving experience

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	44.933[a]	4	.000
Likelihood Ratio	50.434	4	.000
N of Valid Cases	187		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 3.89.			

Table E64: Chi-Square of if respondents drive with a child in their car and highest education received by respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	15.078[a]	4	.005
Likelihood Ratio	18.899	4	.001
N of Valid Cases	187		
a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is .83.			

Table E65: Cross tabulation of gender and if respondents have a child car seat

Gender * Do you have a child car seat Cross tabulation					
			Do you have a child car seat		Total
			No	Yes	
Gender	Female	Count	6	25	31
		% within Gender	19.4%	80.6%	100.0%
	Male	Count	17	4	21
		% within Gender	81.0%	19.0%	100.0%
Total		Count	23	29	52
		% within Gender	44.2%	55.8%	100.0%

Table E66: Cross tabulation of marital status and if respondents have a child car seat

What is your marital status * Do you have a child car seat Cross tabulation					
			Do you have a child car seat		Total
			No	Yes	
What is your marital status	Married	Count	16	23	39
		% within What is your marital status	41.0%	59.0%	100.0%
	Separated	Count	1	1	2
		% within What is your marital status	50.0%	50.0%	100.0%
	Single	Count	6	5	11
		% within What is your marital status	54.5%	45.5%	100.0%
Total		Count	23	29	52
		% within What is your marital status	44.2%	55.8%	100.0%

Table E67: Cross tabulation of age group and if respondents have a child car seat

Age * Do you have a child car seat Cross tabulation					
			Do you have a child car seat		Total
			No	Yes	
Age	18 - 29	Count	4	11	15
		% within Age	26.7%	73.3%	100.0%
	30 - 40	Count	13	12	25
		% within Age	52.0%	48.0%	100.0%
	41 - 50	Count	6	6	12
		% within Age	50.0%	50.0%	100.0%
Total		Count	23	29	52
		% within Age	44.2%	55.8%	100.0%

Table E68: Cross tabulation of highest education received and if respondents have a child car seat

Highest Education Received * Do you have a child car seat Cross tabulation					
			Do you have a child car seat		Total
			No	Yes	
Highest Education Received	Post Graduate	Count	1	1	2
		% within Highest Education Received	50.0%	50.0%	100.0%
	Primary	Count	2	0	2
		% within Highest Education Received	100.0%	0.0%	100.0%
	Secondary	Count	11	13	24
		% within Highest Education Received	45.8%	54.2%	100.0%
	Undergraduate	Count	9	15	24
		% within Highest Education Received	37.5%	62.5%	100.0%
Total		Count	23	29	52
		% within Highest Education Received	44.2%	55.8%	100.0%

Table E69: Cross tabulation of driving experience and if respondents have a child car seat

How Long Have You Been A Driver * Do you have a child car seat Cross tabulation					
			Do you have a child car seat		Total
			No	Yes	
How Long Have You Been A Driver	0 - 10	Count	5	15	20
		% within How Long Have You Been A Driver	25.0%	75.0%	100.0%
	11 - 20	Count	12	7	19
		% within How Long Have You Been A Driver	63.2%	36.8%	100.0%
	21 - 30	Count	6	7	13
		% within How Long Have You Been A Driver	46.2%	53.8%	100.0%
Total		Count	23	29	52
		% within How Long Have You Been A Driver	44.2%	55.8%	100.0%

Table E70: Chi-Square of if respondents have a child car seat and gender

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	19.257[a]	1	.000		
Continuity Correction[b]	16.841	1	.000		
Likelihood Ratio	20.481	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	52				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.29.					
b. Computed only for a 2x2 table					

Table E71: Chi-Square of if respondents have a child car seat and marital status

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.664[a]	2	.718
Likelihood Ratio	.660	2	.719
N of Valid Cases	52		
a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is .88.			

Table E72: Chi-Square of if respondents have a child car seat and age

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.650[a]	2	.266
Likelihood Ratio	2.743	2	.254
N of Valid Cases	52		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.31.			

Table E73: Chi-Square of if respondents have a child car seat and highest education received by respondents

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.014[a]	3	.389
Likelihood Ratio	3.762	3	.288
N of Valid Cases	52		
a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .88.			

Table E74: Chi-Square of if respondents have a child car seat and driving experience

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.777[a]	2	.056
Likelihood Ratio	5.947	2	.051
N of Valid Cases	52		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.75.			

Table E75: Cross tabulation of gender and how many times respondents drove their children with a child car seat in the last week

Gender * In the past week, did you drive your children with a child car seat Cross tabulation					
			In the last week, how many times have you driven with your children while using the child car seat		Total
			No	Yes	
Gender	Female	Count	6	25	31
		% within Gender	19.4%	80.6%	100.0%
	Male	Count	17	4	21
		% within Gender	81.0%	19.0%	100.0%
Total		Count	23	29	52
		% within Gender	44.2%	55.8%	100.0%

Table E76: Cross tabulation of marital status if respondents drove their children with a child car seat in the last week

What is your marital status * In the past week, did you drive your children with a child car seat Cross tabulation					
			In the last week, how many times have you driven with your children while using the child car seat		Total
			No	Yes	
What is your marital status	Married	Count	16	23	39
		% within What is your marital status	41.0%	59.0%	100.0%
	Separated	Count	1	1	2
		% within What is your marital status	50.0%	50.0%	100.0%
	Single	Count	6	5	11
		% within What is your marital status	54.5%	45.5%	100.0%
Total		Count	23	29	52
		% within What is your marital status	44.2%	55.8%	100.0%

Table E77: Cross tabulation of age and how many times respondents drove their children with a child car seat in the last week

Age * In the past week, did you drive your children with a child car seat Cross tabulation					
			In the last week, how many times have you driven with your children while using the child car seat		Total
			No	Yes	
Age	18 - 29	Count	4	11	15
		% within Age	26.7%	73.3%	100.0%
	30 - 40	Count	13	12	25
		% within Age	52.0%	48.0%	100.0%
	41 - 50	Count	6	6	12
		% within Age	50.0%	50.0%	100.0%
Total		Count	23	29	52
		% within Age	44.2%	55.8%	100.0%

Table E78: Cross tabulation of highest education received and how many times respondents drove their children with a child car seat in the last week

Highest Education Received * In the past week, did you drive your children with a child car seat Cross tabulation					
			In the last week, how many times have you driven with your children while using the child car seat		Total
			No	Yes	
Highest Education Received	Post Graduate	Count	1	1	2
		% within Highest Education Received	50.0%	50.0%	100.0%
	Primary	Count	2	0	2
		% within Highest Education Received	100.0%	0.0%	100.0%
	Secondary	Count	11	13	24
		% within Highest Education Received	45.8%	54.2%	100.0%
	Undergraduate	Count	9	15	24
		% within Highest Education Received	37.5%	62.5%	100.0%
Total		Count	23	29	52
		% within Highest Education Received	44.2%	55.8%	100.0%

Table E79: Cross tabulation of driving experience and how many times respondents drove their children with a child car seat in the last week

How Long Have You Been A Driver In the past week, did you drive your children with a child car seat Cross tabulation

			In the last week, how many times have you driven with your children while using the child car seat		Total
			No	Yes	
How Long Have You Been A Driver	0 - 10	Count	5	15	20
		% within How Long Have You Been A Driver	25.0%	75.0%	100.0%
	11 - 20	Count	12	7	19
		% within How Long Have You Been A Driver	63.2%	36.8%	100.0%
	21 - 30	Count	6	7	13
		% within How Long Have You Been A Driver	46.2%	53.8%	100.0%
Total		Count	23	29	52
		% within How Long Have You Been A Driver	44.2%	55.8%	100.0%

Table E80: Chi-Square of if respondents drive their children with a child car seat and gender

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	19.257[a]	1	.000		
Continuity Correction[b]	16.841	1	.000		
Likelihood Ratio	20.481	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	52				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.29.

b. Computed only for a 2x2 table

Table E81: Chi-Square of if respondents drive their children with a child car seat and marital status

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.664[a]	2	.718
Likelihood Ratio	.660	2	.719
N of Valid Cases	52		
a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is .88.			

Table E82: Chi-Square of if respondents drive their children with a child car seat and age

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.650[a]	2	.266
Likelihood Ratio	2.743	2	.254
N of Valid Cases	52		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.31.			

Table E83: Chi-Square of if respondents drive their children with a child car seat and highest education received

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.014[a]	3	.389
Likelihood Ratio	3.762	3	.288
N of Valid Cases	52		
a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .88.			

Table E84: Chi-Square of if respondents drive their children with a child car seat and driving experience

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.777[a]	2	.056
Likelihood Ratio	5.947	2	.051
N of Valid Cases	52		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.75.			

Table E85: Chi-Square of if respondents drive while using their phones and gender

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.218[a]	1	.640		
Continuity Correction[b]	.083	1	.773		
Likelihood Ratio	.221	1	.639		
Fisher's Exact Test				.722	.391
N of Valid Cases	187				
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.30.					
b. Computed only for a 2x2 table					

Table E86: Chi-Square of if respondents drive while using their phones and marital status

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.669[a]	4	.615
Likelihood Ratio	2.550	4	.636
N of Valid Cases	187		
a. 3 cells (30.0%) have expected count less than 5. The minimum expected count is 1.44.			

Table E87: Chi-Square of if respondents drive while using their phones and age

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.218[a]	4	.266
Likelihood Ratio	5.352	4	.253
N of Valid Cases	187		
a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 3.47.			

Table E88: Chi-Square of if respondents drive while using their phones and highest education received

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.696a	4	.153
Likelihood Ratio	6.385	4	.172
N of Valid Cases	187		
a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is .87.			

Table E89: Chi-Square of if respondents drive while using their phone and driving experience

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.674a	4	.154
Likelihood Ratio	6.893	4	.142
N of Valid Cases	187		
a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 4.04.			

Table E90: Cross tabulation of gender and the last road safety enlightenment campaign respondents heard of

Gender * When was the last road safety enlightenment campaign you heard of Cross tabulation

			When was the last road safety enlightenment campaign you heard of				Total
			Never heard of any	Less than 6 Months Ago	6 to 12 Months Ago	Over 12 Months ago	
Gender	Male	Count	26	76	95	15	212
		% within Gender	12.3%	35.8%	44.8%	7.1%	100.0%
	Female	Count	9	20	57	23	109
		% within Gender	8.3%	18.3%	52.3%	21.1%	100.0%
Total		Count	35	96	152	38	321
		% within Gender	10.9%	29.9%	47.4%	11.8%	100.0%

Table E91: Cross tabulation of marital status and the last road safety enlightenment campaign respondents heard of

What is your marital status * When was the last road safety enlightenment campaign you heard of Cross tabulation								
			When was the last road safety enlightenment campaign you heard of				Total
			Never heard of any	Less than 6 Months ago	6 to 12 Months ago	Over 12 Months ago	
What is your marital status	Divorced	Count	0	1	3	1	5
		% within What is your marital status	0.0%	20.0%	60.0%	20.0%	100.0%
	Married	Count	17	64	85	20	186
		% within What is your marital status	9.1%	34.4%	45.7%	10.8%	100.0%
	Separated	Count	2	0	6	3	11
		% within What is your marital status	18.2%	0.0%	54.5%	27.3%	100.0%
	Single	Count	13	27	46	6	92
		% within What is your marital status	14.1%	29.3%	50.0%	6.5%	100.0%
	Widowed	Count	3	4	12	8	27
		% within What is your marital status	11.1%	14.8%	44.4%	29.6%	100.0%
Total		Count	35	96	152	38	321
		% within What is your marital status	10.9%	29.9%	47.4%	11.8%	100.0%

Table E92: Cross tabulation of age group and the last road safety enlightenment campaign respondents heard of

Age * When was the last road safety enlightenment campaign you heard of Cross tabulation							
			When was the last road safety enlightenment campaign you heard of				Total
			Never heard of any	Less than 6 Months Ago	6 to 12 Months Ago	Over 12 Months ago	
Age	< 18	Count	2	1	4	0	7
		% within Age	28.6%	14.3%	57.1%	0.0%	100.0%
	18 - 29	Count	7	15	38	6	66
		% within Age	10.6%	22.7%	57.6%	9.1%	100.0%
	30 - 40	Count	10	34	41	6	91
		% within Age	11.0%	37.4%	45.1%	6.6%	100.0%
	41 - 50	Count	11	42	52	16	121
		% within Age	9.1%	34.7%	43.0%	13.2%	100.0%
	51 - 60	Count	3	0	5	6	14
		% within Age	21.4%	0.0%	35.7%	42.9%	100.0%
	> 60	Count	2	4	12	4	22
		% within Age	9.1%	18.2%	54.5%	18.2%	100.0%
Total		Count	35	96	152	38	321
		% within Age	10.9%	29.9%	47.4%	11.8%	100.0%

Table E93: Cross tabulation of highest education received and the last road safety enlightenment campaign respondents heard of

Highest Education Received * When was the last road safety enlightenment campaign you heard of Cross tabulation

			When was the last road safety enlightenment campaign you heard of				Total
			Never heard of any	Less than 6 Months ago	6 to 12 Months ago	Over 12 Months ago	
Highest Education Received	No Education	Count	0	1	7	0	8
		% within Highest Education Received	0.0%	12.5%	87.5%	0.0%	100.0%
	Primary School	Count	5	5	9	0	19
		% within Highest Education Received	26.3%	26.3%	47.4%	0.0%	100.0%
	Secondary School	Count	14	38	42	7	101
		% within Highest Education Received	13.9%	37.6%	41.6%	6.9%	100.0%
	Undergraduate	Count	11	44	76	20	151
		% within Highest Education Received	7.3%	29.1%	50.3%	13.2%	100.0%
	Post Graduate	Count	5	8	18	11	42
		% within Highest Education Received	11.9%	19.0%	42.9%	26.2%	100.0%
Total		Count	35	96	152	38	321
		% within Highest Education Received	10.9%	29.9%	47.4%	11.8%	100.0%

Table E94: Cross tabulation of driving experience and the last road safety enlightenment campaign respondents heard of

How Long Have You Been A Driver * When was the last road safety enlightenment campaign you heard of Cross tabulation

			When was the last road safety enlightenment campaign you heard of				Total
			Never heard of any	Less than 6 Months Ago	6 to 12 Months Ago	Over 12 Months ago	
How Long Have You Been A Driver	0 - 10	Count	10	27	57	9	103
		% within How Long Have You Been A Driver	9.7%	26.2%	55.3%	8.7%	100.0 %
	11 - 20	Count	10	20	20	2	52
		% within How Long Have You Been A Driver	19.2%	38.5%	38.5%	3.8%	100.0 %
	21 - 30	Count	11	46	60	20	137
		% within How Long Have You Been A Driver	8.0%	33.6%	43.8%	14.6%	100.0 %
	31 - 40	Count	3	1	6	5	15
		% within How Long Have You Been A Driver	20.0%	6.7%	40.0%	33.3%	100.0 %
	Above 40	Count	1	2	9	2	14
		% within How Long Have You Been A Driver	7.1%	14.3%	64.3%	14.3%	100.0 %
Total		Count	35	96	152	38	321
		% within How Long Have You Been A Driver	10.9%	29.9%	47.4%	11.8%	100.0 %

Table E95: Chi-Square of the last road safety enlightenment campaign respondents heard of and gender

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	21.246[a]	3	.000
Likelihood Ratio	21.104	3	.000
N of Valid Cases	321		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.88.			

Table E96: Chi-Square of the last road safety enlightenment campaign respondents heard of and driving experience

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	26.100[a]	12	.010
Likelihood Ratio	25.816	12	.011
N of Valid Cases	321		
a. 6 cells (30.0%) have expected count less than 5. The minimum expected count is 1.53.			