APPLICATION OF HADDON MATRIX TO THE EVALUATION OF RISKS FACTORS OF VULNERABLE ROAD USERS TO ACCIDENTS IN BENIN CITY

BY

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A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG) DEGREE

IN

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NOVEMBER, 2018.

CERTIFICATION

I hereby certify that this project work was done by ITOJE, EMMANUEL OGHENEVWIRORO, with matriculation number; ENG1306650, in the Department of Civil Engineering, Faculty of Engineering, University of Benin, Benin City, Edo State, Under my supervision.

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DEDICATION

This project is dedicated with sincere appreciation to God Almighty for a successful and healthy five year academic stay in the University of Benin and for the timely completion of this project.

ACKNOWLEDGEMENT

My gratitude goes to my project co-ordinator Prof. E. O Eze, and my project supervisor Mr. Igene Morris, who gave me assistance and encouragement throughout the time of writing this project, I would also like to thank the H.O.D, Civil Engineering, Universit Of Benin, Engr. (Dr) J.O. Okovido, and also my lecturers Mr. Nosa Oghoyafedo. Mr. Osasu Osamuyi, Prof J.O Ehiorobo, Prof. O. C Izinyon, Prof. O. U Orie, Prof. O. E Alutu and all other lecturers and staff of the Department of Civil Engineering for their guidance, mentorship and assistance.

Finally, my gratitude goes to my family Mr/Mrs. G. Itoje for their concern and financial support, and also to my sibling for their encouragement. To my friends, Austin Eghomare, Joseph Eshimiakhe, Ajirioghene Orie, Fashola and ThankGod , I want to say thank you for your support.

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ABSTRACT

This project examines road traffic accident problems in Benin City, Nigeria in an epidemiological approach. The project entails the source of data compiled in a questionnaire, hospital records, FRSC reports and press media data on accident reports. The identification of risk factors, data interpretation of accidents and their general preventive measures are discussed. Accident prediction models are used to predict future occurrences.

The Haddon Matrix Analysis was used to model the Pre-crash, Crash and Post-crash phases of accidents. This is done to determine to what extent accident and casualty involvement are related, and so assist policy-makers and relevant authorities to explore counter-measures in the allocation of scarce resources in reducing road traffic accidents. The generalized linear regression method (GzLM) was modelled using number of accident outcomes as the dependent variables while the time of the day (T), host (H) and speed (Sp) of the accidents were selected as the independent variables so as to obtain a model equation.

It was observed that the highest frequency of accident occurs at Isiohor and fatal accidents occur at Main Gate. Also, the host who were majorly affected are the pedestrians and the time range of the highest occurrence was between 6pm to 12am, most especially during the peak hours (6pm-8pm). The results showed that the time of the day (T) is statistically significant at 90% confidence interval and the model equation gotten is to estimate the future possible occurrence caused by the independent variables.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

It is alarming that the daily reports of road accidents across the country have not attracted urgent action from federal and most state governments, yet road accidents are killing and maiming hundreds of Nigerians monthly due to bad roads, deplorable road habits and inefficient law enforcement. The situation demands a collaborative effort by all tiers of government to drastically bring down accident rates on our famished roads. The grim reality was underscored by the recent deaths of six pensioners on the Okene-Lokoja highway in a gruesome crash and the 13 fatalities recorded few days later in a crash on the Benin Lagos Expressway. More casualties are being recorded on our highways than the fatalities in some countries battling with low intensity wars. In its 2011 road safety survey, the United Nations ranked the country as second worst in the world in road accidents 191 out of 192 countries surveyed a record some experts predict will worsen in future rankings unless remedial actions are taken (Peltzer, 2004), their pessimism is informed by such gruesome incidents as the multiple accident two weeks ago on the Abuja Suleja highway in which 18 persons perished. Some major roads like the Okene - Lokoja Road in Kogi State and Lagos Ibadan Expressway have become notorious harbingers of deaths and broken limbs through frequent road accidents. While the Federal Road Safety Commission recorded several accidents in which at least 11 persons died on the Lagos Ibadan stretch last week, several road accidents were also recorded on the Sagamu Ore-Benin Expressway, another notorious road for crashes. Recently too, 22 persons were said to have died in a multiple accident on the Sokoto Abuja Road. According to statistics by the FRSC in 2011, some of the other most accident-prone roads in the country are the Jos, Bauchi, Gombe Road; Katsina Kano Road; Oye Ifaki Ekiti Road; Kabba Omuo-Ekiti Road; Akwanga Lafia highway; Owerri Aba-Port Harcourt Road, and Onitsha Enugu Road, among others. But increased motorization may not necessarily lead to worsened road crashes. The United Kingdom, for example, halved its death rate (per 100,000 head of population) between 1972 and 1999, despite a doubling in motorized vehicles. Sadly, the declaration of 2011-2021 as a Decade of Action on Road Safety by the United Nations has not galvanized our highway managers to serious action beyond a few ceremonies. But proactive action is needed to reverse the carnage on the roads that between January and June 2011 claimed 2,218 lives in 2,234 crashes, compared to 1,822 deaths in 2, 673 crashes in January-June 2010, according to the FRSC (Renner, 2004), that 162 person's die per 100,000 in road accidents here has alarmed the World Health Organization which says that, of the 1.3 million killed in road accidents worldwide each year and 50million who suffer injuries, the developing nations account for 80 per cent. The highest risk circumstances of young drivers in particular male drivers are associated with speeding, drink-driving, non-wearing of seat-belts and drug-driving. Osita Chidoka, chief executive of the FRSC, insists that most road accidents are caused by bad roads. Faulty design, multiple bends, but especially poor or outright lack of maintenance have rendered most of our over 194,000 kilometers of roads death traps. Neither the Federal Government that owns 17 per cent of the roads, nor the states with 16 percent and the local governments with 67 per cent maintains its roads while far newer roads than are needed are being built by the various governments. Governor Ibikunle Amosun lamented only on Thursday that the 649 deaths, 1,333 injuries in 1,980 accidents recorded in the state in 2010 that made it the most accident-prone state were attributable to the state hosting the longest stretches of the federally-owned Lagos-Ibadan and Sagamu Ore Benin expressways Murray and Krug had reported that road traffic injuries are a major cause of death globally, with disproportionate number occurring in developing counties.(Paden 2004).

Road traffic injuries constitute a major public health and development crisis, and are predicted to increase if road safety is not addressed adequately by Member States. The World Health Organization (WHO) has been concerned with this issue for over four decades. As early as 1962, a WHO report discussed the nature and dynamics of the problem

(1). In 1974, the World Health Assembly adopted Resolution WHA27.59, declaring road traffic accidents a major public health issue and calling for Member States to address the problem

(2). For the past two decades, the World Bank has encouraged its borrowers to include road safety components within most of their highway and urban transport projects. Over the last three years, both organizations have intensified their work in road traffic injury prevention. This was reflected in the establishment in March 2000 of WHO's Department of Injuries and Violence Prevention, the development and implementation of a five-year WHO strategy for road traffic injury prevention, and greater financial and human support for road traffic injury prevention activities around the world

(3). Recently, WHO dedicated World Health Day for 2004 to Road Safety. Within the World Bank, an interdisciplinary task force was established to ensure that this important issue was regarded as a major public health issue and tackled jointly by transport and public health specialists. Among other international organizations, the United Nations Economic Commission for Europe, the United Nations Development Fund and the United Nations Children's Fund, have all stepped up their road safety activities over the past decade. In early 2003, the United Nations adopted Resolution on the global road safety crisis

(4). Followed by a report of the Secretary-General on the same topic to the 58th session of the United Nations General Assembly later that year.

(5). In November 2003, a further Resolution was passed by the United Nations, calling for a plenary meeting of the United Nations General Assembly on 14 April 2004. The purpose of the plenary meeting would be to increase awareness of the magnitude of the road injury problem, and to discuss the implementation of the World report on road traffic injury prevention at the United Nations General Assembly

1.2 Statement of Problem

Relation to a critical evaluation and innovation of accident counter measures in Nigeria. Controversy has continued to trail the exact number of deaths recorded yearly through road accidents in Nigeria, with the World Health Organization (WHO), the National Union of Road Transport Workers (NURTW) and the Federal Road Safety Commission (FRSC), giving conflicting reports. While the international agency claimed that 32, 000 died yearly through road accidents in Nigeria, the FRSC Corp Marshal, Chidoka Osita, however, said, there was no year that Nigeria lost 32, 000 lives to road accidents, insisting that the country had only recorded between 4,000 and 5,000 deaths from road accidents, in the last three years. The main users of the roads, NURTW, throwing a tactical support behind the international agency, said that the figure given by WHO was over three times the officially reported. Speaking at the official launching of Road Accident Health Insurance Scheme(RAHIS) in Abuja, , the president of NURTW, Alhaji Giada Hamman, said, "despite the fact that not all deaths and accidents on our roads are officially reported, 8, 672 people were said to have lost their lives to road accidents in Nigeria in 2003, while another 28, 215 people sustained different degrees of injuries within the period. "Statistics from the Federal Road Safety Commission reveals that in 2006 alone, a total of 4, 955 people lost their lives to road accidents in the country, while 17, 390 were injured within the same period in road accidents.

In addition, the World Health Organization (WHO) also gave an estimate that Nigeria recorded over 32, 000 deaths every year through road accidents, which is over three times the number officially, reported. ”More than 17,000 people died in about 31,000 road accidents across Nigeria between 2007 and 2009, according to official statistics released on Sunday by the federal government road safety agency. More than 73,000 were injured in these accidents during the period under review, said the Federal Road Safety Commission (FRSC), which added that it hopes to achieve a 50 percent reduction in road traffic fatality over last year's figure of 5,690. Undisciplined, reckless driving, illiteracy, bad road networks and poor vehicle maintenance are often cited as reasons for road crashes and fatalities in Met Nigeria. State and local health departments continue to face unprecedented challenges in preparing for, recognizing, and responding to threats to the public’s health. At the same time, recent natural disasters have highlighted the need for comparable public health readiness and response capabilities.

Public health readiness and response activities can be conceptualized similarly for intentional attacks, natural disasters, and human-caused accidents. Consistent with this view, the federal government has adopted the all-hazards response model as its fundamental paradigm. Adoption of this paradigm provides powerful improvements in efficiency and efficacy, because it reduces the need to create a complex family of situation-specific preparedness and response activities. However, in practice, public health preparedness requires additional models and tools to provide a framework to better understand and prioritize emergency readiness and response needs, as well as to facilitate solutions; this is particularly true at the local health department level. Here, we propose to extend the use of the Haddon Matrix—a conceptual model used for more than two decades in injury prevention and response strategies—for this purpose.

1.3 Aim and Objectives

This project aims at conducting an Haddon Matrix analysis on vulnerable road in Oredo local government area. The specific objectives are to:

1. To get the data of accident victims from hospitals in Benin City road users.
2. To triangulate the accident data using other sources like federal road safety corps(FRSC), police stations and media houses.
3. To perform haddon matrix evaluation on the crash phases (crash, precrash and post crash).
4. To develop accident poison regression model.

1.4 Scope of Work

This work is detailed on the use of Haddon Matrix to analyse the vulnerability of road users in Benin City. It involves going to hospitals, police stations and one on one interview with the victim to get data which will coordinated using corel and spss in other to get the percentage of accident victims in Benin City, Oredo local government to be précised. GIS of the given locations will also be taken to get a general overview of the places we taking into consideration.

In conclusion this project would provide a clear understanding of the use of Haddon Matrix and also the pros and cons would be explored.

1.5 Justification of Study

Following the principle that "all disasters are local," the Haddon matrix can provide a tool for public health and government agencies to address specific gaps and requirements that must be filled to meet their communities' unique readiness needs. Additionally, the Haddon matrix can serve as a helpful model for disaster preparedness and response in a variety of contexts, from public health readiness policy development to local public health practice emergency response planning for road users.

As an effective creative brainstorming and planning tool, it is ideally suited to facilitate tabletop preparedness exercises at health departments in cooperation with partner first-response agencies. It can assist in needs assessment efforts for public health agencies and their stakeholders. It also can serve as a valuable classroom aid in teaching public health readiness concepts at the secondary and graduate school levels, helping future public health leaders to develop critical problem-solving skills needed to tackle difficult readiness challenges.

These examples and their potential applications highlight five essential features of the Haddon matrix as a tool for public health emergency readiness and response.

First, the Haddon matrix provides a framework for understanding a terrorism incident in a temporal context, including its prevent event (crisis), and post event (consequence) phases.

Second, it can effectively dissect these temporal phases of a public health event into their contributing factors in analyzing accidents occurrence.

Third, it can aid in a public health and government agency's vulnerability assessment of its preparedness and response capacities.

Fourth, it can provide health departments with a useful framework for developing these capacities to deliver a prioritized, targeted approach to the public health dimensions of terrorism prevention and response.

Fifth, it is a sufficiently flexible analytic tool to aid health departments in addressing virtually any type of intentional or naturally occurring public health emergency.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Transport is an important element in economic development and it affords the social and political interaction that most people take for granted (Button, and Hensher 2001). The provision of transport infrastructure has grown extensively across the globe through a range of networks of modes which have undergone technological improvements cutting across the motive power, the tracks as well as the means which serve as compartment for passengers and goods. It is also a key player in the transfer and distribution of goods from the input points through the manufacturing line to the customers (Afolabi, 2014). Perhaps, this led to the assertion that there is no escape from transport since it is a key stone of civilization (Mumby, 1968).

Epidemiology is the study and analysis of the distribution (who, when, and where) and determinants of health and disease conditions in a defined population.

The consequential effect of the negative externalities of transport is accident with its attendant injuries and fatalities capable of neutralizing its social and economic benefits if not well managed. Traffic fatalities from automobile crashes have been known to be high in developing countries in which Nigeria constitute an integral part despite the much lower vehicle ownership in relation to population strength (Gbadamosi, 2015).

Transport is a critical sector of the Nigerian economy, whose catalytic effect, particularly on socio-economic development, cannot be, overemphasized. Over 80% of transportation in Nigeria is done by road (Oni, S.I., and Okanlawon, 2010).

In Nigeria, road transport is the dominant mode of movement for both freight and passenger traffic. The impact of the railway has been dwindling and it eventually collapses about a decade ago. Air transport is unavailable to the urban poor while the potentials of water for inland transportation have not been fully exploited. The mono transport mode nature of urban mobility in the country has been responsible for the collapse of public transport and the concomitant suffering of commuter in urban centres (Badejo, 2011).

2.2 Vulnerable Road Users

"Vulnerable road users" is a term applied to those most at risk in traffic. Thus, vulnerable road users are mainly those unprotected by an outside shield, namely pedestrians and two-wheelers, as they sustain a greater risk of injury in any collision against a vehicle and are therefore highly in need of protection against such collisions. Among these, pedestrians and cyclists are those most unlikely to inflict injury on any other road user, while motorised two-wheelers, with heavier machines and higher speeds, may present a danger to others.

In order to realize the road safety benefits that can be gained through safer vehicle choices it is important to understand the relationship between vehicle safety-related factors associated with specific groups of drivers, passengers, pedestrians and cyclists that are considered 'at risk' of being involved in crashes or sustaining injuries in the crash.

Children, older people, and disabled people may also be included in this category (Department for Transport United Kingdom., 2007; Ministry of Works, Housing & Communications [MOWHC], (Peden et al., 2004).

2.3 Road Traffic Accident

Accident is defined as anything which happens by chance, anything occurring unexpectedly. Road traffic accident is therefore an unexpected phenomenon that occurs as a result of the operation of vehicles (Onakomaiya, 1988).

Accidents can be fatal, resulting in the deaths of the road user or minor. A collision involving at least one vehicle in motion on a public or private road resulting in at least one person being injured or killed is a road traffic accident (Peden et al., 2004). Road traffic crash results from a combination of factors related to the components of the system comprising roads, the environment, vehicles and road users, and the way they interact. Some factors contribute to the occurrence of a collision and are therefore part of crash causation. Other factors aggravate the effects of the collision and thus contribute to trauma severity. Some factors may not appear to be directly related to road traffic injuries. Some causes are immediate, but they may be underpinned by medium-term and long-term structural causes. Identifying the risk factors that contribute to road traffic crashes is important in identifying interventions that can reduce the risks associated with those factors.

Traffic accidents result not only in bodily damage, loss of life, severe pain to individuals and economic loss to the society, but also in reduction of movements or opportunities to travel for the less socially favoured and for the most vulnerable sections of the population.

Traffic accidents in Nigeria vary by states. Nigeria has been consistently being ranked as having the highest incidents of road traffic accidents in the world for obvious reasons in addition to known causes of accidents across the globe which include very bad road arising from poor maintenance culture and poor road management.

The increasing magnitude of fatal road traffic accident globally has been attributed to population explosion and increased level of motorization. Motor vehicle crashes are the leading cause of death in adolescent and people in the prime age (Atunbi, 2009). There has been an upsurge in the proportion and absolute number of traffic fatalities witnessed in a number of developing countries while the industrial nations are witnessing downward trend in the occurrence of accident by more than 20% (Emenike, and Ogbole, , 2008).

2.3.1 **Phases of Accident**

Accident as we all know are caused and as much they don't just happen, the critical evaluation of accident phenomenon clearly indicates three specific phases. The three phases are the total consumption of an accident at any point when it is record. The phases as a matter of fact are interwoven and occur sequent after each other. These phases are: -

1. Pre-Crash Phase,
2. The Crash Phase, and
3. The Post- Crash Phase of highway safety.

1. Pre-Crash Phase

The pre-crash phase groups together all preventive or precautionary measures stages aimed at controlling or abating road accidents. Under this phase, falls all the contributory factors like the environment, the vehicle, the road users/persons, and the preventive or precautionary measures taken to normally avert accident. It is an indication of several conditions that are capable of causing accident. In other words, it implies all situations and circumstances preceding the occurrence of an accident. We can as well evaluate certain conditions that are capable of causing an accident before they are recorded. In short, this phase is concerned with Accident avoidance.

2. The Crash Phase

Once the pre-crash phase cannot be averted, the crash phase is the actual occurrence of the accident, when the mechanical device is involved in actual collision resulting in an accident. The type of outcome from the accident to the victim also belongs to this phase. Similarly, is the spot at which the accident occurred and the time of the day, which are all major indices of the crash phase. Research had demonstrated that up to 80% reduction in deaths of drivers and passengers can be achieved through the use of safety belts alone.

The focus of this second phase, therefore, is on injury prevention.

The following actions should be taken during road traffic accident:

a. Assess the Situation: -

- Locate the victim
- Examine the victims quickly
- Prevent further risk of fire, explosion, road traffic
- Keep the vehicle stationary
- Switch off engine, fuel and battery connection
- Display warning signals
- Send for help.

b. Care of the Victim: -

- Rescue the trapped casualties
- Look for breathing, heart function and consciousness
- Care for unconscious cases first
- Take care of bleeding and fractures
- Use car first aid kit if available
- Transport the casualty to nearest hospital.

c. Care of the Vehicle: -

- Keep the vehicles immobilized and in safe custody
- Protect the property from damage
- Take help of local people
- Inform the police.

3. The Post-Crash Phase

The post-crash phase can be described as the process of evaluating or assessing the consequences of road accidents. Such evaluation is based on socio-economic, environmental and political effects, using quantifiable and qualitative analytical tools. In these phase, we are concerned with saving those who need not die, with reducing hospitalization, permanent disability and unnecessary deaths. Indeed, the focus is on accessibility to adequate and prompt emergency communications, transportation and medical care, that determine the livelihood of the continuing survival of the survivors of the crashes. Therefore, the concern of this phase is on severity reduction, which would include the availability and competence of ambulance drivers and attendants in handling victims at accident scenes and the receptivity of hospital staff to accident victims who are not accompanied by police officers.

2.3.2 Causes of Road Traffic Accidents

In other words, every accident in relation transport is not just a mere occurrence but has been instituted as a result of one factor or the other. A good awareness and knowledge of causes of road traffic accidents will help us to avoid them. Eventually this will bring about the desired goal of safety consciousness of road users in our society.

The causes of road traffic accidents therefore fall under three major categories: -

1. Human factors,
2. Vehicle factors, and
3. Physical/ Environmental factors.

Of these three categories, the human factors are said to be responsible for over 80 percent of all traffic crashes because the drivers' operational ability is very critical to the causes and prevention of traffic accidents.

1. **The Human Factor**

Research has shown that the majority of road crashes or collisions are caused by human factors (Kikoye, 2013).

The human factors constitute about 80% of the cause of road traffic accidents recorded in the country. The major components of human factor are drivers, pedestrian, law enforcement agent and the engineer. Most drivers on Nigeria road are very rude, discourteous and have scant regard for human life. This has led to daily avoidable carnage on Nigeria roads with many losses of lives. Almost to the point of indisputability is the fact that, of virtually all the significant factors contributing to the alarming proportion of accidents on Nigeria roads, the human factor tops the list.

The reasons why the accident occurred due to the error of either the driver, the passenger or even the pedestrians were asked following some questions which would be needed for the analysis of this project.

Indicators to verify the claim are evident:

A. Driver

Sex, Age range of the driver, driver's experience /ability, driver's vision are the main factors a driver is needed to be considered with.

The long-time debate of men versus women drivers has been more of a coffee table discussion rather than a serious study by professionals. In a recent study of traffic data for Catalonia for 2004 and 2008 carried out by Elena et al. (2014), it was found that in accidents involving child pedestrians and young drivers, men are at a greater risk as compared to women. With respect to age groups, old female drivers have higher accident risks. However, men are more prone to being involved in severe accidents and injuries.

i. Fatigue

Most motorists ride without formal training, and less so without education on road safety. Chiron et al. (2008) studied the relationship between work fatigue and road accidents with road crash-related injuries in employees of French electric and gas companies. They were able to determine a relationship between work type and work fatigue as indicators of road crashes. Their study could be used to prevent accidents by controlling work fatigue at work places.

One of the important factors in traffic accidents is sleep deprivation among drivers. Komada et al. (2013) studied traffic accidents related to sleep disorders and sleep deprivation, as well as discussed advances in detecting sleepiness and thus avoiding such accidents.

Brown et al. (2014) studied behavioral adaptation by drivers to changing road conditions and road environment complexity. Their tests using a driving simulator showed that experienced drivers (5–10 years of experience) adapted more easily to driving in changing environments than non-experienced (1–5 yrs.) drivers.

Sleep-related accidents are avoidable but they remain a major cause of traffic accidents. Lucidia et al. (2013) studied sleep-related risk factors and found that young and inexperienced drivers are more susceptible whereas non-urban roads have more sleep related accidents.

ii. Talking on cellphones

Cellphone distractions are risky but eating/drinking while driving also has an equally negative effect on a driver's ability to focus and drive safely.

It is found that driving while using cell phone is one of the human behaviour factors contributing to the cause of road traffic accidents. "A hand –held cellular phone is used in a variety of circumstances by road users in Nigeria while walking down the street (pedestrians) or driving motor vehicle." (Komba, 2006). The various tasks entailed in using a cellular phone each require a different amount of time, mental energy, and coordination, leading to potentially different complications of the driving task and resulting risk of collision. As the driver concentrates on the cellular phones, accident victims notice unstable movements of the vehicle before a crash or collision to another vehicle happens.

Cellphones are considered as one of the major reasons for distractions, accidents, and fatalities. However, Loeb et al. (2009) in their study of effects of cellphone use on pedestrian fatalities found that pedestrian fatalities increased when cellphones were first introduced, but decreased as cellphone numbers approached a critical threshold. But this trend has reversed and pedestrian fatalities continue to increase with the increase in cellphone numbers and usage.

iii. Alcohol consumption

Risks of traffic accidents caused by the use of prescribed drugs by drivers were high and are even higher during the first seven days of usage of the drugs. More attention needs to be paid in devising policies and warning systems to avoid such traffic accidents (Engeland et al.,2007).

Effect of alcohol intervention programs (Alcohol Free on the Road) on the behavior and alcohol law compliance by young drivers is found that drivers who attended these programs showed greater awareness and lesser involvement in alcohol-related accidents. However, this may not be true for the drivers who did not attend the program, suggesting that such intervention programs are effective (Brookhuis et al., 2011).

Alcohol and distracted driving are major causes of traffic accidents and fatalities, and the fatality rates continue to grow. Wilson et al. (2013) studied the effect of alcohol use and distracted driving in traffic fatalities. They emphasized the negative effects of this trend on policies to counter distracted driving.

Young et al. (2008) used driving simulators and found that a driver’s ability to drive safely reduced substantially with increased eating and drinking.

iv. Speed Range

Speed is often singled as biggest factor contributing to road accidents in the world. Speed has been identified as a key risk factor in road traffic injuries, influencing both the risk of a road crash as well as the severity of the injuries that result from crashes. Over 40% of fatal collisions are caused by excessive or inappropriate speed. A 5km/h difference in speed could be the difference between life and death for a vulnerable road user like a pedestrian. Excess speed is defined as exceeding the speed limit. Inappropriate speed is defined as driving at a speed unsuitable for the prevailing road and traffic conditions. Excess and inappropriate speeds are responsible for a high proportion of the mortality and morbidity that result from road crashes. Controlling vehicle speed can prevent crashes happening and can reduce the impact when they do occur, lessening the severity of injuries sustained by the victims. Roads in towns and cities are usually shared by pedestrians, cyclists, other users of public transport as well as higher speed traffic. Speeding is identified as a major cause of accidents, also at the same time they stated that speeding is increasingly becoming a socially acceptable traffic violation. This sheds light on the fact that personal and social perception resulting in traffic rules violations may diminish the role of traffic safety regulations in reducing accidents and fatalities. Education, awareness, and emphasis on traffic safety regulations should be the focus of long-term traffic safety agenda (Tay et al. 2002).

v. Over Taking

Impatient drivers that do not get their way will often resort to overtaking if they can. Yes, there are also those selfish individuals out there that hog the middle and the outside lane. They have no idea that there is a queue of traffic waiting to get past them, probably because they are in their own little world thinking about what to have for dinner. This causes some individuals to lose patience and undertake.

B. Passengers

i. Use of Seat-belts or child restraints

Janssen (1994) conducted a field experiment to study the effects of seatbelt legislation on the reduction of traffic fatalities. In an instrumented-vehicle study, Janssen found that habitual seatbelt wearers, who were offered incentives for safe driving, did not show considerable improvement in driving behavior over the study period. On the other hand, the non-seatbelt wearers showed an increase in risky behavior, such as increased speed and close following after being asked to wear seatbelts. The study suggested that there was change in driver behavior but not as expected, i.e., in the safe direction.

C. Pedestrians

In the event of a crash, (>55) older pedestrians and bicyclists tended to have a higher probability of getting involved in a fatal crash (p-value < 0.05). In terms of gender, the findings suggested that male pedestrians had higher odds of being in a fatal crash than women at a significant level (Brown et al.,2014).

Two variables were used for pedestrian characteristics, age and gender. Most of the studies classified age into different categories, defining elder pedestrian as people over the age of 65.

A 2006 database from the South Korean Police agency was used for this purpose. The findings suggested that elder pedestrians had a greater likelihood of being involved in a fatal and severe crash than younger pedestrians. Kim et al. (2008) studied police reported crash data between 1997 and 2000 to investigate the relationship of age in the severity of the crash. The authors found that as the people get older, the probability of fatal or severe injuries after a crash increased. Similarly, Zheng (2014) showed that elder pedestrians are at a higher risk of a severe crash than younger pedestrians. These findings were attributed to the fact that walking speed, visibility reaction time, and body resistance tend to be lower for this demographic group.

Unguided pedestrians increase the risk of accidents to occur by causing confusion and misleading other road users, their movement towards the use of the road remains inconsistent while they are unprotected. Pedestrians behavior can be widely variant quite inconsistent, difficult to control and is linked to many other related and unrelated factors. It is very common to pedestrians crossing the road without paying proper attention to the vehicular traffic and this shows that their behaviors in using the road is also one of the risk factors contributing to traffic accident.

i. Walking along the road

Uneducated pedestrians may not know that they must use the footpath if there is one, that they must walk as near as possible to the right hand side of the road facing the oncoming traffic; that they should not walk more than two abreast, especially if the road is narrow or carries heavy traffic, and that they should instead walk in single file.

ii. Crossing the road

Pedestrians may not be attentive when crossing the road, they may not look for a safe place to cross, they may take their time when crossing, they may cross at a corner or bend and other necessary precautionary measures wouldn't be taken.

D. Cyclist

Two-wheeled motorists and cyclists are among the vulnerable population in the case of road accidents. It is estimated that half of the world's road traffic deaths occur among motorcyclists-23%, pedestrians-22% and cyclists-5% (WHO, 2013).

Other factors that can also be caused by humans are listed below

a. Prevalent disregard of road traffic signs by road users
b. Lack of proper training of drivers

c. Irresponsible driving habit particularly among teenage drivers
d. Inexperience and incompetent drivers
e. Lack of respect / consideration for other road users
f. Impatience and negligence
g. Overloading of vehicles
h. Poor vision

2. The Vehicle Factor

The vehicle also constitutes one of the major factors of road traffic accident. This is due to poor vehicle maintenance which lead to damage that may eventually show up while the vehicle is in motion. Road safety however goes beyond periodic check or prompt repair of vehicles. It should be a daily routine of care and check of all components of a vehicle.

The main vehicle factors are defects in tyres, brakes and inputs all arising from poor maintenance of the vehicle. The global economic recession has badly affected the quality of products in the Nigerian markets such that people now favour the use of sub-standard products like Tokunbo tyres, spare parts and Tokunbo vehicles. These, coupled with over speeding and reckless driving, negate the principles of safety when considered against the phenomenon of used vehicles. Any of those parts malfunction can eventually affect smooth driving, which in the end, can lead to serious accident.

The different component of mechanical factor that resulted into accident are:

a. Brake failure
b. Burst tyres
c. Engine failure
d. Use of fake spare parts
e. Defective and Dazzling lights

f. Poorly maintain vehicles.

In essence, a deficient vehicle, an unserviceable car, or a poor maintained automobile are all dangers with high probability to cause accidents on the highways.

In terms of vehicles movements, crashes caused by a vehicle moving straight had higher odds to be fatal than crashes caused by vehicles turning.

i. Air-bags and seatbelts

Air-bags and seatbelts are the most common and effective safety features used in cars, however, not a lot of studies focus on correlating the use of these devices with facial injuries. This is important because head and facial injuries are serious and more often lead to fatalities. Murphy et al. (2000) did a study of accident data from the Pennsylvania Trauma Outcome Study Database and found that use of these devices, either individually or in combination, decreased the incidence of facial fractures and lacerations in motor accidents.

Although seatbelts and airbags have saved numerous lives and injuries to vehicle occupants, occasionally they have also resulted in injuries and even deaths. In order to address this issue, NHTSA made policy changes and introduced new advanced airbag rules for all vehicles sold in the United States. Anishetty and Little (2001) in their study reviewed such technologies and proposed new regulations and strategies to enhance occupant protection.

ii. Road worthiness

The particulars of vehicle are incomplete and are not worthy for highways. Due to the fact that of the low per capita income in developing countries, owners are less likely to buy the updated parts of their vehicles such as tyres, updating their braking system, headlights, etc, which could easily lead to road accidents.

1. **The Physical/ Environment Factor**

There is a strong debate within the context of Nigeria as to whether the high incidence of road accidents should actually be attributed to bad roads. Or, if they are not a paradoxical function of the good and modern highways that the country invested on so much. The contention is against the backdrop that despite the construction of new roads in the country, appreciable reduction has not been witnessed in accidents rates but rather seem to be increasing.

In other words, there is need to focus on other factors, particularly the human elements contributing to the disaster.

Environmental factors include

a. Bad road
b. Weather conditions
c. Dangerous bend
d. Broken down/ abandon vehicles
e. Animals not under control
f. Obstruction on the road.

Road designs and management are also factors of road traffic accidents as well as the weather condition of the area. Also, today's road designs, management systems, and safety measures may be subconsciously biased towards certain types of motor vehicles (Chang and Yeh 2006).

2.4 **Haddon Matrix**

The Haddon Matrix was developed in the 1960s road safety arena, and has since been used in many public health settings. The literature and two specific case studies are reviewed to describe the background to the Haddon Matrix, identify how it has been critiqued and developed over time and practical applications in the work-related road safety context. Haddon's original focus on the road, vehicle and driver has been extended and applied to include organizational safety culture, journey management and wider issues in society that affect occupational drivers and the communities in which they work. The paper shows that the Haddon Matrix has been applied in many projects and contexts.

Practical work-related road safety applications include providing a comprehensive systems-based safety management framework to inform strategy. It has also been used to structure the review or gap analysis of current programs and processes, identify and develop prevention measures and as a tool for effective post-event investigations. Introduction, background and method There is a body of research from around the world, summarized by Murray el al (2009), showing that people driving for or to work make up a significant proportion (over 50%) of all road deaths and worker fatalities, at a very high cost to both society and organizations (NHTSA 2003, Davey & Banks 2005). For this reason increasing attention has focused on improving work-related road safety and developing models and frameworks for good practice (Monclús 2010, Mooren & Grzebieta 2010, Newnam & Watson, 2011, Mitchell et al 2012). The focus of this paper is on the Haddon Matrix, which is one example of such a framework that has been widely used to guide research, policy and practice in the area of work-related road safety allowing a systems-based approach to be adopted. Against this background, four main aims are presented:

1. To describe some contextual background to the use of the Haddon Matrix, including research in public health, general road safety and work-related road safety arenas.
2. To set out how the Haddon Matrix has been reviewed, developed over time and Applying the Haddon Matrix in the context of work-related road safety, peer reviewed 2
3. Several conclusions, recommendations and areas for further work are outlined with regards to utilization of the Haddon Matrix as a tool for work-related road safety.

Background to the Haddon Matrix and its application in road safety William Haddon was an American epidemiologist and a prominent advocate for collision prevention and injury control (Haddon 1968, 1970, 1972, 1980). He was instrumental in applying scientific methods to the study of motor vehicle injuries, seeking to identify the phases and factors related to each event. He identified three temporal phases which he called opportunity reduction (Pre-event phase), injury protection (Event phase) and the minimization of adverse consequences (Post-event phase). These phases make up the rows of his two dimensional Matrix in Figure 1. Three epidemiological factors make up the columns of the Matrix: Human, Vehicle/Equipment and Environment/Road-based. Haddon argued that together these phases and factors yield the first of a series of matrices of both practical and theoretical value in categorizing road-loss phenomena, knowledge, countermeasures and program efficacy. In accordance with the model, interventions for preventing crash and injury numbers and severity may involve changes in factors during any of the three phases.

The World Health Organization, for example, identified the Haddon Matrix as a dynamic systems-based framework for road safety (Peden et al 2004), with each cell allowing opportunities for intervention to reduce road crash injury. They suggested that Haddon's work led to substantial advances in the understanding of the behavioral, road and vehicle-related factors that affect the number and severity of casualties in road traffic collisions, providing a systems approach to identify and rectify the major sources of error or design weakness that contribute to fatal and severe injury crashes, as well as to mitigate the severity and consequences of injury. This included reducing exposure to risk, preventing road Applying the Haddon Matrix in the context of work-related road safety, peer reviewed 3 traffic crashes, reducing the severity of injury and reducing the consequences of injury through improved post-collision care.

The European Commission (2011) adopted a similar approach, identifying how a systems approach looks at the traffic system as a whole and at the interactions between roads, vehicles, and road users to identify where there is potential for intervention. The systems approach seeks to identify and rectify major sources of error or design weakness that contribute to fatal and severe injury crashes, recognizing that people make errors which the traffic system needs to accommodate for. Similarly, the '5 Pillars' safe systems model advocated by the United Nations Road Safety Collaboration and cited in the Challenge Bibendum White Paper (Michelin 2010) draws heavily on, although does not directly cite, the Haddon Matrix factors in focusing on: road safety management, safer road systems, safer vehicles, safe road users and improved post-collision care. More recently, the international standard on Road Traffic Safety, is shaped very much around such a systems based approach with factors covering areas such as: leadership, route selection, journey management, driver management, vehicle management and post-event responses. Despite this, the Haddon Matrix has its critics. Questions have focused on Haddon's approach favoring passive rather active safety features (Gladwell 2001, Robertson 2001) which may have delayed the implementation of seatbelt legislation while advocating for vehicle airbags. Other more recent criticisms by Mooren and Grzebieta (2010) focused on the problems of evaluating the impact of multiple simultaneous interventions and the value of the Haddon Matrix as a predictive tool. They also questioned the extent to which the Haddon Matrix can be defined as a systems-based model in line with current safe systems thinking in road safety.

In this context, human error and frailty is placed at the center of the system which is designed to accommodate these limitations to ensure safety, focusing particularly on the interactions between infrastructure, speed and physical vulnerability (OECD 2008). While acknowledging such criticisms, the Haddon Matrix continues to be widely utilized as a systems-based framework in a range of public health and work-related road safety settings. Applications of the Haddon Matrix beyond the road safety field – public health Many researchers, policy makers and practitioners have extended beyond Haddon's original focuses on energy exchange events and how to address them. For example, Bunyan (1998, 2003) described the Haddon Matrix as a compelling framework for understanding the origins of injury problems and for identifying multiple countermeasures to address them. Examples were given from fire prevention and firearm use in schools. A third dimension, incorporating the use of value criteria in the decision making process, was added including cost, freedom, equity, stigmatization, participant preference and feasibility. Bunyan (2003) surmised that the Matrix has been used both to conceptualize etiologic factors for injury and to identify potential preventive strategies. This makes the Haddon Matrix a useful tool not only for guiding epidemiologic research but also for developing interventions in a structured way. Bunyan and Yonas (2008) focused on the Haddon Matrix as a framework for analysis and preventative countermeasure development in public health and injury prevention. They argued that the Matrix was consistent with, and overlapped with, other public health models such as Bronfenbrenner's social-ecologic model, which focused on the individual in a broader context, citing teen driving as an example. Six factors were included:

a. Host – the injured teen;
b. Peers;
c. Parents;
d. Vehicles;
e. Institutions/organizations; and,

f. Sociocultural Applying the Haddon Matrix in the context of work-related road safety, peer reviewed 4 practices and norms. They concluded that the Haddon Matrix provides a useful tool for policy development and implementation.

In total, Haddon (1972) has been cited in 130+ studies in areas as diverse as blunt thoracic injury in older adults (Hawk et al 2012), burns epidemiology (Deljavan et al 2012), obstetric fistulas (Wall & Lewis 2012), injury events in emergency medical services (Brice et al 2012), outpatient drug safety (Budnitz et al 2007), pesticide self-poisoning (Eddleston et al 2006), construction injuries (Bondy et al 2005, Glazner et al 2005), public health readiness (Barnett et al 2005), death investigations (Conroy & Fowler 2000), rape (Mantak 1995), electrocutions (Pineault & Barr 1994) and seatbelt usage (Robertson et al 1974). The Haddon Matrix in the context of work-related road safety Specifically in the field of work-related road safety, a number of researchers and practitioners have utilized and developed the Haddon Matrix.

Swedish researchers Albertsson et al (2003) and Albertsson & Falkmer (2005) applied the Haddon Matrix as a tool for formally reviewing incidents, analyzing data to inform countermeasures and taking corrective actions in the bus and coach sector. In particular, they focused on investigating whether seatbelts would have reduced injuries, and highlighted the triage problem in a severe mass casualty situation. In two comprehensive reviews of work-related road safety practice (Murray et al 2003, Murray et al 2009a) it was noted that traditional fleet safety interventions in many organizations typically focused on driver behavior and training. The research, however, identified the need for a more systematic or holistic occupational safety and health (OHS) based approach to road safety in organizations led by multi-disciplinary stakeholder groups. Although several theoretical frameworks were discussed, the Haddon Matrix was identified as and expanded into a comprehensive systems-based framework for piloting, implementing, structuring and embedding good practice, policy and interventions in organizations. Haddon's original three phases (Pre-event, At-scene and Post-event) were retained, but the factors have been expanded to include five categories: Management culture; Journeys, Road/site environment; People - drivers and managers; Vehicles and External/societal/community/ brand. These studies focused on how, in addition to being a strategic framework for generating and categorizing work-related road safety countermeasures, the Haddon Matrix could be used to structure fleet gap analysis reviews, employee safety culture surveys, post event investigations and program evaluations.

Over time the approach has evolved and been applied in a range of organizations. Applying the Haddon Matrix in the context of work-related road safety, peer reviewed 5 Two peer reviewed case studies of driver safety improvement programs, implemented by cross organizational multi-functional committees led by OHS professions, are described. Both programs, undertaken by Wolseley (Murray et al 2009b) and British Telecommunications (BT) (Wallington et al 2014), involved the extended Haddon Matrix. In each case sustained long-term improvements in their road safety performance and costs were achieved. Work-related road safety was identified as the biggest risk factor for asset damage and human harm faced by the company. One of the first initiatives was for the organization's new OHS Manager to take over the running of the Fleet Safety Steering Group (FSSG), with key stakeholders from across the organization, which was set up to implement the recommendations from the initial gap analysis. As well as for framing its gap analysis, Wolseley used the Haddon Matrix to extend its post collision investigation processes beyond the typical focus on 'driver error' to include organizational, management and journey-based risks. Like BT (below), Wolseley has extended its influence beyond the workforce to focus on community road safety initiatives.

Many researchers have carried out research work in the area of road accidents. Some of them have analyzed accident data in different ways. Some of them Identification of Blackspot zone. Some of them have developed accident models for forecasting future accident trends.

They have also proposed strategies for road safety. In the present chapter literature review is carried out covering the different issues related to road accident and road safety. Yannis, (2014) was presented with a Review of The Effect of Traffic and Weather Characteristics on Road Safety. Despite the existence of generally mixed evidence on the effect of traffic parameters, a few patterns can be observed. For instance, traffic flow seems to have a non-linear relationship with accident rates, even though some studies suggest linear relationship with accidents. Regarding weather effects, the effect of precipitation is quite consistent and leads generally to increased accident frequency but does not seem to have a consistent effect on severity. The impact of other weather parameters on safety, such as visibility, wind speed and temperature is not found straightforward so far. The increasing use of real-time data not only makes easier to identify the safety impact of traffic and weather characteristics, but most importantly makes possible the identification of their combined effect. The more systematic use of these real-time data may address several of their search gaps identified in this research.

Goliya (2013) were presented an analysis of accidents on small portion NH-3Indore to Dhamnod. The data for analysis is collected for the period of 2009 to September 2011. More accidents occurred in Manpur region by faulty road geometry. The trend of accidents occurring in urban portion (Indore) is more than35 % to rate of total accidents in each year. This may due to high speeds and more vehicular traffic. In the present study area the frequency of fatal accidents are 2 in a week and 6for minor accidents in a week. More number of accident observed in 6 p.m. to 8 p.m. duration because in that time more buses are travels between villages and city. One fatal and five casualties are occurring per km per year in the study area. The volume of the trucks passing through study corridor is increasing by year.

At Rajendra Nagar from 2000onwards the traffic is reduced due to the construction of by passes in that area. The geographical approach to the study of traffic accidents relates the concept of place, time and environment to accident occurrence. It is believed that land use, road element, width of the road, bending of the road, hilly area, topography and regional distribution in occurrence of road traffic accident.

2.5 Review of Related Theory

A handful of theories have been put forward to explain Road Traffic Accidents causations. Some of the best known theories use System theory and Risk theory in an attempt to explain the causation of Road Traffic Accidents.

The systems perspective views human performance as a function of many interacting system-wide factors. In the context of human error and accident causation, for example, it is now accepted that errors are a consequence of 'systems' failure rather than merely aberrant psychological factors within individuals. Human error is thus no longer always seen as the primary cause of accidents, rather, it is treated as a consequence of latent failures residing within the wider system (Reason, 2000). In a road safety context, elements of the system beyond road users, such as vehicle design and condition, road design and condition, road policies, and so on, all shape driver's behavior on the road. Although there are other models of accident causation (e.g.Levenson, 2004; Hare, 2000), the systems based models is the most prominent and it is now widely accepted that the accidents which occur incomplex socio-technical systems are caused by a range of interacting human and systemic failures (Salmon and Lenne, 2009). Systems-based accident analysis and investigation, described also in the 'Swiss model', (Reason, 2000) has been applied with significant success in a range of safety critical domains such as in road transport, aviation, process control, rail transport and in a range of other domains which they have been applied successfully (Salmon et al., 2009; Smith et al., 2001; Wiegmann et al., 2003).

Road traffic accidents risk, according to Dejoy (1989) is a function of four elements. The first is the exposure or amount of movement or travel within the system by different users or a given population density. The second is the underlying probability of crash, given a particular exposure. The third is the probability of injury given a crash. The fourth element is the outcome of injury. Risk can also be explained by human error (Reason, 2000; Rasmussen, 1999); kinetic energy, tolerance of human body and post-crash care (Bustide et al, 1989).

Lupton (1999) also asserts that Risks can be seen from four perspectives. These are the rationalist, realist, constructionist and middle positions. The rationalist sees risks as real world phenomena to be measured and estimated by statistics, prioritized by normative decision theory and controlled by scientific management. The realist sees risks as objective hazards or threats that exist and can be estimated independently of social and cultural processes but that may be distorted or biased through social and cultural frameworks of interpretation. The constructionist sees nothing as a risk in itself. Rather, what we understand to be a risk, the constructionist sees as the product of historically, socially and politically contingent ways of seeing. Proponents of the middle positions between realist and constructionist theory see risk as an objective hazard or threats that is inevitably mediated through social and cultural processes and can never be known in isolating from these processes (see Jaeger et al., 2001; Horden,2004).

2.6 Accident Prediction Models

According to Sayed et al. (1999), accident prediction are statistical regression models which relate accident occurrence to traffic and geometric characteristics of a location, and are developed based on a group of locations of similar geometric make-up. The models can be used to predict future accident occurrence at other locations of similar characteristics. They can also be used to identify accident-prone locations, to set up critical accident frequency curves, to rank accident-prone locations, and to perform before-and-after studies to show the effectiveness of an implemented treatment.

2.6.1 The Generalized Linear Regression Method (GzLM)

The generalized linear regression method (GzLM) is used to estimate the parameters of accident prediction models. GzLM has the advantage of overcoming the limitations associated with the use of conventional linear regression in modeling accident occurrence, which is random, discrete, and non-negative in nature. Since the conventional linear regression requires that the model must be a linear combination of the explanatory variables, the error terms of which must be normally distributed, uncorrelated, and have equal variance, it is not suitable for modeling accident occurrence (Jovanis et al., 1986; Hauer et al., 1988 and Saccomanno et al., 1988).

Based on the work of Hauer et al. (1988), Kulmala (1995) and Sayed et al. (1999), Let Y be a random variable that represents the number of accident at a location in a specific time period, and assume it follows the Poisson distribution with parameter X. Let Λ be the variable that represents the mean of the Poisson distribution, such that $\Lambda = \lambda$. Hauer et al. (1988) showed that for an imaginary group of locations of similar characteristics, Λ can be regarded as a random variable which follows the gamma distribution with parameters κ and κ/μ, the mean and the variance of which are as follow:

2.6.2 Goodness-of-Fit Test

A measure of goodness of fit of the Poisson regression model is obtained by computing the deviance statistic of a base model against the full model. A base model includes only the intercept, while the full model includes the intercept and all the x variables

The deviance is defined as **-2** multiplied by the **log-likelihood ratio**

$$\text{Deviance} = -2\ (\ \ln L(\text{base model}) - \ln L(\text{full model})\ ).$$

The deviance is used as a test statistic for testing H_0: the base model has a good fit against H_1: the full model has a good fit. Under H_0, the deviance has a chi-squared distribution with the degrees of freedom = number of x variables in the good model.

If the deviance is large (formally, p-value < 0.05), then H0 is rejected and the conclusion is that the full model has a good fit.

Conclusively, despite the growing popularity of accident prediction models, they are related to a number of limitations. First, the models do not necessarily reflect cause-and-effect relationships. Many factors contribute to accidents, but not all of them are well understood and quantifiable. Also, the development of regression models depends heavily on the availability and accuracy of the data. If data are unavailable or inaccurate, the ability of the models to reflect cause-and-effect relationships would be weakened.

Second, accident prediction models should reflect local conditions and be current. For example, models developed for one region may not be applicable for another region due to reasons such as differences in climate, driver populations, and accident reporting practices. Thus, different jurisdictions are required to develop their own sets of models, unless calibration procedures are available so that models developed for one region can be calibrated and applied in another region. Third, practitioners may be tempted to interpret each coefficient in the model as the true effect of an incremental change in the associated location characteristics on accident occurrence. This interpretation is not necessarily true. If the independent variables are either correlated to other variables in the model or to some important variables which have not been included, it would be difficult to isolate their individual impact. Fourth, it should be noted that accident prediction models are reliable only within the range of independent variables of the original data used for model development

CHAPTER 3

RESEARCH METHODOLOGY

3.1 The Study Area

The data needed for this study are the number of deaths and the number of injured persons resulting from Road Accidents in Edo State, Benin City in Nigeria for the period 2017-2018. The data were collected from records of Hospitals, the Nigerian Police Force Stations, the Federal Road Safety Commission office in Benin City (Oredo LGA) The collected data were then collated, analyzed and presented in a form using Haddon Matrix Method of Road Traffic Accidents casualties. These are shown in figures 2, 3 and 4. In addition, regression method was used to build statistical models for the explanation of the spatial pattern of Road Traffic Accident casualties in the state. The analyses were carried out using the Statistical Package for the Social Sciences (SPSS) and Excel.

3.2 Data Collection

The data was collected from hospital facility names provides critical care to accidents victims and has 24-hrs functioning diagnostic and emergency operative services and an intensive care unit. Study Participants included all road traffic crash victims whose first point of treatment was accident victims for either medical or surgical consultation.

For the purposes of the study, a road traffic accident or crash was defined as an accident that took place on the road between two or more objects, one being a moving vehicle. To ensure maximum collection of data in pre-crash-crash and post-crash phase, individuals who incurred road injuries that did not involve moving vehicles, resided outside Oredo Local Government, were referred from an outside facility or were declared dead on reaching facility were excluded.

Data Collection Information about the subjects was obtained from the following four sources:

a. Medical Record Department: Data was collected for both outpatient and inpatient admissions over the 12-month period. With the approval of the Chief Medical Director of the hospital, data was manually extracted from 90 Study Participants records from the period of one year (November 2017-October 2018) using a pre-designed questionnaire (sample is above). The data on demographics (gender, literacy level, occupation, marital status), site of injury and incident details (day, month, location, alcohol intake) as documented in the registry was recorded.
b. Police stations where accidents victims were registered: Information from police records supplemented missing data, such as the exact location of the crash and the nature of factors associated with the crash.
c. Federal Road Safety Commission (FRSC): Data was also collected from the office of the field marshal.

Epidemiological data collected from these sources was triangulated and interpreted using the Haddon matrix. Data was entered in Microsoft Excel and then transferred to SPSS for statistical analysis.

A questionnaire was made from Microsoft word which carried questions about the victims and was to Hospitals (getting medical reports from the Doctors and one on one discussion with the patient), Police station etc.

Here are most of the questions asked on the questionnaire:

3.2.1 Explanations on some of the questions asked on the questionnaire:

1. Hospital: This will take the name of the hospital which the accident victim was taken or referred to.

2. Location of the area: This is the area where the accident occurred.
3. Date or Period of accident: The date the accident occurred is recorded here.
4. Sex: This has to do with the gender of the victim.
5. Age: This talks about how old the victim was before the accident.
6. Marital Status: This talks about the marital status of the victim e.g to know if the victim is married, divorced, widow e.t.c
7. Educational Status: The educational status of the victim is asked that is to know if the victim was a graduate, a dropout or didn't attend any school.
8. Occupational Status: To know if the victim is working or not.
9. Occupants: This has the records of how many persons was in the vehicle before the accident.
10. Light or Heavy Vehicle: This has the record of the type of vehicle that was involved in the accident. i.e. Toyota camry or lorry van respectively.
11. Road Worthiness: This has the record of the availability of
12. Lighting and Braking system: This gives the info if the light and brake of the car is in good or bad condition.
13. Overloading: This helps to check if the vehicle involved was overloaded.
14. Presence of speed limits and defect in road designs: This helps in getting the record of the amount of speed limits on the if there was any and if the road had portholes or not.
15. Road type and site of crash: This has the record of the type of road whether its paved or not and the type of road that the accident took place e.g Y-junction e.t.c
16. Road object not crash protective, beating of traffic light and traffic volume: This helps in recording the kind of object that was the road that the accident occurred

i.e. if the object had a caution sign.it also records the behavior of the driver if he obeyed the traffic light and if the traffic condition was heavy, low or clear.

17. Time and day of incident: This takes into consideration the time of the time and day the incident occurred.
18. Pedestrian walkway: This helps to check if there was presence of walkway for pedestrian.
19. Host, is the driver, drivers experience and drivers vision: This has in record the person involved in the accident, if the driver has any driving experience and to check the vision of the driver before the crash.
20. Activity reported at the time of crash, talking on mobile and alcohol consumption: This helps to take into record the activity that was done by the pedestrian before the accident e,g crossing the road e.t.c. Also helps to know if the person involved was talking on phone or drank alcohol during the time of the crash respectively.
21. Part of the vehicle affected and presence of airbag: This helps to note the part of the vehicle that was hit during the crash and if the vehicle had airbag.
22. Presence of seatbelt and speed range: This helps to talk note if there was seatbelt on the vehicle, if it was used too and the speed range before the crash.
23. Overtaking, direction of moving vehicle and motion of vehicle: This helps to note if there was any form of overtaking, the direction of the vehicle and the motion of the vehicle i.e. if it on motion, applying brake etc.
24. Ease of access, presence of fire extinguishers and presence of fire resulting from collision: This help to check the ease during accessing the road, if there was fire extinguisher on the vehicle and if there was fire after the clash.
25. Leakage of hazardous materials: This helps to check if there was any leakage of hazardous materials.

26. Appropriate prehospital first aid care, care in hospital emergency rooms and extracting people from vehicles: This helps to check the amount of care given to the person involved in the crash in the hospital, the first aid care given and how difficult it was to extract the people.
27. Outcome of the accident victim within and after 1 hour of incident: This helps to check how the victim was after 1hour of the incident and before 1 hour of the incident.

CHAPTER FOUR

RESULTS AND ANALYSES OF RESULT

4.1 Data Corelation

After retrieving the questionnaires from the victims, the percentage of each questions asked was calculated using corel draw to calculate and analyse the answers given by the victims. Below are the percentage gotten:

Host factors

Age of the victims

<18 years = 29 (32.2), 18–60 = 59 (65.5), >60 years = 2 (2.2)

Gender

Male = 60 (66.6) Female = 30 (33.3)

Occupation status

Civil servant = 13 (28.8) Student = 38 (42.2) Business Professional = 16 (17.7)

Unemployed = 23 (25.5)

Marital status

Married = 28 (31.1), Single = 49 (54.4), Widow = 6 (6.6) Widower = 3 (3.3)

Divorced = 7 (7.7)

Education status

Tertiary = 26 (38.8), Secondary school = 34 (37.8), Primary school = 1 (1.1),

Uneducated = 29 (32.2)

Occupant:1 = 19 (21.1), 2 = 28 (31.1), 3 = 25 (27.8), 4 = 8 (8.9), 5 or more = 10 (11.1)

Pre crash phase

Vehicle

Light vehicle = 63 (70) Heavy vehicle = 33 (36.6)

Road worthiness

Complete = 60 (66.6),   Incomplete = 25 (31.1), Don't know = 5 (6.6)

Lighting

Good = 66 (73), Bad = 24 (23)

Braking System

Good = 46 (51.1), Bad = 44 (48.8)

Overloading

Yes = 39 (43.3), No = 46 (51.1), Don't know = 5 (5.5)

Physical Environment

Presence of speed limit

Yes = 45 (50), No = 36 (40), Don't know = 9 (10)

Defect in road design e.g potholes

Yes = 28 (31.1), No = 54 (60), Don't know = 8 (9)

Road type

Paved road = 69 (77), Unpaved = 21 (23)

Site of clash

Y-junction = 8 (9), Crossing = 46 (51.1), Mid-block 4 (4.4), At block = 6 (6.6),

Round-about = 2 (2.2), U-turn = 2 (2.2), Don't know = 22 (24)

Road side object crash-protective

Yes = 36 (40), No = 40 (44), Don't know = 14 (16)

Beating of traffic light

Yes = 41 (45.5), No = 49 (54.4)

Traffic volume

Moderate/heavy = 33 (37), Low visibility = 40 (44), clear visibility = 17 (19)

Weather condition

Rainy = 21 (23), Sunny = 52 (58), Clear = 17 (19)

Time of incident

6am – 12pm = 13 (14.4), 12pm – 6pm = 65 (72.2), 6pm – 12am = 9 (10), 12am – 6am = 3 (3.3)

Day of incident

Monday/Tuesday = 33 (37) Wednesday to Friday = 34 (38), Saturday or Sunday = 13 (14)

Pedestrian walkway

Yes = 17 (18.8), No = 53 (58.8), Don't know = 20 (22.2)

Human

Host

Driver = 38 (42.2), Passenger = 13 (14.4), Pedestrian = 39 (43.3)

Is the driver

Young = 36 (40), Advanced/Elderly = 50 (55.5), Old = 4 (4.4)

Driver's experience/ability

Good = 39 (43.3), Bad = 30 (33.3), Don't know = 21 (23.3)

Driver's vision

Good = 18 (20), Bad = 51 (56.6), Don't know = 21 (23.3)

Activity reported at time of clash

Crossing the road = 53 (58), Driving = 27 (30), Fall or hit while getting down from the vehicle = 1 (1.1), Passenger or pillion riders = 3 (3.3), Walking along the road = 4 (4.4), Standing at the roadside = 2 (2.2)

Talking on mobile phone

Yes = 7 (7.7), No = 51 (56.6), Don't know = 33 (36.6)

Alcohol consumption

Yes = 14 (15.5), No = 69 (76.6), Don't know = 7 (7.7)

Crash phase

Vehicle

Part of vehicle affected

Front = 55 (61.1), Side = 18 (20), Rear = 11 (12.2), Whole = 11 (12.2)

Presence of airbags

Yes = 21 (23.3), No = 30 (33.3), Don't know = 39 (43.3)

Presence of seat belts or other safety devices

Yes 30 (33.3), No = 48 (53.3), Don't know = 12 (13.3)

Speed Range

Less than 50Km/Hr = 1 (1.1), 51-70Km/Hr = 8 (8.8), 71-100Km/Hr = 35 (38.8), Above 100Km/Hr = 46 (51.1)

Over taking

Yes = 45 (50), No = 42 (46.6), Don't know = 3 (3.3)

Direction of moving vehicle

Right turn = 20 (22.2), Straight = 65 (70), Left turn = 4 (4.4), Not known = 3 (3.3)

Motion of vehicle at time of clash

Accelerating = 50 (55.5), Applying = 32 (35.5), Halted/stop = 2 (2.2), slowing down = 3 (3.3), Don't know = 1 (1.1)

Physical Environment

Presence of stationary object/animal

Yes = 18 (20), No = 72 (80)

Presence of medians barriers

Yes = 25 (27.7), No = 36 (40), Don't know = 29 (32.2)

Presence of roadside embankment

Yes = 20 (22.2), No = 41 (45.5), Don't know = 29 (32.2)

Other crash-protective roadside objects

Yes = 29 (32.2), No = 59 (65.5), if Yes, Specify = 2 (2.2)

Human

Type of Collision

Front = 66 (73.3), Side = 16 (17.7), Rear = 8 (8.8)

Post crash phase

Vehicle

Ease of access

Good = 52 (57.7), Bad = 22 (24.4), 16 (17.7)

Presence of the fire extinguishers

Yes = 52 (57.7), No = 16 (17.7), Don't know = 22 (24.4)

Presence of fire resulting from collision

Yes = 40 (44.4), No = 39 (43.3), Don't know = 11 (12.2)

Leakage of hazardous materials

Yes = 21 (23.3), No = 54 (60), Don't know 15 (16.6)

Physical Environment

Appropriate Pre-Hospital First Aid care

Yes = 87 (96.6), No = 3 (3.3)

Appropriate care in hospital emergency rooms

Yes = 85 (94.4), No = 5 (5.56)

Rescuing and extracting people from vehicle

Difficult = 31 (34.4), Not Difficult = 59 (65.5)

Human

Outcome of Accident Victims as Per Transit Time Within First Hour of Incident

No Unfavorable outcome = 76 (84.4), Died of left Disabled = 14 (15.5)

Outcome of Accident Victim as Per Transit Time After 1 Hour of Incident

No Unfavorable outcome = 62 (68.8), Died of left Disabled = 28 (31.1)

4.2 Results:

90 persons (Crash Victims) were taking into consideration from the records gotten from Hospitals and Federal road safety commission (FRSC).

Host (Patients) Characteristics:

From the data below the majority of crash victims were Young with ages of 18-60 (65.5%) and were majorly Males (66.6%), from the socio economic scale gotten they were Advanced/Elderly (55.5%) while some others were Young (40%)Single (54.4%), and were either Students(42.2%) that are in Secondary school (37.8%) or were Unemployed (25.5%). Pedestrians (43.3%) and Drivers (42.2%) who claimed to have good experience driving (43.3) were worst affected. Few victims conveyed that they were under the influence of alcohol (15.5%) or were using a mobile phone (7.7%) during the time of the crash. While some were hit while crossing the road (58.8%) with those driving coming as the second highest percentage (30%).

Agent (Vehicle) Characteristics:

Most commonly reported were collisions between light vehicles (70%) from front (61.1%) while trying to overtake (50%) other vehicles on a straight roads (70%), most of them claim they were accelerating (55.5%) during the crash but they admitted driving the vehicle above 100km/hr (51.1%) limits but were not using seat belts at the time of crash which was present during the time of the crash (53.3%) but the presence of airbag wasn't really known (43.3%).

When asked they claimed to have good lighting (73%) but the braking system wasn’t good (48.8%) owing to the fact that they tried halting but to no avail and they claimed that the vehicle wasn’t overloaded (46%).

About (57.7%) claimed that they had fire extinguishers and (44.4) recorded that there was presence of fire after the crash but no leakage of hazardous materials were noticed (60%).

Physical Environment Characteristics:

Common sites of crashes were Crossings (51.1%) and at curves (6.6%) in paved roads (77%) with speed limits (50%) were most of them were not having pedestrian walkway (58.8%) because of the defects on the roads (60%) with little roadside embankment that are not crash protective (44%).Low visibility (44%) coupled with moderate/heavy traffic (37%) which majority try to beat (45.5%).Most of these times were sunny (58%) was significantly associated in accidents which occurred between afternoons 12 p.m. to evening 6 p.m (72.2%) from Wednesdays to Fridays (38%).Most of the records mentioned the victims being entrapped in a vehicle but recuing them wasn’t hard (65.5%) and most of the victims were provided first aid during the transit (96.6), after which appropriate care was given to them on the emergency room (94.4%). Less statistical significance was found in outcome (death or left disabled) of patients because most of them had no unfavorable outcome within first hour of incident (84.4%) and after one hour of incident (68.8%).

Distribution of epidemiological determinants in pre-crash phase of crashes for motorized host factors and victims.

Predominant characteristics among victims included advanced/elderly, male gender, student status and lower socio-economic status. In this case of motorized victims, other contributory factors included unclear weather conditions, slippery and unpaved roads, use of mobile phones, driving under the influence of alcohol. Crashes occurred most frequently among drivers and pedestrains occupants during rush hour timings which is 12p.m to 6 p.m and days such as Wednesdays to Fridays, as a result of poor speed control because of low visibility on stretches of roads with heavy traffic volume or due to roadside object not crash protective.

During Incident

Pedestrians and light vehicle drivers were mainly affected during this phase. GIS mapping revealed that out of 90 crash sites recorded within the some radius from the hospitals, crash spots clustered near bus stands, market areas, construction sites and traffic light areas. All these factors along Died of left Disabled = (46.6%) with poor compliance to the speed limits available shows poor sense of traffic rules among victims and lack of planned road traffic crash prevention strategies and their strict implementation.

4.2.1 Post-incident

First aid was administered to most of the victims, including those who were transported by ambulances. The reasons for delayed transit times to local trauma centres in a developed city such as Benin city were not investigated; however, these are likely due to either delay on the part of victim relatives to select a health facility or unsatisfactory management of victim and thereby referral from one facility to another by previously visited health facilities.

The current study not only highlights the influential factors that play a critical role during each of the stages of crash but also sheds light upon the dire lack of suitable policies and intervention measures required to ensure a safe road environment.

This work is to inform the relevant body on the need to work on the use of motorized vehicle, the importance of systematic reporting of vehicular speed and programmable vehicle speed limiters, the need for safer intersections and roundabouts and skid-resistant roads and the use of light passenger cars, safe walking lanes for pedestrians and bicyclists and strict legislative action towards repeat offenders.

Below you will find the frequency table and bar chart that represents the explanation above

4.2.2 Frequency Table, Bar Chart and GIS image hotspots from results respectively represented:

Below are the graphs and charts of the results gotten after carefully analyzing the number of accidents victims using Haddon matrix evaluation, GIS image was also created to show the places or positions of the accident :

INSTITUTION NAME

	FREQUENCY	PERCENT	VALID PERCENT
FRSC	12	13.3	13.3
GODSCARE	17	18.9	18.9
TIME HOSPITAL	58	64.4	64.4
UBTH	3	3.3	3.3
TOTAL	90	100.0	100.0

LOCATION OF INSTITUTION RESPONDENT

	FREQUENCY	PERCENT	VALID PERCENT
AGHO JUNCTION	5	5.6	5.6
ASORO BUS STOP	4	4.4	4.4
COLLEGE ROAD	9	10.0	10.0
EREDIAUWA, EKHEWAUN	9	10.0	10.0
GOODWILL	13	14.4	14.4

ROAD			
OGBEMUDIA STREET, EKHEWAUN	22	24.4	24.4
OWINA ROAD	11	12.2	12.2
SAPELE ROAD	17	18.9	18.9
TOTAL	90	100.0	100.0

SEX OF RESPONDENT

	FREQUENCY	PERCENT	VALID PERCENT
MALE	60	66.7	66.7
FEMALE	30	33.3	33.3
TOTAL	90	100.0	100.0

AGE OF RESPONDENT

	FREQUENCY	PERCENT	VALID PERCENT
<18	29	32.2	32.2
18-60	61	67.8	67.8
TOTAL	90	100.0	100.0

OCCUPATION OF RESPONDENT

	FREQUENCY	PERCENT	VALID PERCENT
STUDENT	37	41.1	41.1
UNEMPLOYED	23	25.6	25.6
BUSINESS PROFESSIONALS	18	20.0	20.0
CIVIL SERVANT	12	13.3	13.3
TOTAL	90	100.0	100.0

VEHICLE

	FREQUENCY	PERCENT	VALID PERCENT
YES	63	70.0	70.0
NO	27	30.0	30.0
TOTAL	90	100.0	100.0

PRESENCE OF SPEED LIMITS

	FREQUENCY	PERCENT	VALID PERCENT
YES	44	48.9	48.9
NO	37	41.1	41.1
DON'T KNOW	9	10.0	10.0
TOTAL	90	100.0	100.0

TYPE OF ROAD

	FREQUENCY	PERCENT	VALID PERCENT
PAVED ROAD	69	76.7	76.7
UNPAVED ROAD	21	23.3	23.3
TOTAL	90	100.0	100.0

SITE OF CRASH

	FREQUENCY	PERCENT	VALID PERCENT
CROSSING	46	51.1	51.1
AT CURVE	6	6.7	6.7
Y-JUNCTION	8	8.9	8.9
MIDDLE BLOCK	4	4.4	4.4
U-TURN	2	2.2	2.2
ROUND ABOUT	2	2.2	2.2
DON'T KNOW	22	24.4	24.4
TOTAL	90	100.0	100.0

TIME OF INCIDENT

	FREQUENCY	PERCENT	VALID PERCENT
6AM-12PM	14	15.6	15.6
12PM-6PM	65	72.2	72.2
6PM-12AM	8	8.9	8.9
12AM-6AM	3	3.3	3.3
TOTAL	90	100.0	100.0

DAY OF INCIDENT

	FREQUENCY	PERCENT	VALID PERCENT
MONDAY/TUESDAY	33	36.7	36.7
WEDNESDAY-FRIDAY	44	48.9	48.9
SATURDAY OR SUNDAY	13	14.4	14.4
TOTAL	90	100.0	100.0

HOST OF INCIDENT

	FREQUENCY	PERCENT	VALID PERCENT
PEDESTRIAN	39	43.3	43.3
DRIVER	38	42.2	42.2
PASSENGER	13	14.4	14.4
TOTAL	90	100.0	100.0

DRIVER

	FREQUENCY	PERCENT	VALID PERCENT
ADVANCED/ELDERLY	51	56.7	56.7
YOUNG	35	38.9	38.9
OLD	4	4.4	4.4
TOTAL	90	100.0	100.0

ALCOHOL CONSUMPTION

	FREQUENCY	PERCENT	VALID PERCENT
YES	6	6.7	6.7
NO	51	56.7	56.7
DON'T KNOW	33	36.7	36.7
TOTAL	90	100.0	100.0

SPEED RANGE LIMIT

	FREQUENCY	PERCENT	VALID PERCENT
LESS THAN 50KM/HR	4	4.4	4.5
51-70KM/HR	9	10.0	10.2
71-100KM/HR	35	38.9	39.8
ABOVE 100KM/HR	40	44.4	45.5
TOTAL	88	97.8	100.0
SYSTEM	2	2.2	
TOTAL	90	100.0	

MOTION OF VEHICLES AT TIME OF CLASH

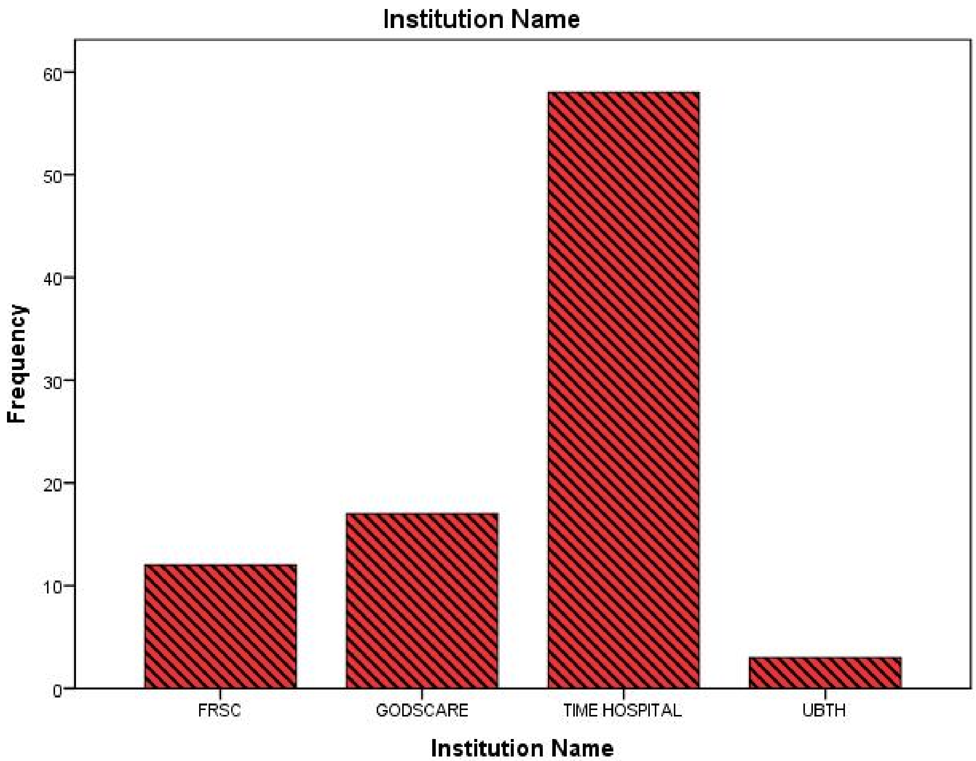
	FREQUENCY	PERCENT	VALID PERCENT
ACCELERATING	50	55.6	56.8
APPLYING BRAKE	32	35.6	36.4
HALTED/STOP	2	2.2	2.3
SLOWING DOWN	3	3.3	3.4
DON'T KNOW	1	1.1	1.1
TOTAL	88	97.8	100.0
SYSTEM	2	2.2	
TOTAL	90	100.0	

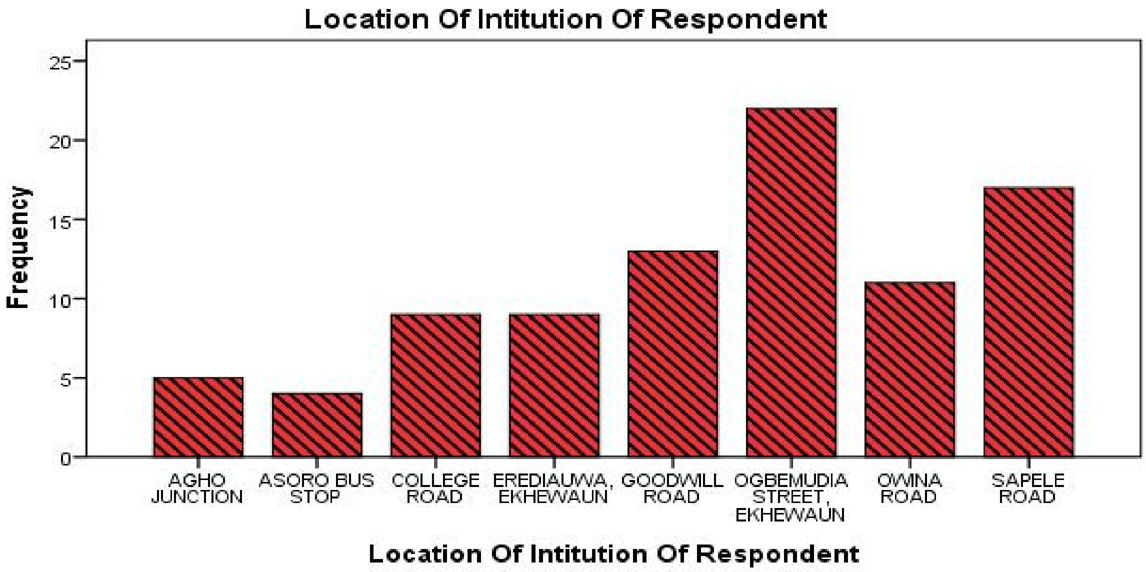
PRESENCE OF ROAD SIDE EMBARKMENT

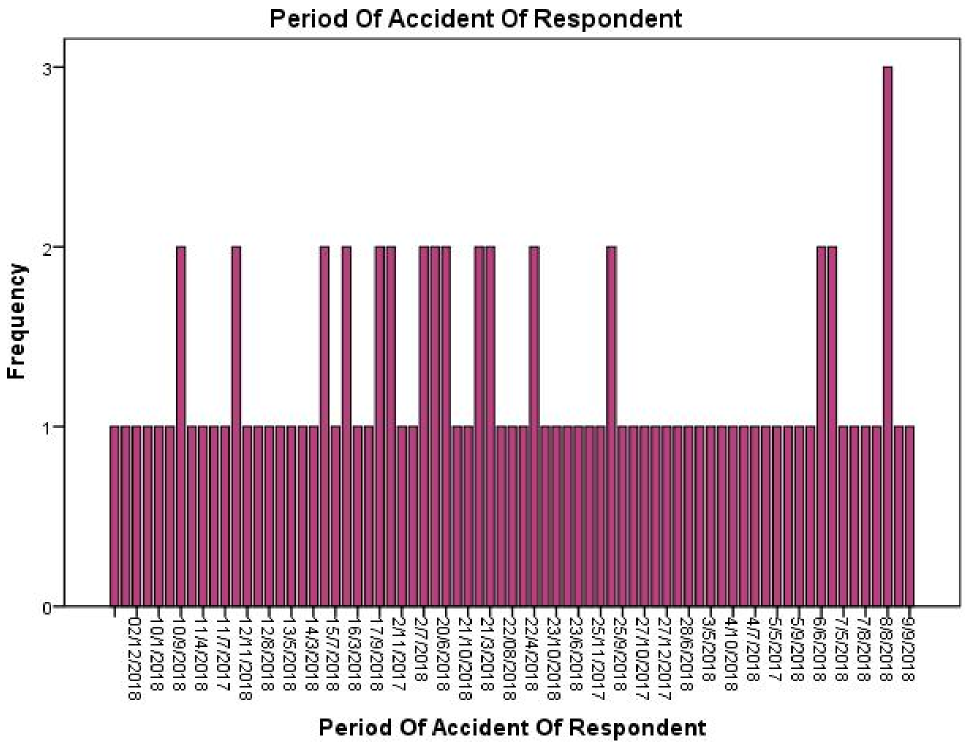
	FREQUENCY	PERCENT	VALID PERCENT
YES	17	18.9	19.3
NO	42	46.7	47.7

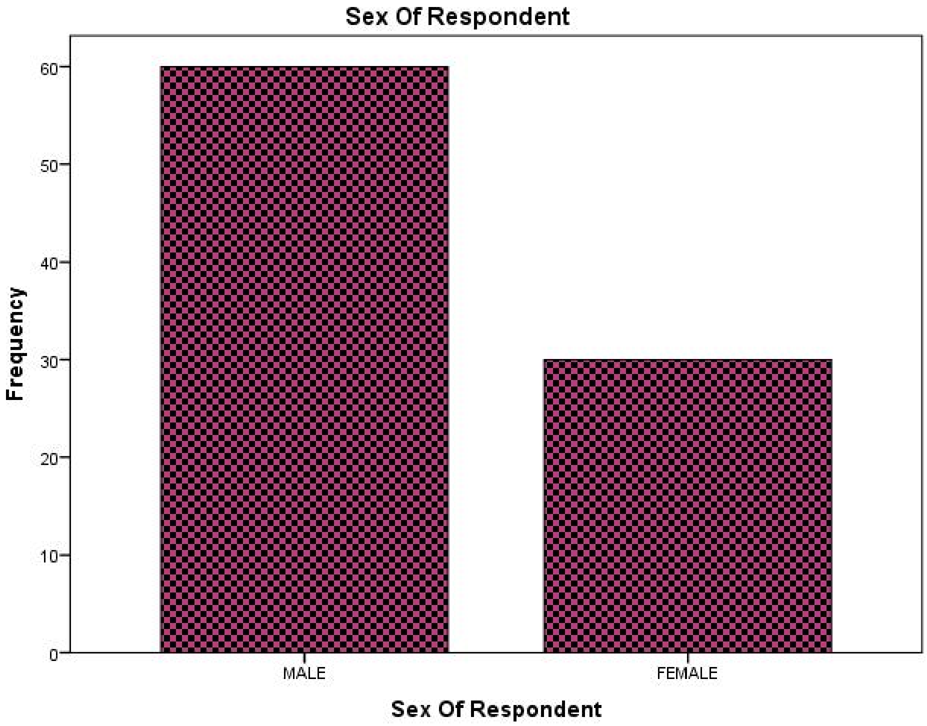
DON'T KNOW	29	32.2	33.0
TOTAL	88	97.8	100.0
SYSTEM	2	2.2	
TOTAL	90	100.0	

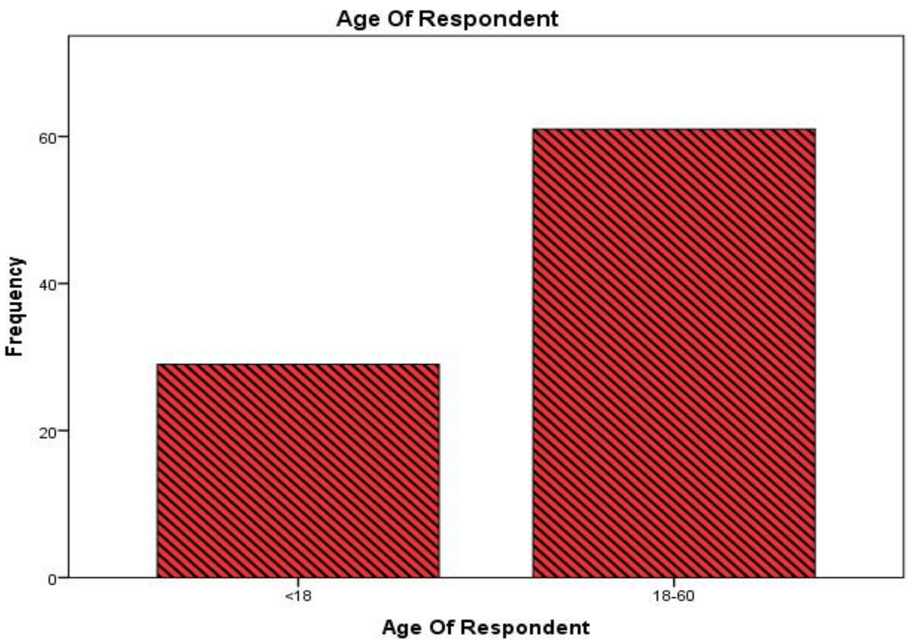
Bar Chart

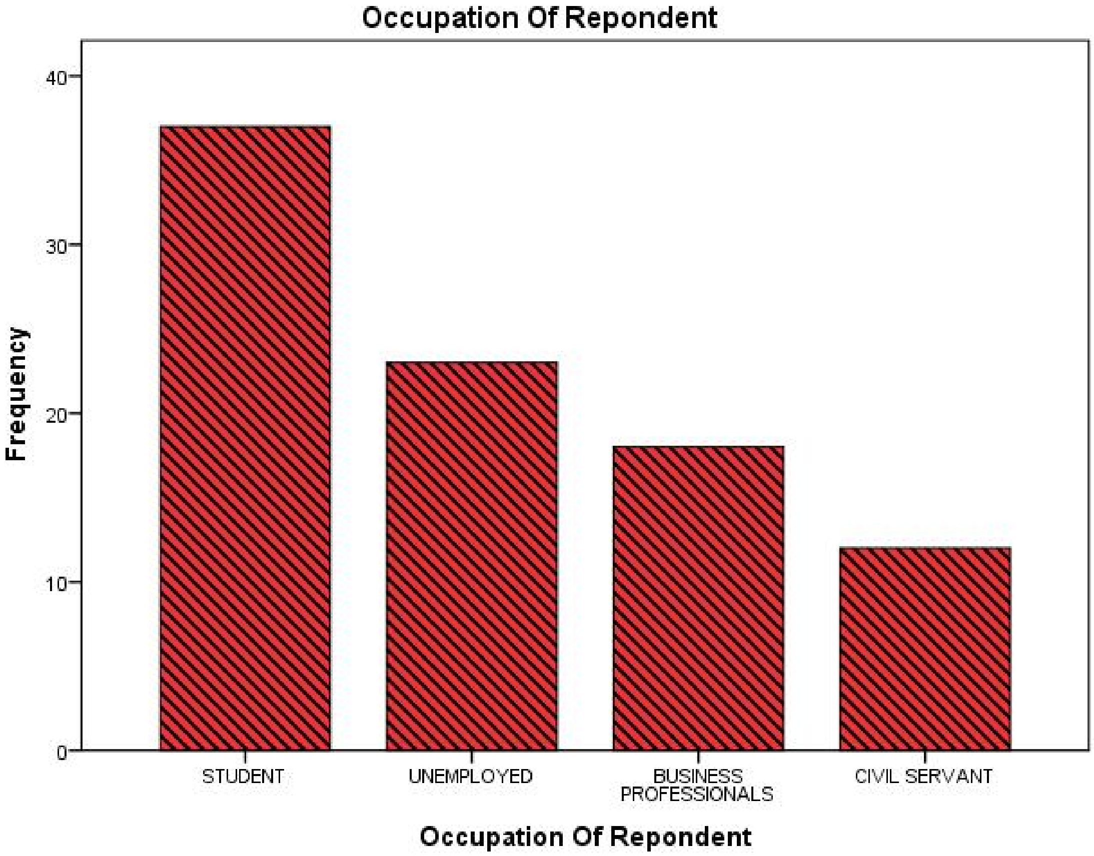


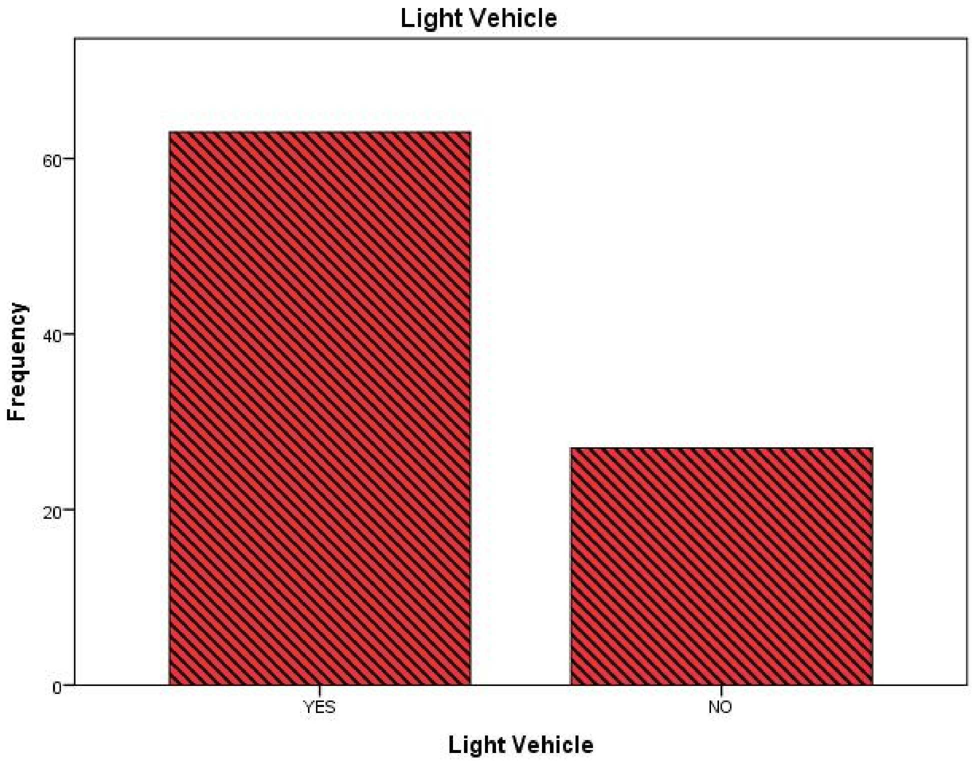

Location Of Intitution Of Respondent
Frequency
0
5
10
15
20
25
AGHO JUNCTION
ASORO BUS STOP
COLLEGE ROAD
EREDIAUWA, EKHEWAUN
GOODWILL ROAD
OGBEMUDIA STREET, EKHEWAUN
OWINA ROAD
SAPELE ROAD
Location Of Intitution Of Respondent

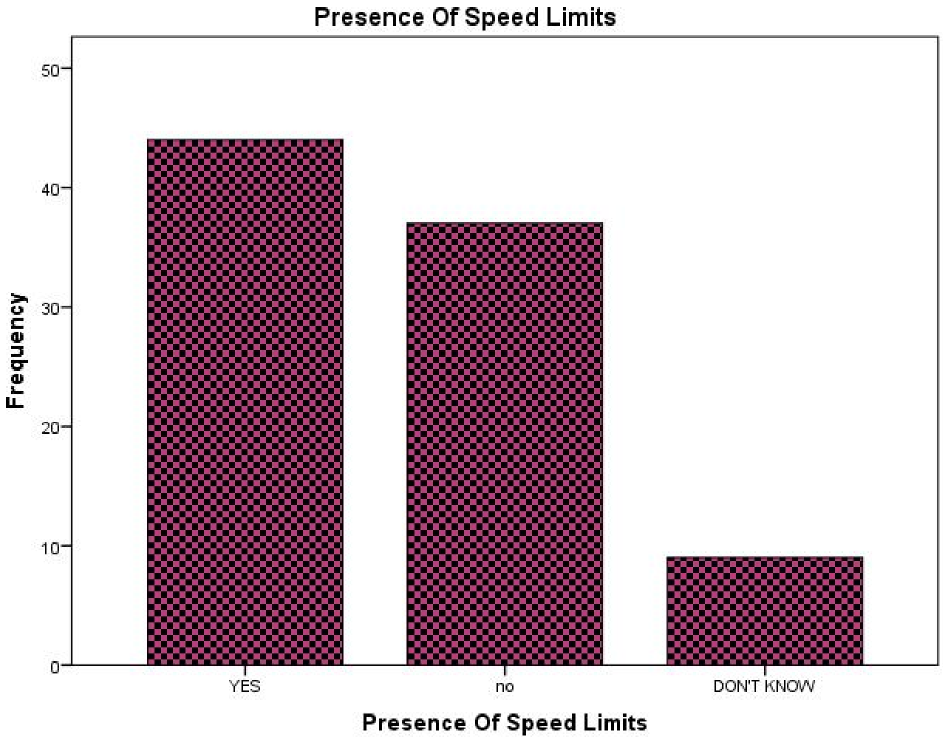

Period Of Accident Of Respondent
Frequency
0
1
2
3
02/12/2018
10/1/2018
10/9/2018
11/4/2018
11/7/2017
12/11/2018
12/8/2018
13/5/2018
14/3/2018
15/7/2018
16/3/2018
17/9/2018
2/11/2017
2/7/2018
20/6/2018
21/10/2018
21/3/2018
22/08/2018
22/4/2018
23/10/2018
23/6/2018
25/11/2017
25/9/2018
27/10/2017
27/12/2017
28/6/2018
3/5/2018
4/10/2018
4/7/2018
5/5/2017
5/9/2018
6/6/2018
7/5/2018
7/8/2018
8/8/2018
9/9/2018
Period Of Accident Of Respondent

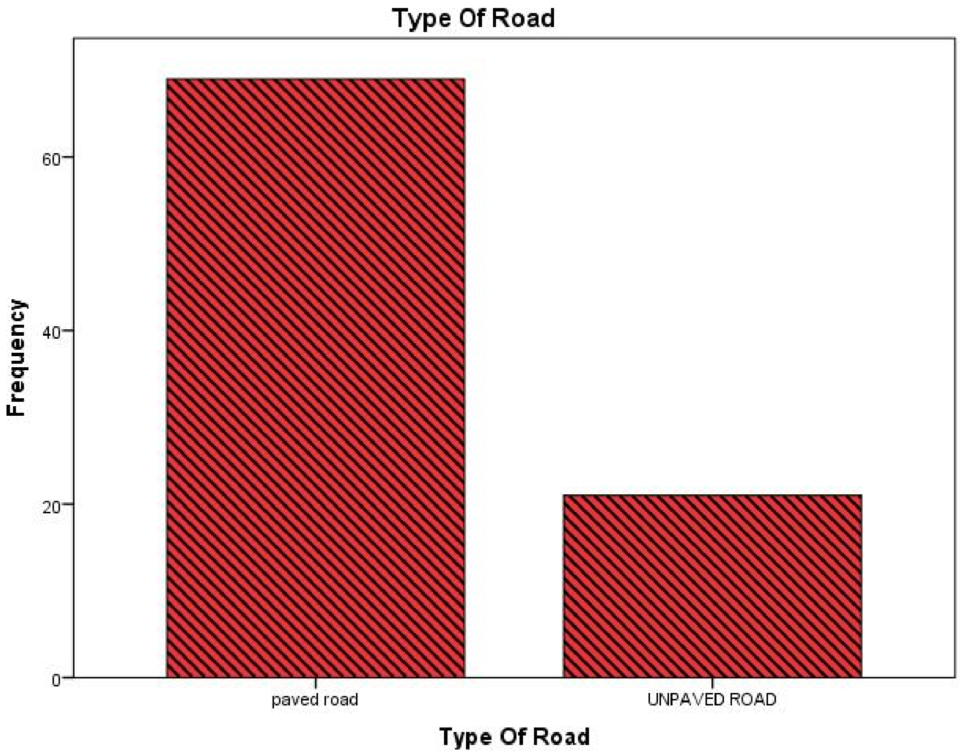

Sex Of Respondent
Frequency
60
50
40
30
20
10
0
MALE
FEMALE
Sex Of Respondent

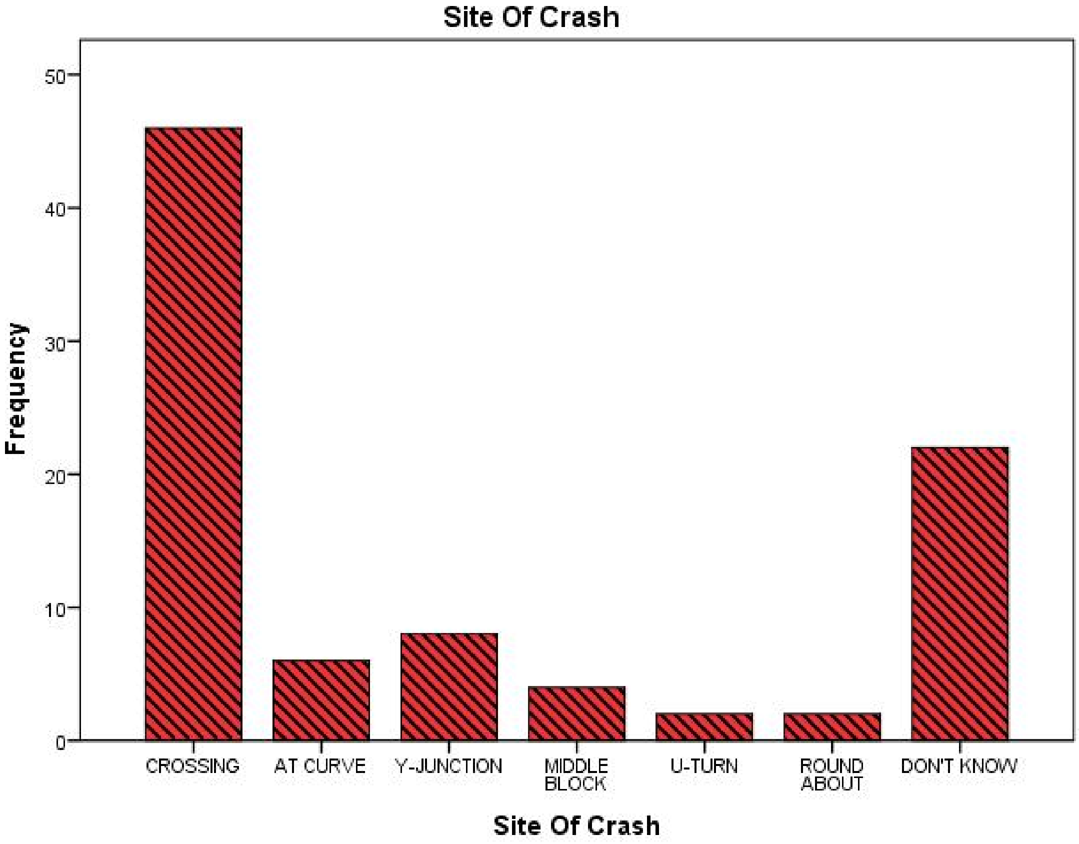

Age Of Respondent
Frequency
60
40
20
0
<18
18-60
Age Of Respondent

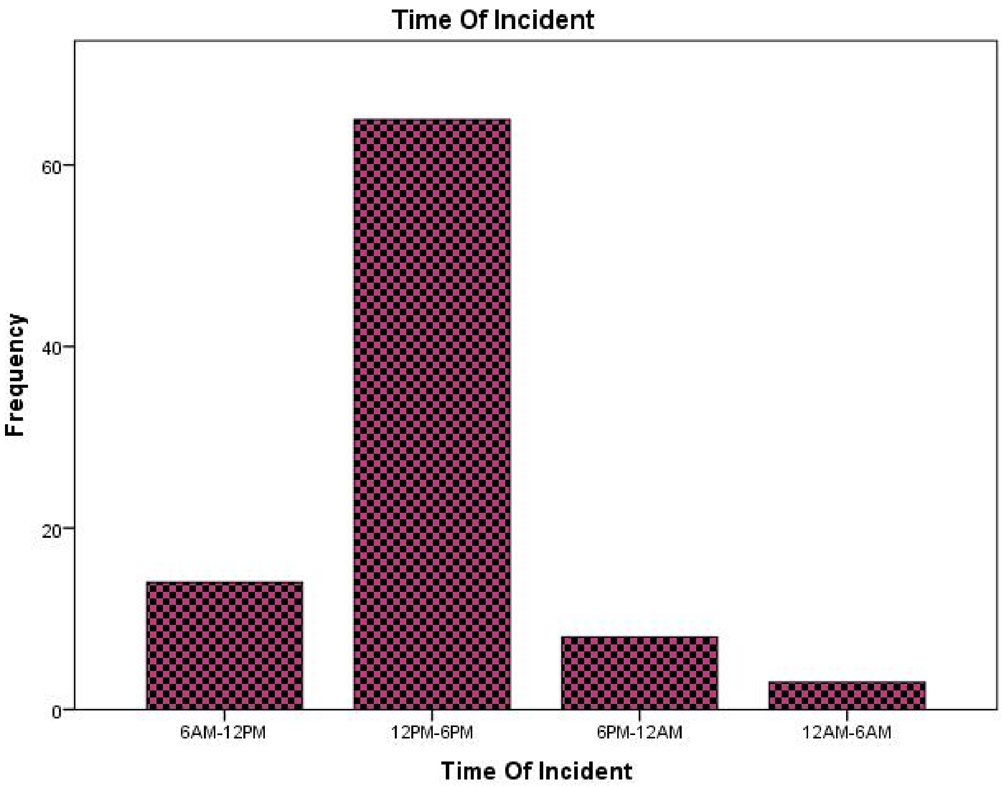

Occupation Of Repondent
Frequency
40
30
20
10
0
STUDENT
UNEMPLOYED
BUSINESS PROFESSIONALS
CIVIL SERVANT
Occupation Of Repondent


Light Vehicle
Frequency
60
40
20
0
YES
NO
Light Vehicle

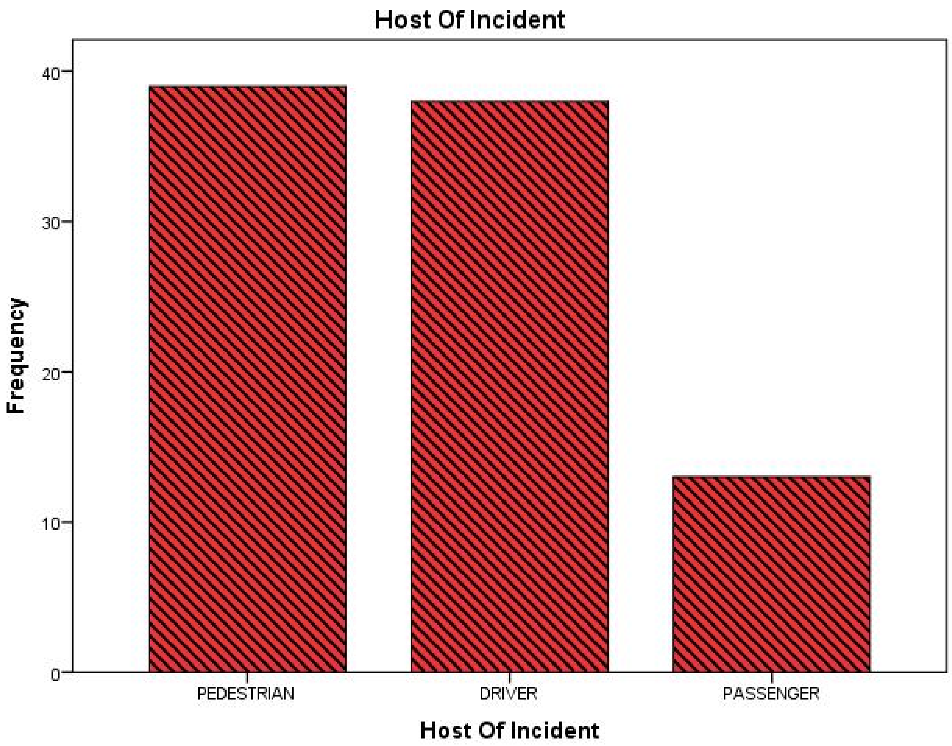

Presence Of Speed Limits
50
40
30
20
10
0
Frequency
YES
no
DON'T KNOW
Presence Of Speed Limits

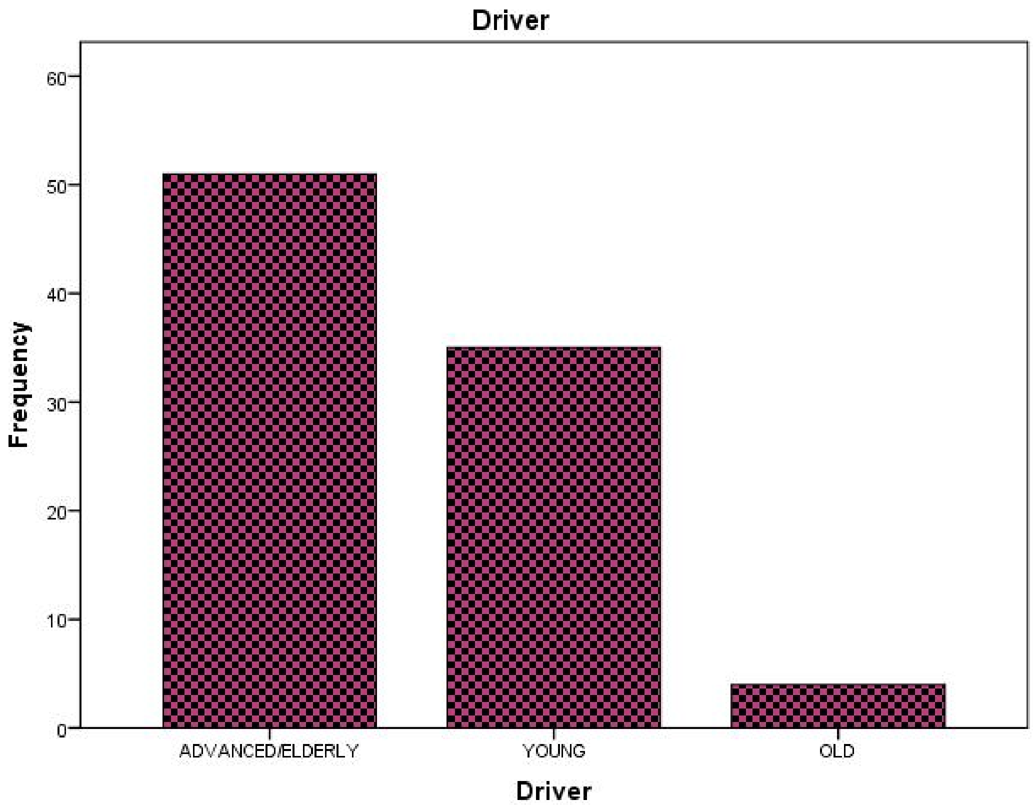

Type Of Road
60
40
20
0
Frequency
paved road
UNPAVED ROAD
Type Of Road

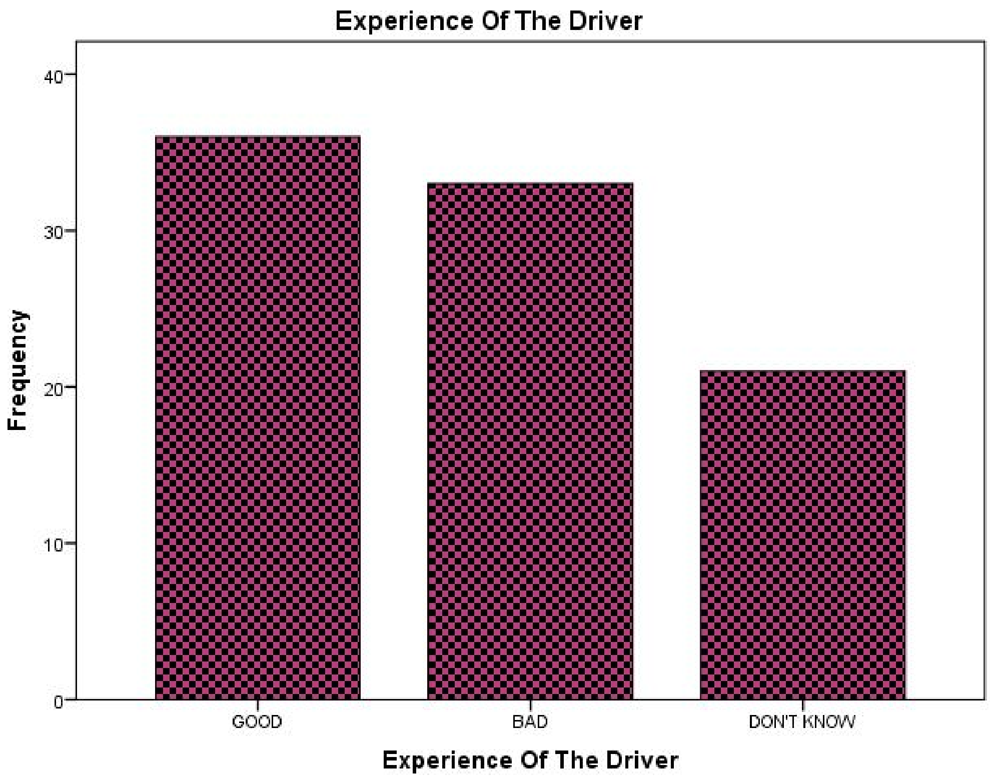

Site Of Crash
Frequency
50
40
30
20
10
0
CROSSING
AT CURVE
Y-JUNCTION
MIDDLE BLOCK
U-TURN
ROUND ABOUT
DON'T KNOW
Site Of Crash

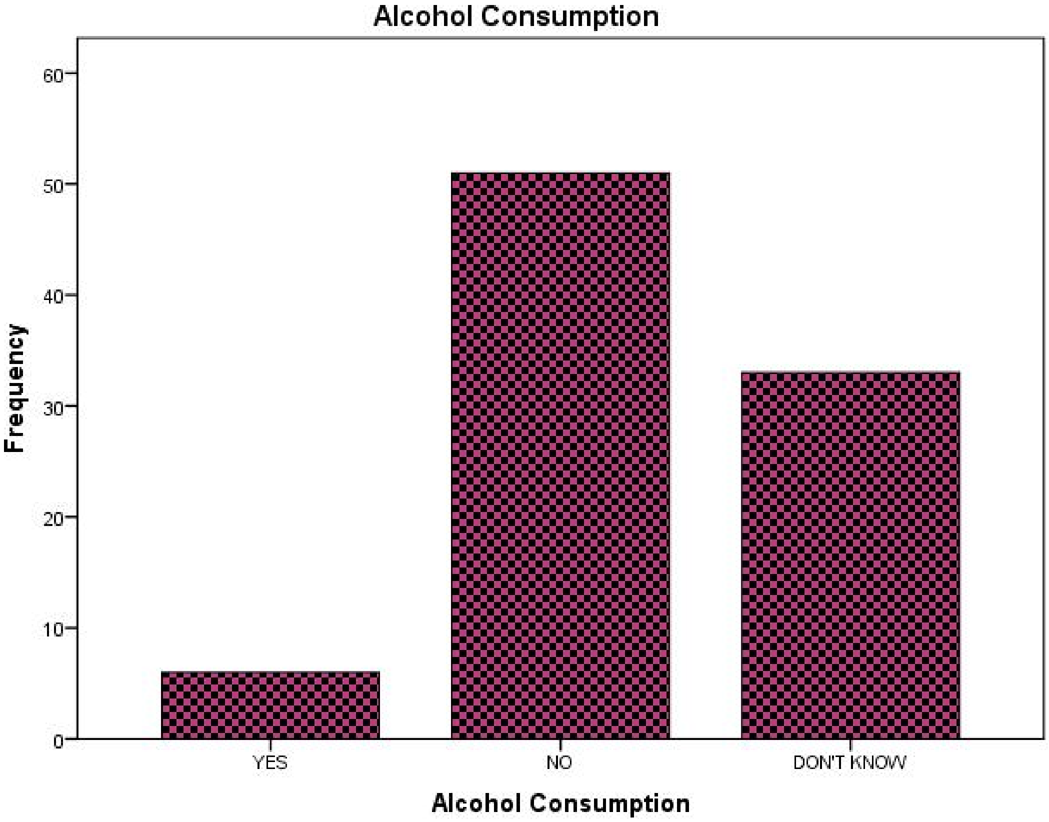

Time Of Incident
Frequency
60
40
20
0
6AM-12PM
12PM-6PM
6PM-12AM
12AM-6AM
Time Of Incident

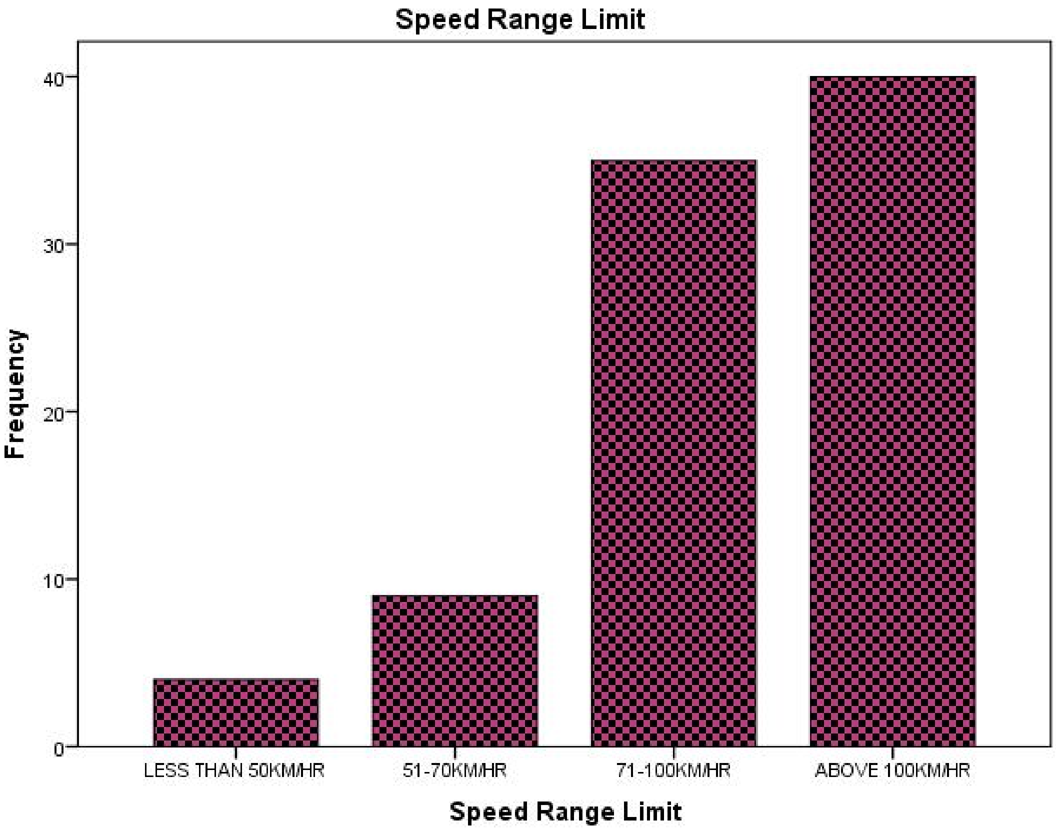

Day Of Incident
Frequency
50
40
30
20
10
0
MONDAY/TUESDAY
WEDNESDAY-FRIDAY
SATURDAY OR SUNDAY
Day Of Incident


Host Of Incident
Frequency
40
30
20
10
0
PEDESTRIAN
DRIVER
PASSENGER
Host Of Incident

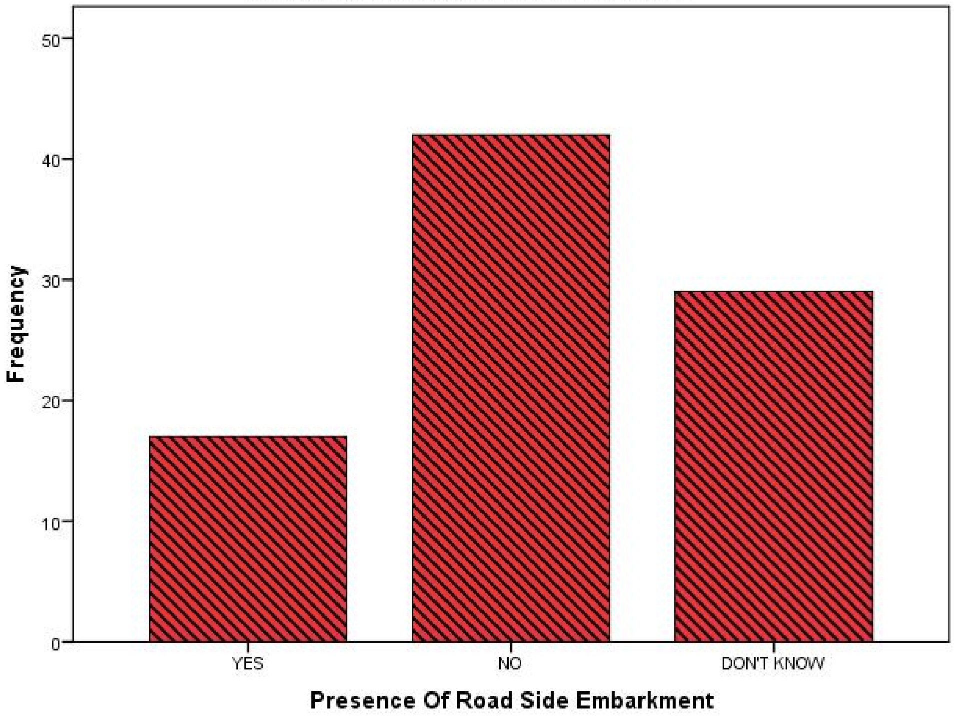

Driver
60
50
40
30
20
10
0
Frequency
ADVANCED/ELDERLY
YOUNG
OLD
Driver


Experience Of The Driver
40
30
20
10
0
Frequency
GOOD
BAD
DON'T KNOW
Experience Of The Driver

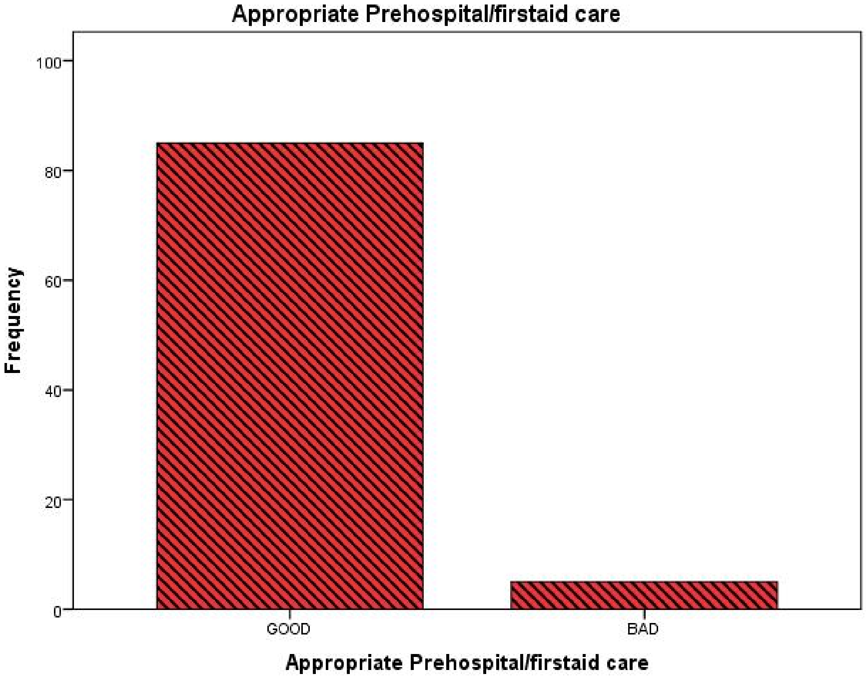

Alcohol Consumption
Frequency
60
50
40
30
20
10
0
YES
NO
DON'T KNOW
Alcohol Consumption

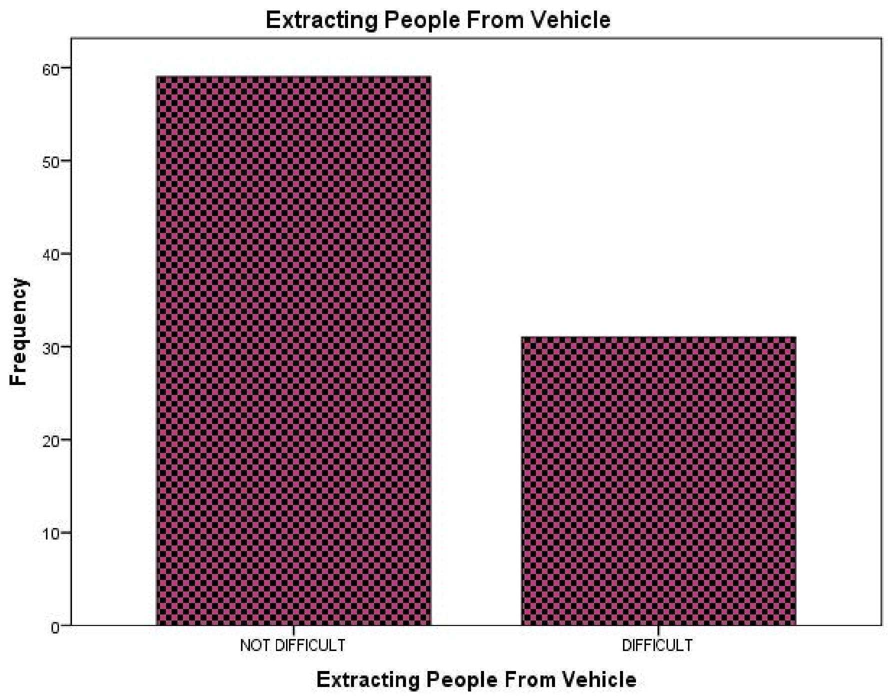

Speed Range Limit
Frequency
40
30
20
10
0
LESS THAN 50KM/HR
51-70KM/HR
71-100KM/HR
ABOVE 100KM/HR
Speed Range Limit

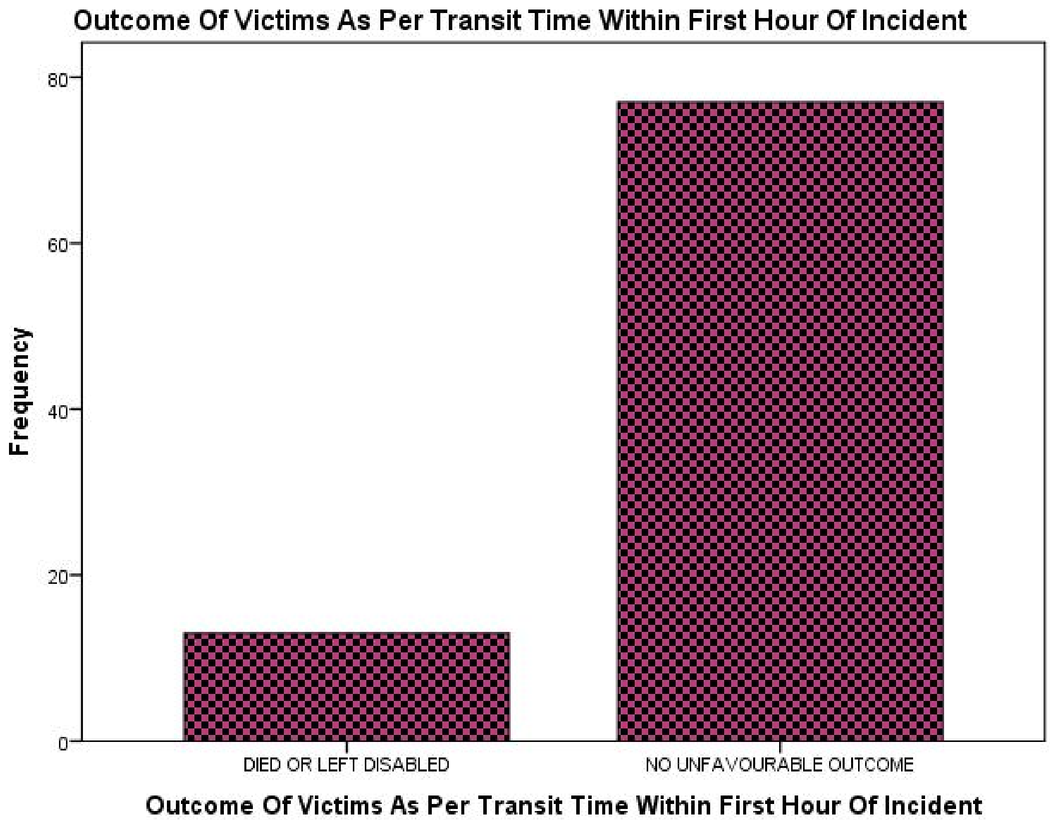
Presence Of Road Side Embarkment



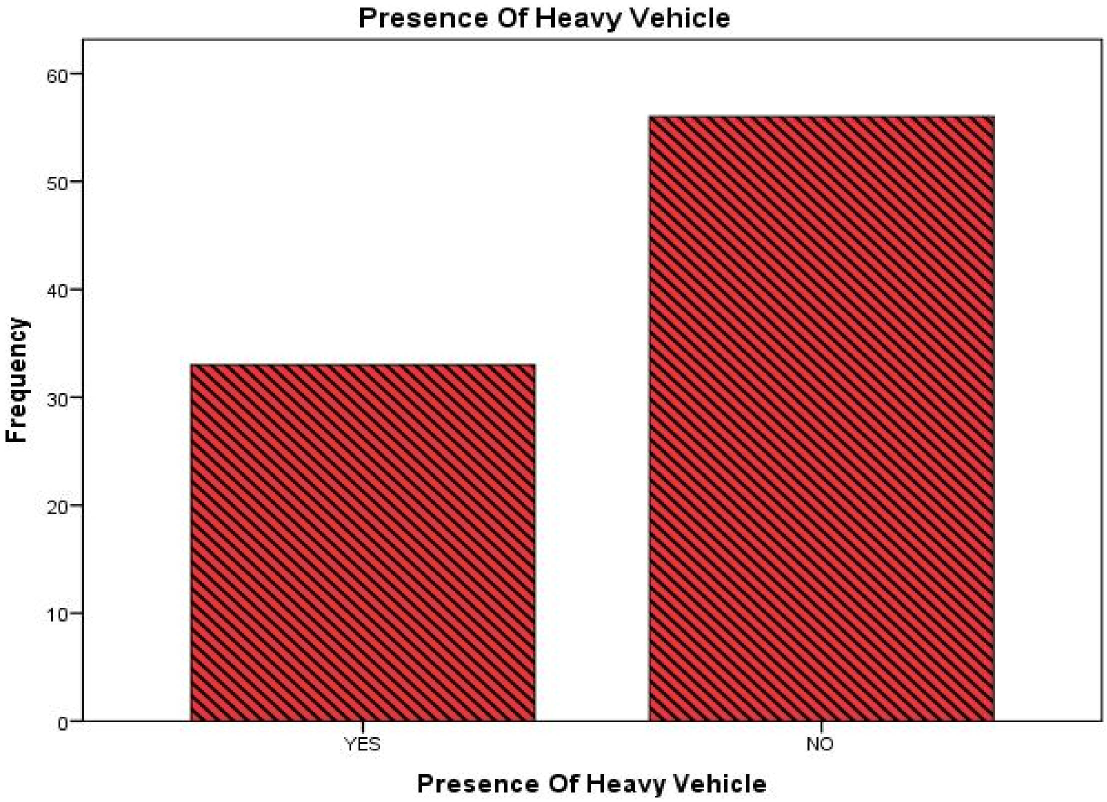
Appropriate Prehospital/firstaid care

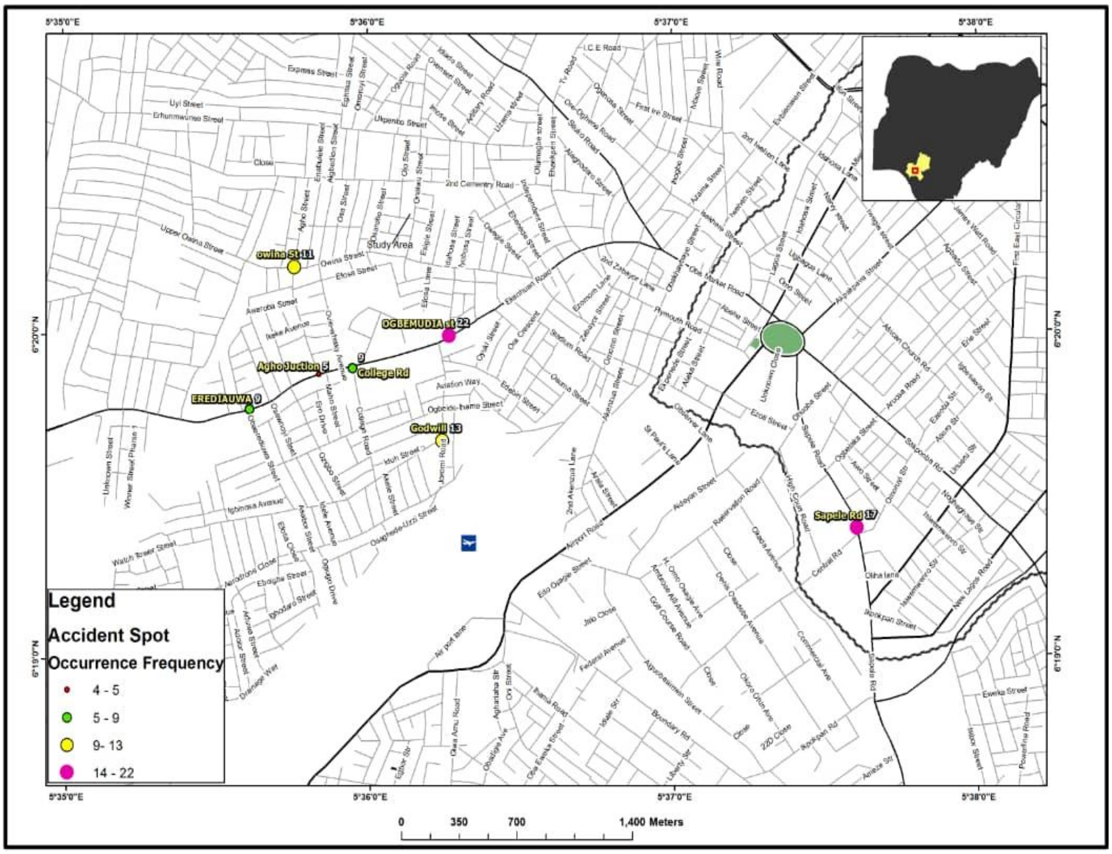



Extracting People From Vehicle
Frequency
0
10
20
30
40
50
60
NOT DIFFICULT
DIFFICULT
Extracting People From Vehicle


Outcome Of Victims As Per Transit Time Within First Hour Of Incident
Frequency
0
20
40
60
80
DIED OR LEFT DISABLED
NO UNFAVOURABLE OUTCOME
Outcome Of Victims As Per Transit Time Within First Hour Of Incident


Outcome Of Victims As Per Transit Time After First Hour Of Incident
Frequency
60
40
20
0
DIED OR LEFT DISABLED
NO UNFAVOURABLE OUTCOME
Outcome Of Victims As Per Transit Time After First Hour Of Incident


Presence Of Heavy Vehicle
Frequency
60
50
40
30
20
10
0
YES
NO
Presence Of Heavy Vehicle



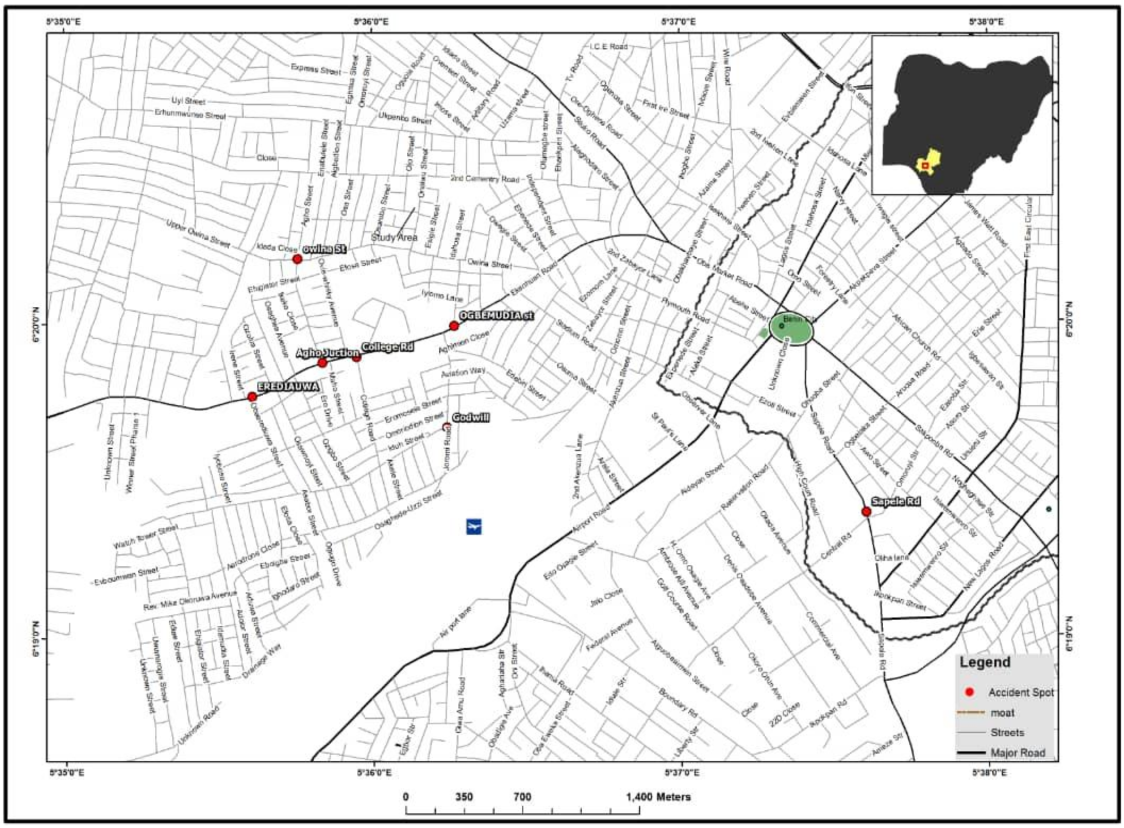


Fig4.2 Maps showing the accident locations and their frequencies in Oredo LGA.

4.3 Model Relating Vehicle Stability to Safety

Accident occurrence per two (2) year period (Acc/2yrs) was selected as the dependent variable while the time of the day (T), host (H) and speed (Sp) of the accidents were selected as the independent variables. Table (4.2) shows the summary statistics of data used for model development.

Summary Statistics of Data Used For Model Development

Continuous Variable Information						
		N	Minimum	Maximum	Mean	Std. Deviation
Dependent Variable	Accident per 2 years period	84	0	4	0.81	1.21
Covariate	Time of the Day (T)	84	0	2.1	0.93	0.60
	Host (H)	84	0	25	6.95	8.35
	Speed (S)	84	-0.45	0.05	-0.02	0.10

A model which relates Road Accident to Locations is presented in Table 4.3.

Table 4.3 Results from model showing the Relationship between Road Accident to Locations (L)

Parameter Estimates										
			90% Wald Confidence Interval		Hypothesis Test				90% Wald Confidence Interval for Exp(B)	
Parameter	B	Std. Error	Lower	Upper	Wald Chi-	Df	Sig.	Exp(B)	Lower	Upper

					Square					
(Intercept) T	-2.95 1.96	1.107 0.653	-4.771 0.889	-1.13 3.036	7.092 9.048	1 1	0.01 0.00	0.052 7.119	0.008 2.434	0.324 20.83
H S (Scale) (Negative binomial)	-0.01 -5.05 .484 1	0.071 3.827	-0.126 -11.35	0.107 1.242	0.018 1.743	1 1	0.89 0.19	0.99 0.006	0.881 1E-05	1.113 3.464

Dependent Variable: Accident per 2years period (Acc/2yrs)

Model: (Intercept), Time of Day (T), Host (H) and Speed (S)

$$Acc/2yrs = e^{(-2.95)} x\ e^{(1.96T)} x\ e^{(-0.01H)} x\ e^{(-5.05S)}$$

Goodness of Fit

	Value	df	Value/df
Deviance	6.924	17	0.407
Scaled Deviance	14.299	17	
Pearson Chi-Square	8.231	17	0.484
Scaled Pearson Chi-Square	17	17	
Log Likelihooda	-19.303		
Adjusted Log Likelihoodc	-39.868		
Akaike's Information Criterion (AIC)	46.607		
Finite Sample Corrected AIC (AICC)	49.107		
Bayesian Information Criterion (BIC)	50.785		
Consistent AIC (CAIC)	54.785		

It can be seen from Table (4.3) that only the time of the day (T) is statistically significant at 90% confidence interval, but as expected, Host (H) is negatively correlated to accident occurrence per five (2) year period as indicated by the negative parameter estimate.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The Haddon matrix is a well-known evaluation tool, which has been rarely utilized especially in low- and middle income countries as crash data is underreported and the multiple authorities involved (hospital, police, etc.) each have their own specifications on the parameters to be reported and nature of reporting. The current study applies this matrix to highlight the risk factors and counterstrategies needed to be implemented on priority basis.

ii. Pre-crash Factors

None of the victims reported negligence related to speed limit or seat belt use; however, this might be falsely reported in view of legal implications. The speed at which the drivers drove and the associated crash are influenced by multiple factors such as age, sex, alcohol intoxication, number of people in vehicle, road conditions, traffic and other environment related factors. The higher odds of experiencing crashes in heavy traffic conditions may be explained by instigating factors for speeding and risky driving on wide urban roads, specifically on young/elderly males in poor weather or roads conditions.

Unfortunately, in spite of the widespread advocacy efforts and legislative measures looking to create safer road environments, there is a social and political apathetic attitude towards adopting crash preventive behaviours and demonstrating safety compliance. The overall improvement in all-cause mortality of both genders over the last few decades is reported to be poorly reflected among 18–60 years as they are worst affected in road traffic injuries. In current study, males who were 20–49 years of age were most severely affected, conforming to a global scenario where males of 15–44 years contributed to maximum burden of road traffic. Children are also subjected to high risk in RTAs as they often remain unattended or unsupervised by the road side and given the absence of designated pedestrian passages. This necessitates action while planning road infrastructure to take into consideration the inherent vulnerability of such road users.

Reported alcohol consumption by victims or their near ones in current study may be lower because of lack of any objective test as compared to global statistics (8 to 29% in non-fatally injured drivers in low- and middle-income countries).

Mobile phone use among drivers, which increases the probability of a crash by almost four times due to the cognitive distraction, is reportedly similar to the statistics of other countries.

iii. Crash

As seen in this study, pedestrians and drivers are the most common crash victims. Infact, collision with motorized vehicles is one of the predominant modes of pedestrian injury. This is an illustration of the unsafe scenario on the streets in Benin city where pedestrians, bicyclers, drivers and two-wheeler riders share and compete for space. The presence of parked vehicles near the edges of narrow roads, the absence of side lanes and the lack of barriers to residential areas all pose serious environmental hazards as observed through geospatial analysis where aggregation of crashes was observed near construction sites, temples and market areas and on stretches of roads near schools.

Head and limb injuries are the most frequently reported injuries in road traffic crashes, and students are one of the predominant groups of victims. The increased frequency of crashes noted near crossing and Y-junctions should be investigated further. Confusion or delayed reactions at these locations may lead to inappropriate driver responses, particularly, in light of additional factors such as inadequate visibility due to unclear weather, dim illumination and no or inappropriate use of lights or reflectors.

iv. Post-crash Factors

Pre-hospital care to stabilize and transport victims to definitive care facilities is integral. Less than a fifth of victims were transported in centralized ambulance transport (CAT) vans. The majority of victims were transported by other means, such as motorized three-wheelers and police control room vans.

Further, the use of the Haddon injury analysis framework in the current study establishes the paucity of existing policy measures and their strict implementation to ensure safer roads in era of rapid urbanization in developing countries like Nigeria. Although the studied population underrepresents the most severe of cases, such as those who died at incident site or who were brought dead, it still identifies vulnerable road users, such as pedestrians, drivers, students and labourers.

This study has examined the spatial distribution of road traffic accident casualties in Benin City (Oredo local government area). The study shows that regional variations exist in the incidence of road traffic accident casualties in the state within the study period of Nov 2017– Oct 2018.The study has tried to model motor vehicle deaths and motor vehicle injuries on Nigerian roads. The results show that total road traffic accidents, population estimate, road lengths and number of registered vehicles are important variables to take into consideration in examining road traffic accident casualties in the country.

5.2 Recommendation

In order to curtail road traffic accidents on Nigerian roads, the following recommendations are pertinent:

1. Drivers should be trained and retrained as a means of effectively dealing with road traffic accident reduction.
2. Motorists should drive within speed limits and with a speed consistent with road conditions.
3. Motorists should not drink and drive and should comply with the legislation on speed limits.
4. New gadgets are to be developed for collision prevention and should befitted on all vehicles. Research organizations should be asked to develop such gadgets on a war footing. For example, gadgets can be developed to automatically slow down the vehicle, if safe distance commensurate with the speed of the vehicle in front is not maintained.
5. Road Accidents Safety awareness should begin from childhood, as it is difficult to impart awareness to a grown up a human. If safety awareness is imparted at childhood, safety will be a habit.
6. Tamper proof speed controllers should be made mandatory for all heavy vehicles. New heavy vehicles should have built in tamper proof speed controllers. Roads should be properly maintained. Permanent contracts / arrangements should be in place for maintaining all roads in good condition 24 hours a day,365 days a year. If a gutter is repaired in time it can save a life!!!
7. Visibility should be increased near curvatures. Sometimes, even cutting of grass to increase visibility can help save many lives.
8. Seat belts should be worn by motorists for both short and long trips.
9. First aid kit should be provided in every vehicle and emergency first aid facilities should be made available for accident casualties.
10. Road safety education should be part of the curriculum in our educational institutions.
11. Traffic laws must be judiciously enforced by the various law enforcement agencies in the country.
12. New gadgets are to be developed for collision prevention and should be fitted on all vehicles. Research organizations should be asked to develop such gadgets on a war footing. For

example, gadgets can be developed to automatically slow down the vehicle, if safe distance commensurate with the speed of the vehicle in front is not maintained.

13. Road Accidents Safety awareness should begin from childhood, as it is difficult to impart awareness to a grown up a human. If safety awareness is imparted at childhood, safety will be a habit.
14. Tamper proof speed controllers should be made mandatory for all heavy vehicles. New heavy vehicles should have built in tamper proof speed controllers. Roads should be properly maintained. Permanent contracts / arrangements should be in place for maintaining all roads in good condition 24 hours a day,365 days a year. If a gutter is repaired in time it can save a life!!!

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