

**KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,
KUMASI, GHANA**

**FACTORS CAUSING THE HIGH RATE OF MOTORCYCLE CRASHES IN
THE BOLGATANGA MUNICIPALITY**

BY

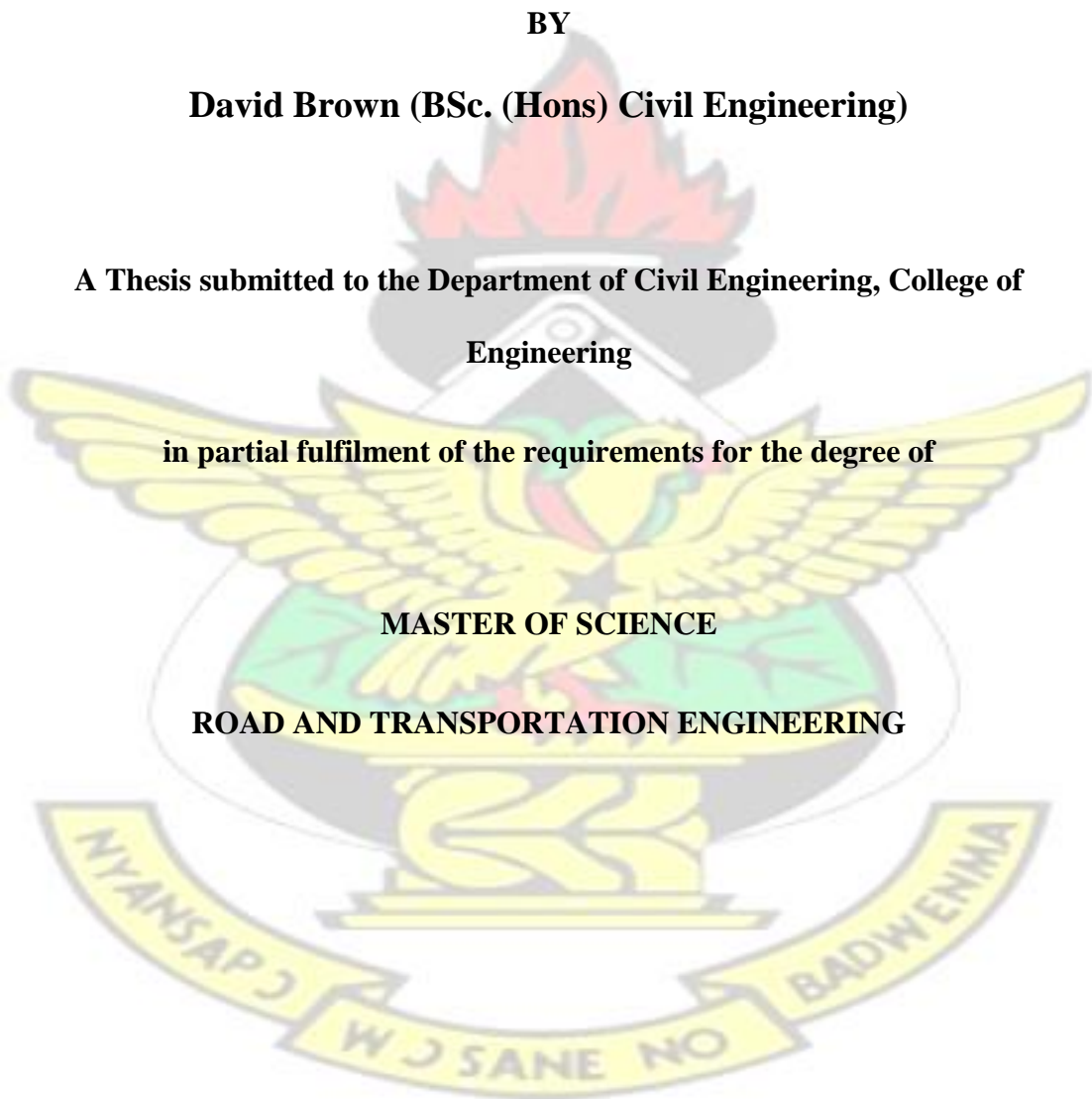
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**A Thesis submitted to the Department of Civil Engineering, College of
Engineering**

in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE

ROAD AND TRANSPORTATION ENGINEERING



October, 2015.

DECLARATION

I hereby declare that this submission is my own work towards the MSc and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University except where due acknowledgement has been made in the text.

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DEDICATION

This dissertation is dedicated to my family.

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ABSTRACT

Motorcycles are considered very important and are the most patronised motorized transport modes in the Bolgatanga Municipality. Motorcycles are seen to contribute to the economic livelihoods of the people in the municipality. However, the most worrying situation is the high spate of motorcycle crashes in the municipality. This study sought to examine the factors causing motorcycle crashes in the Bolgatanga Municipality. Data were obtained through questionnaires administered to motorcyclists and officials of stakeholder organisations such as the National Road Safety Commission, Motor Traffic and Transport Unit of the Ghana Police Service and Motorcycle crash data obtained from Building and Road Research Institute. The study found that the use of motorcycles in the Municipality play very significant role in providing a cost-efficient means of transport, easy accessibility, increased productivity, source of employment and revenues. Generally, the factors causing high rate of motorcycle crashes in the Bolgatanga Municipality are over speeding, the use of alcohol and drugs whiles driving, malfunctioning of traffic signals, weak law enforcement, lack of formal motorcycle riding training, rampant violation of road traffic regulations, ignorance of road signs by road users and inexperience on the part of motorcyclists. Due to the adverse effects of motorcycle crashes which include loss of lives, serious injuries, disability, huge hospital bills, emotional trauma, loss of investment and revenue, the development of the Bolgatanga Municipality has been impeded. The recommendation is that the municipal authorities need to erect and maintain more road signs, road markings, crosswalk, speed humps and adequate and functioning traffic signals in regulating the speed of motorists. They also need to provide formal training skills on motorcycle riding for the motorcyclists and ensure that this is mandatory for all motorcyclists so as to improve on their riding experience and skills. The motorcyclists should be educated to avoid over-speeding, overloading, alcohol use during riding, crossing and parking at unapproved locations.

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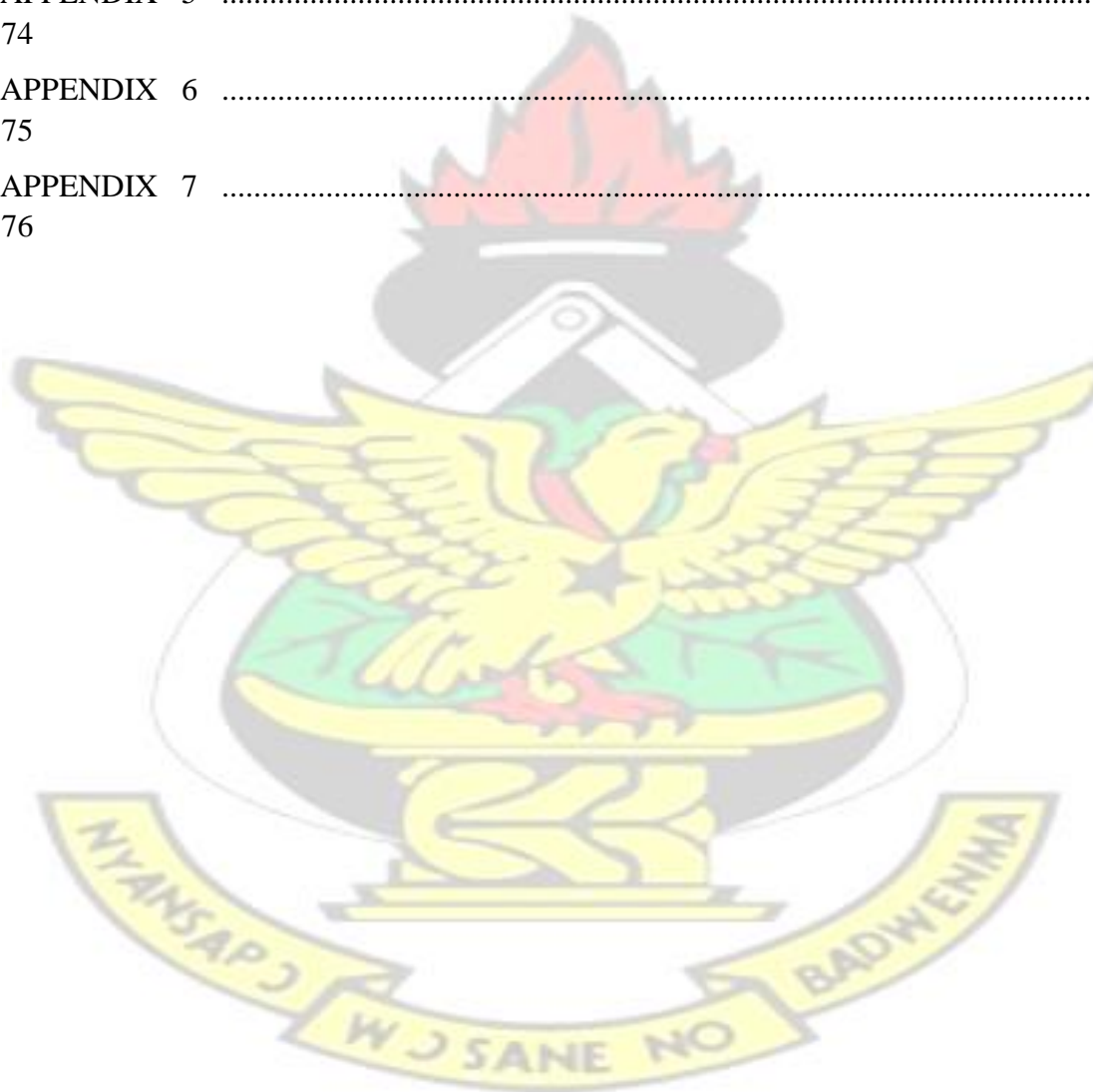
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LIST OF ABBREVIATIONS



BRRI	Building and Road Research Institute
CO ₂	Carbon Dioxide
CO ₂	Carbon Dioxide
DVLA	Driver Vehicle and Licensing Authority
GDP	Gross Domestic Product
GNA	Ghana News Agency
GNP	Gross National Product
GRSP	Global Road Safety Partnership
GRSP	Global Road Safety Partnership
HC	Hydrocarbons
MDGs	Millennium Development Goals
MTTU	Motor Traffic and Transport Unit
NO _x	Nitrogen Oxides
Pb	Lead
PM	Particulate Matter
RRSC	Regional Road Safety Commission
SPSS	Statistical Package for Social Sciences
VOCs	Volatile Organic Compounds
WHO	World Health Organisation

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CHAPTER 1: INTRODUCTION

1.1 Background to the Study

Transportation is an important factor in every human endeavour, and it enhances economic, social and political interactions (Button and Hensher, 2001). The transportation infrastructure provision has developed over the last few decades. This increase in infrastructure has been made possible through the evolution of various transportation networks and modes using improved and enhanced technology for the movement of passengers and goods (Gbadamosi, 2006). In this regard, human mobility has always been inevitable and in effect people would always need means of transportation.

In developing countries, vehicle ownership is very low and majority of the people are dependent on public transport in order to commute from one place to the other for their daily activities. However, in Ghana, due to financial constraints, government of Ghana interventions in providing public transport for the people have been ineffective and unsuccessful. One of such interventions is the introduction of City Express transport services. Other interventions by the government like the Intercity State Transport Services and Metro Mass Transport Services have also not been able to address the transportation needs of the Ghanaian masses. This leaves the private sector to step in to augment government's efforts in the provision of means of transportation but many are those who find such means of transportation expensive and unaffordable (Kumar, 2011). The commuting population have resorted to motorcycle for personal mobility and public transportation as a result of the transportation problem created. This has also forced the market to create solutions to address travel needs of the populace in Ghana. The transportation problem in Ghana has worsened as results of enormous ownership of personal transportation means, the use of the carriageways by both vehicles and

pedestrians, insufficient high capacity buses for mass transportation coupled with inefficient traffic management and operations (Tamakloe, 1993; Addo, 2005; Agyemang, 2009). The cost of crashes and its associated consequences is estimated at 1.6% of Gross Domestic Product (GDP) which translates to US\$ 165million in Ghana (NRSC, 2010; Oduro, 2012). These unresolved deficiencies in the system coupled with urban youth unemployment has paved the way for the use motorcycles to provide commercial services popularly known as „Okada“ (Oteng - Ababio, 2011; Grant and Oteng - Ababio, 2012).

The use of motorcycle as an alternative means of transport in rescuing the mobility problems in Northern Ghana has brought along with it issues concerning road safety, registration issues, employment and the repair and maintenance activities associated with these motorcycles (Dinye et al, 2013). Motorcycles are a convenient way of travelling in the Bolgatanga Municipality, the Upper East Regional capital. This means of transport is associated with high accident rates (Kumar, 2011). These crashes often result in injury, incapacitation and sometimes death. All these end up adding economic burden on individuals, families and the Bolgatanga Municipality as a whole. It is, therefore, against this background that this study sought to examine the factors causing motorcycle crashes in the Bolgatanga Municipality.

1.2 Problem Statement

Motorcycles are considered a very important mode of transportation and one of the most patronised motorized means of transportation especially in urban areas such as the Bolgatanga Municipality. Motorcycles are seen to contribute to the economic livelihoods of the people in the municipality. However, the high spates of motorcycle crashes in the Municipality over the years have been of concern.

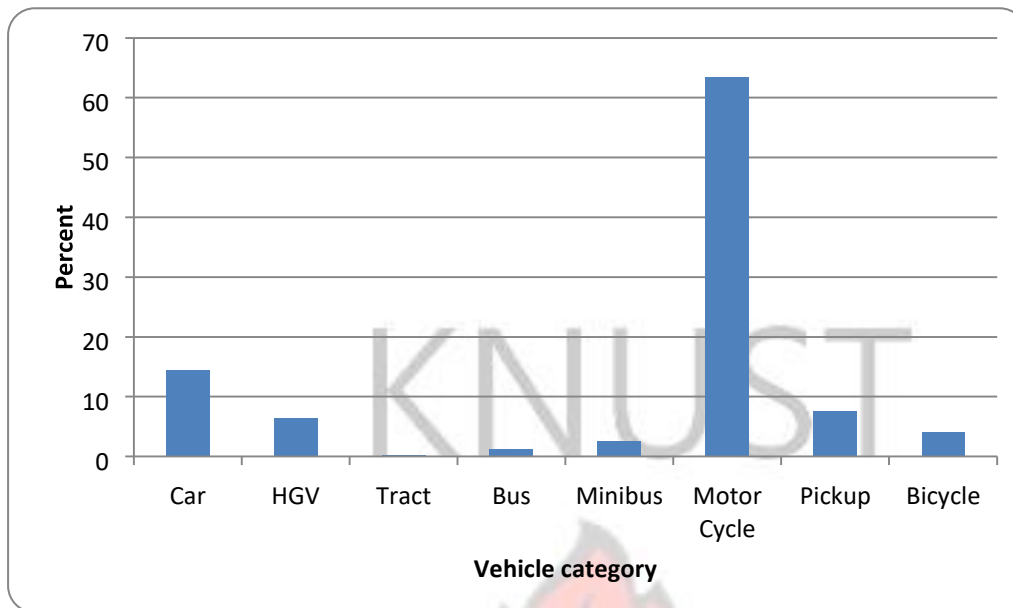


Figure 1.1: Number of Crashes by Vehicle Category (2005-2013) Source: BRRI data, 2015.

From Figure 1.1, motorcycle crashes constitute about 63% of the total number of crashes in the Bolgatanga Municipality from 2005 to 2013. This brings to light the need to evaluate motorcycle crashes. Motorcycle crashes and the associated costs of personal injuries, loss of lives, and economic burden among others are a major concern in the Bolgatanga Municipality and Ghana at large. In effect, personal injuries and mortalities in motorcycle crashes are a public problem. Motorcycle crashes are threats to human lives and socio-economic development in the Bolgatanga Municipality. For instance, according to statistics, the Municipality loses about \$1.2 million annually as a result of motorcycle crashes. Out of this figure, 52% are accidents-related costs of property damage and 48% are casualty-related costs such as medical expenses (GNA, 2015). Furthermore, report by the Ghana News Agency (GNA) indicates that motorcycle crashes is one of the main causes of mortality in the municipality accounting for a daily average admission of six victims to the

Bolgatanga Municipal Hospital. With fatalities, the statistics show that 54 people died in 2009, 45 died in 2010, 54 died in 2011 and this trend continues to rise year-by-year (GNA, 2015).

The rampant increase in motorcycle crashes in the Bolgatanga Municipality which results in loss of lives and economic wealth seem to suggest that there is something seriously wrong somewhere. The questions that provoke academic interrogation are: what really are the causes of the rapid increase in motorcycle crashes in the Bolgatanga Municipality and why is the Municipality not able to curtail the high incidence of motorcycle crashes? Better still, what are the effective interventions that can be implemented in addressing the problem of motorcycle crashes in the Bolgatanga Municipality?

Another problem for this study is the gap in existing literature on causes of motorcycle crashes. It is intriguing to note that so far, investigations have it that few studies have focused on economic burden of motorcycle accidents (Kudebong et al., 2011), social cost of motorcycle accidents (Kudebong, 2009) and prevalence of helmet use among motorcycle users (Ackaah and Afukaar, 2010). Therefore, this study is considered worthwhile as it seeks to add to the scanty existing literature on the subject in Ghana.

1.3 Research Objectives

The main objective of this study was to examine the factors causing the high rate of motorcycle crashes in the Bolgatanga Municipality. The specific objectives of the study were:

- i. To assess the level of road safety awareness among motorcyclists.

ii. To identify the main causes of motorcycle crashes. iii.

To examine the economic benefits of motorcycle uses. iv.

To analyse the effects of motorcycle crashes.

1.4 Significance of the Study

The result of this study will be of significant benefit to the key stakeholders such as the Bolgatanga Municipal Assembly, Driver Vehicle and Licensing Authority (DVLA), the Motor Traffic and Transport Unit of the Police Service (MTTU) and motorcyclists in the Bolgatanga Municipality. The study will provide relevant information on the main factors causing the high rate of motorcycle crashes and recommend effective interventions in addressing the problem. These insights will be useful to the Bolgatanga Municipal Assembly in the larger context. By so doing, the outcome of the study will inform decision makers on solutions options to the problems of motorcycle crashes. To motorcyclists and other road users, the study will help create awareness on road safety.

Even though there are many studies on road crashes, not much has been reported on motorcycle crashes in Ghana. Therefore, the research will contribute modestly in providing the required knowledge to fill any gaps which exist in the literature about motorcycle crashes in Ghana especially as it relates to the Bolgatanga Municipality.

1.5 Limitation of the Study

The main scope of this study was on the Bolgatanga Municipal Assembly and in effect the study involved the key stakeholders in roads safety, namely, the Bolgatanga Municipal Development Planning Unit, Driver Vehicle and Licensing Authority (DVLA), the Motor Traffic and Transport Unit (MTTU) of the Ghana Police Service and motorcyclists in the Municipality.

This study has certain limitations that point to its potential weaknesses. The potential weaknesses stemmed from lack of up-to-date and adequate data on motorcycle crashes

and fatalities. The data for this study were retrieved from secondary sources and questionnaire responses (primary) and therefore the authenticity of the data was dependent on the accuracy of the data accessed.

1.6 Chapter Disposition

The study is structured in five main chapters. Chapter 1 covers the introduction which contains the research background, problem statement, objectives of the study, research questions, significance of the study, scope and limitation as well as organisation of the study. Chapter 2 covers the literature review, which provides theoretical underpinnings to the study. Thus, relevant studies conducted by other researchers were extensively reviewed. These include definitions and explanations of concepts and theories as well as empirical studies on the subject matter under consideration. The methodology of the study is provided in Chapter 3 and covers the study population, sampling methods, questionnaire design and administration, data collection procedure and data analysis method. In Chapter 4, the data collected are presented, also the Chapter presents interpretation and discussion of the findings obtained from the data analysis and summary of research findings. The final chapter, Chapter 5 contains the conclusions and recommendations.

CHAPTER 2: REVIEW OF LITERATURE

2.1 Introduction

This chapter reviews previous studies conducted on motorcycle transport and other subjects related to this study. The chapter begins with the description of the study area, Bolgatanga Municipality. Other areas reviewed in this chapter are motorcycle crashes, health and safety issues, causes and effects. The chapter concludes with discussion on the various empirical studies on the subject matter.

2.2 Description of Study Area

The Bolgatanga Municipal is the Upper East Regional capital. The Municipality forms part of the Thirteen (13) Districts and Municipals in the Region. This makes it the largest urban centre in the Region.

The Municipality shares boundaries with Bongo District to the North, to the East with Nabdam District, to the South with Talensi District and to the West with Kassena Nankana East District. The Administrative capital is Bolgatanga and a hub for all administrative and commercial activities in the region. The Bolgatanga Municipality is occupying about 729 sq km with population of 131,550 (GSS, 2010 Population and Housing Census). The town is located 820 km north of Accra. Bolgatanga is mostly populated by Grunis people who speak Frafra (Ghana Districts, 2006).

Road Transportation

The municipality depends solely on road transport to link up with the other parts of the country. Bolgatanga town, the capital of the Upper East Region is about 820kms from Accra, 540kms and 160kms from Kumasi and Tamale respectively. Bolgatanga is the pivot of road transportation in the Upper East Region with all the three major roads to the other districts radiating from it. Four long-distance bus companies apart from the GPRTU operate to and from Bolgatanga. These are Vanef-STC Ltd, Imperial Transport, Metro Bus and O&A travel, (Source: Ghanadistricts.com). Roadbased public transportation in the form of taxis is the most convenient means of getting around Bolgatanga for visitors to the town. The popular means of travel for the locals, however, is by motorcycles.

2.3. Types of Motorcycles in use in the Bolgatanga Municipality

Apart from the two-wheeled motorcycles found in the Bolgatanga Municipality, there are three-wheelers also known as “tricycles”. Three wheelers are generally used for

transportation of goods and passengers. Varying names are used in different countries and by the type of transportation service provided. Three wheelers operating as taxis are known as „autorick shaws“ in India and Sri Lanka (Kamakate and Gordon, 2009). Three-wheelers are commonly referred to as „baby taxis“ in Bangladesh. Diesel threewheelers with six-seater capacity are called „tempos“ in India, Sri Lanka, and Bangladesh (Kamakate and Gordon, 2009).

2.4 Motorcycle Accidents, Health and Safety Issues

The past three decades have seen alarming rate in traffic fatalities in developing countries (Hinds et al., 2007). The issue of the extent of reporting of fatalities as studies on road traffic crash have proven that there was an under-reporting in the official crash statistics in Ghana over an eight-year period (1997–2004) data (Salifu & Ackaah, 2012). The results indicate that the level of non-reporting varied considerably with the severity of the crash from about 57 for property damage crashes through 8% for serious injury crashes to 0% for fatal crashes. Crashes involving cyclists and motorcyclists were also substantially non-reported.

It appears the increasing motorization in recent times may be a major reason for the increasing traffic fatalities. The probability of death in traffic crashes increases sharply with increased speed, with the obvious fact that motor vehicles can travel much faster than non-motorized modes. The unsafe vehicles, inadequate road space, diver behaviour and inadequate traffic signals, signs and traffic management have compounded the danger increased motorisation poses. Compared to motor vehicle passengers, the danger faced by motorcyclists, bicyclist and pedestrians makes them more vulnerable and are likely to be killed or injured in a crash (WHO,2009).

Most of the world's accidents occurred in low-income and middle-income countries whereby public transport vehicles, private cars, three and two-wheeled vehicles and pedestrians significantly contributed to road accidents (WHO, 2009). Road traffic injuries will be ranked fifth from the ninth position in 2004 (WHO, 2009) as the cause of death globally by the year 2030. The total amount of developmental aid received by low and middle income country is to be said lower than the annual costs of road traffic crashes and these are estimated to be between US\$65-100 billion. (Hyder et al., 2007). The estimated costs as a percentage of the Gross National Product (GNP) in most African countries range from about 0.8%, 1%, 2.3%, 2.7% and 5% in Ethiopia, South Africa, Zambia, Botswana and Kenya respectively (Gbadamosi, 2006). The estimated cost as a percentage of Gross Domestic Product is 1.6% percentage in Ghana as stated by the National Road Safety Commission of Ghana in 2007 (Odera, 2009). However, the contribution of the various vehicles including motorcycles are not indicated in the report from the National Road Safety Commission of Ghana. Also Odera (2009) noted that motorcycle accidents accounted for 4% of all road traffic accidents in Ghana.

The most dangerous form of motorized transportation is motorcycle transportation. Due to the small size of the motorcycle, riders represent a vulnerable group of road users. Motorcyclists are about three times more likely than car occupants to be injured in a crash, and 16 times more likely to die (Atubi, 2012). Unlike the occupants in a car crash, In a motorcycle crash they often absorb all the kinetic and compressive energy resulting from the crash (Atubi, 2012).

According to WHO (2009), even in developed countries where morbidity and mortality rates from motorcycle accidents are low, the risk of dying from a motorcycle crash is twenty times higher than a motor vehicle crash. Another study by Atubi (2012) noted

that riders often ignore safety measures, making them more vulnerable to accidents. According to Kumar (2011), the leading cause of death and injuries in Ghana has been established as road traffic crashes, and that majority of road traffic fatalities and injuries occurred on roads in rural areas. Incongruously, motorcycle can be said to be one of the main types of vehicles in most rural areas. However, helmet use by motorcyclists among riders which serves as a precautionary measure is generally poor (Kumar, 2011).

2.5 Motorcycle Use of Lanes

The width of a motorcycle (0.75 m) accounts for only around 25% of the lane width (3 m). A motorcycle can follow another vehicle at an oblique position due to their narrowness and small size. This action makes the motorcyclist get a better view and the greater opportunity to filter, overtake or avoid a potential collision. Such short headways could be due to motorcycles' oblique following or lateral following (Tamakloe, 1993).

The nature of motorcycles gives the advantage of carrying out manoeuvres which bigger vehicles or cars cannot undertake under dense traffic situations. Weaving is a typical manoeuvre pattern of motorcycles which combines longitudinal and lateral movements. As a result of its size, motorcyclist manoeuvring in and out of traffic seems tolerable by vehicles in his surroundings. Apparently, motorcycles have a higher tolerance for a small following distance (Tamakloe, 1993).

2.6 Urban Motorcycle Traffic

The motorcycle transport system has seen an increasing trend in urban as well as rural areas. This presents city authorities with clear challenges such as increased road safety issues, poor level of service from public operators (Kwakye and Fouracre, 1998). The deficits in the current transport system and their attendant frustrations in the face of

growing urban youth unemployment (Oteng and Ababio, 2011; Grant Oteng and Ababio, 2011) have given birth to the use of motorcycles for commercial services, a practice popularly referred to as “Okada”. In Ghana, this practice is in contravention of the Motor Traffic Act, 2004 (Act 683) as amended 2008, Act 761.

2.7 Impact of Motorcycle Transport on Health and Environment

Developmental prerequisite of any society are reliable, comfortable, affordable and safe transportation. This developmental prerequisite (transportation) is also a high contributor to the greenhouse gas emission causing climate change. In spite of the flexibility and affordability provided by motorcycles and three-wheelers transport for many people around the globe, the less sophisticated engine technology of motorcycles and the lack of strict emission regulations in many parts of the world have resulted in high emissions of pollutants by motorcycles. According to Addo (2005), in many cities in developing countries, motorcycles are among the main sources of urban air pollution. The main pollutants in motorcycle exhaust fumes depend on several factors, such as the fuel used. These include particulate matter

(PM), hydrocarbons (HC), volatile organic compounds (VOCs), nitrogen oxides (NO_x), carbon dioxide (CO₂) and lead (Pb). Carbon dioxide (CO₂) is known to contribute to climate change. Together, these pollutants seriously affect human health and the environment including but not limited to the following; respiratory diseases, cardiovascular disease (diseases of the heart and lungs) and climate change.

2.8 Motorcycle Accidents Causation Factors

Over-speeding, driving in the wrong lanes, careless overtaking, overloading, carrying wide loads and making manoeuvres at prohibited points without proper turning signals were some of the unethical driving behaviour found in a study conducted in Kenya,

Odera (2009). The causes of road crashes mentioned in Kenya seem to be applicable to Ghana. Other causes of motorcycle crashes are discussed below:

Collisions

Hurt et al. (1981) conducted a research in Los Angeles, USA and established that most motor cycle accidents were as a result of collisions among other passenger automobiles or some stationary objects. It was also observed that over-speeding while negotiating sharp corners resulted in the rider sliding and falling off the moving motorcycle (Hurt et al., 1981; Haworth, 2007; Haworth, 2010). Other reasons were poor road network planning, where roads were shared by both the motor cyclists and four-wheeled vehicles (Hurt et al., 1981; McCarthy et al., 2007). In other instances, some vehicles were found encroaching the right- of- way of motorcyclists (Hurt et al., 1981; Samaha, 2010). The inability of vehicle drivers to detect and recognize motorcycles while in the traffic was another cause; some motorists were deliberately obstructing motorcyclists, hence causing crashes (Hurt et al., 1981; Samaha et al., 2010). Road junctions were death spots where traffic lights were often ignored (Hurt et al., 1981; Samaha et al 2010). Also, lack of formal training and lack of legal riding street experience were some of the causes of motorcycle crashes (Hurt et al. 1981; Haworth, 2010). The study also established that some motorcyclists did not concentrate when riding, and some rode under the influence of alcohol (Hurt et al., 1981; Samaha, 2010).

Alcohol Consumption

In reviewing the effect of alcohol on driving, Havard (2012) concluded that driving performance deterioration occurs at a relatively low concentration of alcohol in the tissue which certainly is much lower than required to produce the conventional clinical

picture of intoxication. At such concentrations, both drivers and pedestrians are more likely to be involved in accidents.

In Kenya, it has been found that 18 of 324 motorcycle accident patients reported by Deaner (2011) showed unequivocal instances of alcohol ingestion by chemical, biochemical and physical findings. However, in this environment most authors report a low incidence of alcohol use at the time of the accident. This may be because it is difficult to obtain such unequivocal information. As Odelowo (2006) observed, few patients admit alcohol ingestion for medico-legal, socio-cultural and religious reasons.

Personal Characteristics

According to Atubi (2012), in the Nigerian situation, the motorcyclist is particularly vulnerable, partly because of his and other road user's road-behaviour. Atubi (2012) stated that the motorcyclists sometimes appear as if they think that their movement on the road is not subject to any traffic regulation as they overtake on the wrong side; cross other vehicles without signals; and where traffic is halted, they do not observe the halt sign and signal.

Motorcycle Factors

Odelowo (2006) posited that small-engine motorcycles have the smallest ratio of accident producing collisions, probably because they are easier to control, and because their speed is limited. The state of maintenance of the vehicle is also very important, as a poorly maintained vehicle increases risk.

Non-use of Protective Gear

It has long been known that protective helmets protect the motorcyclist from head injuries. Crash bars, fitted to the motorcycles have also been shown to protect the legs

from injuries, particularly when the impact is from the side. Goggles or visors protect the eyes against wind and grits (Odelowo, 2006).

Environmental Factors

Environmental risk factors include the season, time of the day and the condition of the road. The condition of the roads in Ghana is often bad. The road surface is uneven with lots of potholes. When they are not paved, in the dry season, dust inhibits road visibility thus creating conditions which often end in head-on collision. Shifting sands arising from the wearing out of the road surface sometimes leads to loss of control of vehicles and consequent crashes into roadside objects. In the rainy season, road surfaces are softened by rainwater, thus leading to slipperiness, which in turn, sometimes causes accidents (Atubi, 2012).

2.9 Effects of Motorcycle Crashes on Society

One of the public health problems which is not mentioned in the Millennium Development Goals (MDGs) is the aftermath of motorcycle crashes. It comes with long term disabilities which are similar to HIV/AIDS, tuberculosis and cancer. Road injuries continue to increase in many countries. Around 1.2 million die in road accidents annually, 65% being pedestrians and 35% of pedestrian deaths are children (UNECA *et al*, 2011). Low and middle-income nations account for 85% of all road traffic deaths (Arumugam, 2007) and it is the top cause of death (UNECA *et al*, 2011). Disability due to road traffic injuries account for about 30-50million people (ibid). The traumas involved account for about 1 to 3% of GDP in most countries which implies that road injuries result in a lot of expenditure (UNECA *et al*, 2011).

Over-speeding in most cases ends tragically with deaths and severe injuries (WHO, 2007). Rune *et al*. (2004) asserted that the probability of sustaining fatal or serious in motorcycle crashes increases dramatically with increasing impact speeds.

Facial disfigurement is usually expected once an accident occurs, especially when a full-face helmet is not used (Hurt et al. 1981, Odera, 2009; Samaha 2010); muscle tears at the elbows, shoulders, hips, knees and wrists, fingers, spine and neck if the rider had not put on the riding protective clothing, which are abrasion resistant in design (Rome, 2006).

Fatal accidents usually result in disability. Disability can be a physical ailment, mental, intellectual or sensory malfunctioning which inhibits one from performing the daily living activities in persons who were once independent (WHO, 2010). Disability may be defined as a person's lack of capacity in "functioning at the body, person, or societal levels, in one or more life domains, as experienced by an individual with a health condition in interaction with contextual factors" (WHO, 2010). One example is the traumatic brain injury which renders the survivor completely dependent (Emejulu et al., 2010).

When incapacitated, patients have to stay in hospital for long periods of time to undergo surgery and receive medications. In the long run, the hospital bills become so huge that they overwhelm most families and at the same time put a strain on national health resources (WHO, 2007; Odera, 2009; WHO, 2009).

Other consequences associated with road traffic injuries are the indirect costs for individuals, such as the loss of both employment and property (WHO, 2010b). Estimates show that most countries of the world lose between 1% – 2% of its gross national product (WHO, 2010). The Kenyan economy spends over US\$ 50 million on accidents, and this estimate does not take into account the lost lives (WHO, 2004).

Accident survivors experience several emotional problems such as “acute, moderately severe emotional distress and acute stress syndrome characterized by mood disturbance and horrific memories of the accident” (Richard et al., 1993). Poverty is also a consequence of road crashes. For example, many households in India, Bangladesh, Bangalore and Vietnam became victims of poverty after road crashes (WHO, 2008).

2.10 Road Safety Fatalities and Injuries Trend in Ghana

In developing countries, it has been established that motorization has been accompanied by rapid growth in road traffic injuries which has become a leading cause of death and disability according to a research conducted in Ghana by Yankson et al (2010).

Also the conference proceedings highlighted that road crashes are the second leading cause of death in 5 to 44 year age group. The foregoing assertion is truly reflected in the spate of crashes in Ghana.

The Chronicle Newspaper (Monday 11 August 2008 edition) reported that Ghana records about 10,000 fatal road accidents every year out of which an average of 1600 people perish, while 150 people sustain serious injuries.

The Global Road Safety Partnership (GRSP) indicated that between 2002 and 2005, 70% of persons killed in road accidents were males and 20.8% were children under six years old. Pedestrians are the very vulnerable group accounting for more than 40% of annual road accidents fatalities, with 21% being children under 16 years. According to the Building and Road Research Institute (BRRI, 2001), at the national level, an average of 29% of all accidents are pedestrian accidents and the most vulnerable is the 6 – 10 years aged group, accounting for 18% of all casualties.

Yankson et al. (2010) noted that, as in many other developing countries, pedestrian injuries are the most common road traffic death: 43% of all deaths in Ghana were due to pedestrian accident. Atubi (2012) analysed 38 separate studies on road accidents and found out that pedestrian fatalities were highest in 75% of the studies, accounting for 41% to 75%, followed by passengers (38-51%) in 62% of the studies. Drivers were third in 55% of the studies, and never ranked first in any country. Pedestrians and motorcyclists killed were ranked first in India as fatalities of motorcycle accidents (Atubi, 2012)

Atubi (2012) stated further that passengers ranked first amongst the non-fatal casualties reported in 14 studies. According to Ameratunga et al. (2006), the provision of pavements (sidewalks) separately from motorized traffic, especially at high-risk crash sites, has the potential to lead to substantial reductions in pedestrian injuries. Roads without sidewalks, a common scenario in many low-income countries, are associated with a two-fold increased risk of a crash compared with those that do (ibid). Also implementation of road-design measures to facilitate reductions in speed, through various traffic-calming measures, is another key strategy that can be used with potential reductions in deaths and injuries of 11% (Ameratunga et al., 2006). According to Ameratunga et al. (2006), the introduction of speed humps in Ghana showed a 55% reduction in all deaths and a 51% annual reduction in crashes in which a pedestrian was hit (ibid). The researchers added that, while road safety fatalities and injuries are reducing in the developed world, it is increasing at an alarming rate in the developing countries.

Amoah (2011) cited Arthur Kennedy in an article “Perishing on the road” that many of our prominent politicians have been involved in accidents, including the Former Presidents of Ghana; Rawlings and Kufour and many other prominent politicians and

members of the parliament of Ghana. Amoah (2011) again cited Amofa (the deputy director Health Service) “road accidents kill more Ghanaians annually than typhoid fever, pregnancy – related complications, and malaria in pregnancy, diabetes or rheumatism”. He added that, the death of three Urologists of the Korle-Bu Teaching Hospital on the Kumasi-Accra highway leaves a scarlet in the minds of Ghanaians. Obour (2011) and Akoto-Manu (2011), noted that, statistics of deaths on the Ghana’s roads is too alarming. Statistics from the MTTU (2011) indicate that the spate of road accidents in Ghana is on the ascendancy (see Figure 2.1).

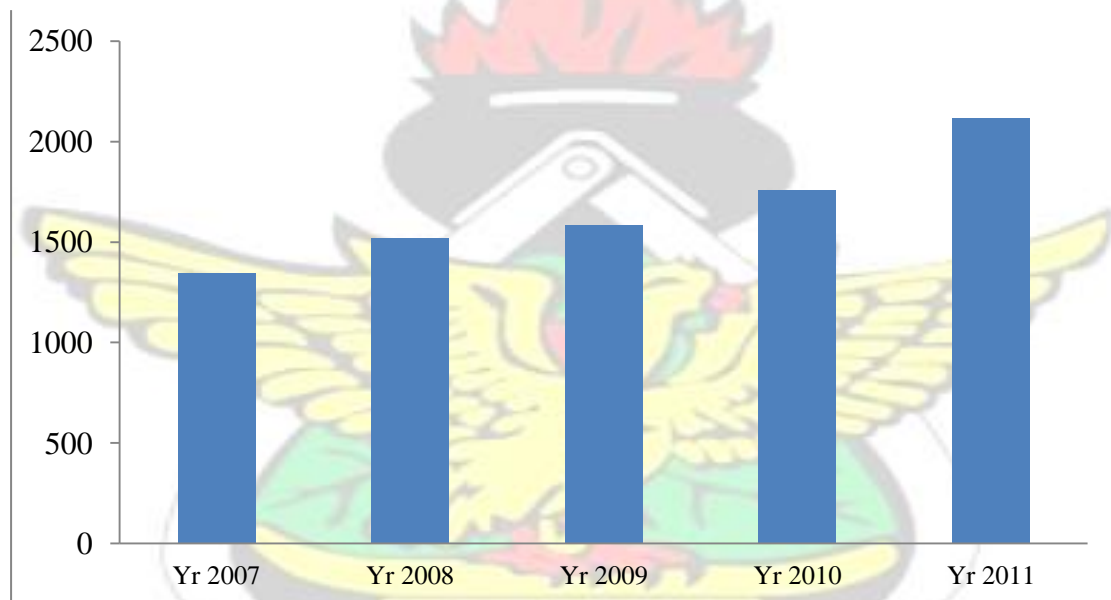


Figure 2.1: Number of people killed in road accidents in Ghana Source: MTTU, 2011

The MTTU (2011) cautioned road users to be careful as the accidents are rampant getting to the end of the year, especially in the months of November and December. According to the Ghana Road Safety Programme (G R S P), road accidents kill, on average, four persons daily in Ghana. The Herald Newspaper (November 21, 2011 edition) reported the Vice President of Ghana, as saying “the current rate of 1800 deaths through road accidents is unacceptable”. The situation is too scary as the Chronicle

Newspaper (Monday 11 August, 2008) reported a popular statement by Akorsah that “the most deadly disease in Ghana at the moment is motor accidents”.

2.11 Motorcycle Accident Mitigation Measures.

Motorcycle users sustain the most serious injuries leading to disability and death around the head and neck (WHO, 2013a). Wearing a standard, good quality motorcycle helmet can reduce the risk of death by 40% and the risk of serious injury by over 70% (Abbas et al., 2012; WHO, 2013b). Introducing and enforcing legislation on helmet use is effective at increasing helmet-wearing rates and reducing head injuries (Hyder et al., 2007; Kanitpong et al, 2008; Liu et al., 2008).

The effect of the introduction of helmet use legislation for drivers and passengers was reported in Thailand and Vietnam, and in both evaluations significant increases in helmet use were found compared to the situation before the implementation of the legislation in both countries. Multi-sectoral or community intervention programmes in localised areas in Lagos and Thailand led to significant increases in motorcycle helmet use in pre-post and controlled study designs (Peltzer and Pengpid, 2014)

Mandatory helmet legislation is one way of protecting riders of motorcycles in many countries. Researches have shown that helmet legislation compels riders to use helmets, which ultimately leads to a reduction of deaths resulting from motorcycle accidents (Begg, 2004). A study by WHO (2004) in the United States indicated that the average motorcyclist death rates were reduced by 22-33% in certain states with universal helmet legislation when compared with an era of no helmet legislation. It was also indicated that helmet legislation that covered only certain categories of riders reduced the average death rates by 7-10%.

In developing countries such as Ghana, motorcycle use is very common and is even being used as commercial taxis in Niger, Togo, Nigeria and Benin. This is because it has some advantages such as its easy manoeuvrability, good fuel economy and time saving over conventional taxis. However, in Ghana, there is less documentation on helmet usage by both riders and passengers as a safety measure. In addition, the use of motorcycle as commercial taxis is creeping into Ghana and now being practiced, though on illegal basis. Therefore, safety measures should be strong to prevent a lot of deaths from motorcycle riding. It was observed by Kelly et al. (2001) that the number of motorcycles involved in accident is on the ascendancy. Most of these accidents involved victims without helmets. A study by Kelly et al. (2001) indicated that motorcycle riders in developing countries seemed more likely to ignore safety measures.

The Hurt Report (1981) noted that of the 900 cases they investigated in Los Angeles, USA, 59.7% sustained injuries because they were not wearing helmets. Failure to wear approved helmets when riding contributed significantly to more injuries (UN, 2010; WHO, 2010b), a situation that is most conspicuous with a large percentage of Kenyan riders (Odera, 2009).

To enhance conspicuity of motorcyclists by motorists, motorcyclists must make use of motorcycle headlamps during the day; wear bright colour clothing such as yellow, orange or bright red jackets whenever riding as this significantly reduced involvement in accidents while on the road (Hurt et al. 1981). These measures are lacking in Kenya especially with majority of motor cycle passengers (Odera, 2009).

Legislation by governments can be a valuable tool that can greatly benefit the citizenry if they are provided with the necessary human and physical resources. The governments of Romania and Cambodia provided qualified medical personnel and emergency

medical services to the injured, measures which saved many lives than before (WHO, 2008).

The use of helmets by both the motorcycle riders and the passengers is the best way to prevent severe injuries (Hinds, 2007). Helmet use reduces severe injuries from 70% to 40% (WHO, 2010b). WHO reports on road safety have it that governments should enforce laws on mandatory use of standard helmets (WHO, 2010b) and protective clothing by motorcycle riders and passengers (Rome, 2006; WHO, 2009). According to Hinds (2007), in Kenya, pillion passengers ride without safety riding gears such as helmets or reflective clothing.

There is need for the Ghanaian government to implement specific actions aimed at preventing road traffic crashes and minimize injuries. Such measures include the enforcement of speed limits and at the same time ensure reduced drunk-driving (UN, 2010; WHO, 2010b). Research has shown that pedestrians have 90% chances of surviving car crashes of 30kph or less and 50% survival chances at 45kph (WHO, 2010b).

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter provides an explanation of the methods employed for the study. The main areas covered are population, sampling procedure and sample size, research instruments, data collection procedure and data analysis method.

3.2 Study Population

The population for this study consisted of motorcyclists who are directly related to this study, officials from the Bolgatanga Municipal Development Planning Unit, Bolgatanga Driver Vehicle and Licensing Authority (DVLA), Bolgatanga Regional Road Safety Commission (RRSC) and the Bolgatanga Motor Traffic and Transport Unit (MTTU) of the Ghana Police Service. These are the relevant institutions directly involved with road safety within the Bolgatanga Municipality.

3.3 Sample and Sampling Method

For the purpose of this study, a random sampling method was adopted; the only criteria for selection was that either one owned a motorcycle or was a rider.

Statistical method was used in establishing the sample size for the motorcyclists for the study. The sample size was determined using the following simplified formula (Israel, 1992),

$$n = \frac{N}{(1 + Ne^2)} \quad (3.1)$$

Where n is the sample size, N is the population size, and e is the level of precision. The population size was the number of motorcycles registered with DVLA for the 2010-2013 (Appendix 7). The precision rate of 10% was used hence the sample size of 100.

In effect, the study randomly selected 100 motorcyclists and 34 officials from the Bolgatanga Municipal Development Planning Unit, Driver Vehicle and Licensing Authority (DVLA) and the Motor Traffic and Transport Unit (MTTU). Table 3.1 represents the number of respondents for each stakeholder organisation.

Table 3.1: The Number of Respondents for each Stakeholder Organisation

Stakeholder Organisation (Regional Level)	Number of Respondents
National Road Safety Commission	7
Bolgatanga Municipal Development Planning Unit	5
Motor Traffic and Transport Unit	17
Driver Vehicle and Licensing Authority.	5
Total	34

Source: Field Data (2015)

3.4 Questionnaire Design and Administration

Two sets of closed and opened-ended questionnaires were designed: one for the motorists and the other for the officials from the Bolgatanga Municipal Development Planning Unit, Building and Road Research Institute BRRI, Regional Road Safety Commission, (RRSC), DVLA and MTTU. The questionnaires consisted of five sections for both categories of respondents. The first section sought the background data of the respondents. The second section sought information on the economic benefits of motorcycle usage and the third section of the questionnaire assessed the level of road safety awareness among motorcyclists. The fourth and fifth sections sought the main causes of motorcycle crashes and the effects of motorcycle crashes on the Municipality respectively.

Interviews were also conducted among the sampled motorcyclists. There were some who could neither read nor write, for these, the researcher sought the assistance of interpreters. The reasons for using interview were to obtain additional relevant data from the motorists. Interviews were used due to their flexibility and adaptability in the face-to-face encounter. They allowed for follow-up questions.

Apart from the questionnaires and interviews, field observations of motorists were made in the Municipality including photographs of motorists, road signs, crashed motorcycles parked at the MTTU taken during the observation. The site observation provided useful insights into how road safety measures and regulations were being adhered to by the motorists.

3.5 Pre-Testing of Questionnaire

Initial questionnaires developed were piloted or pre-tested with five motorists and five officials each from the stakeholder organisation. This process allowed for constructive suggestions and comments to be incorporated in the final questionnaires to be administered. The reason for this process was to obtain feedback so that reliable data would be obtained when data was collected as well as to ensure that the questionnaires were consistent, accurate, clear and not ambiguous.

3.6 Data Analysis and Presentation

The data analysis comprised of characteristics (age, work experience, number of years riding) of the various classes of respondents i.e officials from stakeholder organisation and sampled motorcyclists in the municipality. Analysis was also conducted on the road safety awareness, the use of crash helmet among motorcyclists, causes of accidents, effects of motorcycle crashes and the benefits of the motorcycle transportation within the municipality. This was done using Statistical Package for Social Sciences (SPSS Version 16) and Microsoft Excel 2007.

The 5-Likert scale was used in helping the respondents express their views accordingly.

The questionnaire results were collated and the weighted average formula was used to evaluate the weight of each results. The weighted average formula is given below.

$$WA = \frac{\sum W}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N} \quad (3.2)$$

Where WA means weighted average

A is high weight

N is total sample size

N1 is number of responses to strongly disagree on the questionnaire

N2 is number of responses to slightly disagree on the questionnaire

N3 is number of responses to not sure on the questionnaire

N4 is number of responses to slightly agree on the questionnaire

N5 is number of responses to strongly agree on the questionnaire

A demonstration of the application of the Likert- Scale was as follows: For a particular response for the cause of crash such as over-speeding, the responses were categorized such that the number of respondents who strongly agreed that over speeding was a cause of crash were collated; the number of respondents who slightly agreed that over speeding was a cause of crash were collated; the number of respondents who were not sure that over speeding was a cause of crash were also collated; the number of respondents who slightly disagreed that over speeding was a cause of crash were collated and those who strongly disagreed that over speeding was a cause of crash were collated. The numbers collated from each class of responses were then evaluated using the formula in Equation (3.1)

$$\frac{5(72) + 4(22) + 3(1) + 2(2) + 2}{5(100)} = \frac{457}{500} = 0.914$$

The result obtained from the above calculation was then compared with Table 3.2 to determine the type of interpretation. For instance, 0.914 fell within the range of 0.81-1 which interprets over speeding as an extremely high cause of crash within the Bolgatanga Municipality.

Table 3.2: Vagias Anchor for Interpreting Views of Respondents

Average Range	Interpretation of Questionnaire Results
0.81 – 1.00	Extremely High
0.61 – 0.80	Very High
0.41-0.60	High
0.21-0.40	Very low
0.01-0.20	Extremely low

Source: Vagias(2006)

3.7 Motorcycle Traffic Crash Data

Motorcycle traffic crash data for the research was collected from the Building and Road Research Institute (BRRI) accident database in Kumasi. The data for the study area was obtained by querying the Micro-Computer Accident Analysis Package (MAAP) and analysed with Microsoft Excel Package (2007). The data covered the period of 2005-2013.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

The data collected from the primary source (questionnaires) and secondary source (BRRI and DVLA) were analysed. The results are presented and discussed. The chapter is structured in line with the specific objectives of the study.

4.2 Characteristics of Respondents

This data from the questionnaires were analysed using Excel application software. Altogether there were 34 respondents from DVLA, MTTU, MDPU and RRSC. Out of the 34 respondents from the stakeholder organisation, 20% (7 respondents) were from DVLA, 50% (17 respondents) were from MTTU, 15% (5 respondents) were officials of RRSC and 15% (5 respondents) were from MDPU.

The experience of the respondents from the stakeholder organisations is shown in table 4.1. According to the data, 59% of them have worked with their organisations for a period of time ranging from 2 to 15 years. Some 41% of the respondents may have been recently employed as they have less than two years" experience working for their organisations.

Table 4.1: Working Experience of respondents from stakeholder organisation

Work Experience	Frequency	Percentage (%)
Less than 2 years	14	41
2-5 years	11	32
6-10 years	8	24
11-15 years	1	3
More than 15 years	0	-
Total	34	100

Source: Field Data, 2015

According to the data in the table on the ages of the motorcyclist respondents, 6% were less than 21 years, some of the respondents were between the ages of 21 – 30 years, followed by 41% who were between the age of 31 – 40 years, 6% of the respondents were between the age of 51 – 60 years. Also, none of the respondents was above 60 years. These results suggest that majority of motorcyclists are below 50, specifically between 21 and 40 years. Therefore, the question is whether majority of motorcycle

crashes in the municipality can be attributed to youthful factors. Table 4.2 contains data on the age distribution below illustrates the age distribution of the motorcyclist.

Table 4.2: Age Groups of Motorcycle Respondents

Age Group	Frequency	Percentage (%)
Less than 21 years	6	6
21-30 years	47	47
31- 40 years	41	41
41-50 years	0	0
51- 60 years	6	6
61 and above	0	0
Total	100	100

Source: Field Data, 2015

Table 4.3 shows the educational background of the motorcyclist respondents and from the table it is seen that 44% have diploma while 19% have a first degree. Surprisingly 1% holds a doctorate degree. None of the respondents had any professional qualification.

Table 4.3: Educational Qualification of Motorcyclist

Educational Qualification	Frequency	Percentage (%)
No education	7	7
SSSCE/O'A' Level	20	20
Diploma	44	44
First Degree	19	19
Master	9	9
Doctorate	1	1
Professional	0	0
Total	100	100

Source: Field Data, 2015

The more number of years of riding motorcyclists is an important contributory factor to gaining motorcycle riding experience and consequently we can assume will contribute to reducing motorcycle crashes.

Regarding the possession of a driving license, 35% of the motorcyclist respondents said they had acquired their driving /riding license while 65% stated that they had not acquired driving license. This means a very large number of motorcycle riders have not been trained or tested for the award of a state recognised License.

Table 4.4: Years of Riding Motorcycle

Year	Frequency	Percentage (%)
Less than 2 years	15	15
2 – 5 years	28	28
6 – 10 years	14	14
11 – 15 years	15	15
More than 15 years	28	28
Total	100	100

Source: Field Data, 2015

4.3 Road Safety Awareness

The responses from the officials of stakeholder organisation on various safety issues were calculated on a 5 point Likert scale from strongly agree (5) to strongly disagree (1) are presented in Figure 4.1.

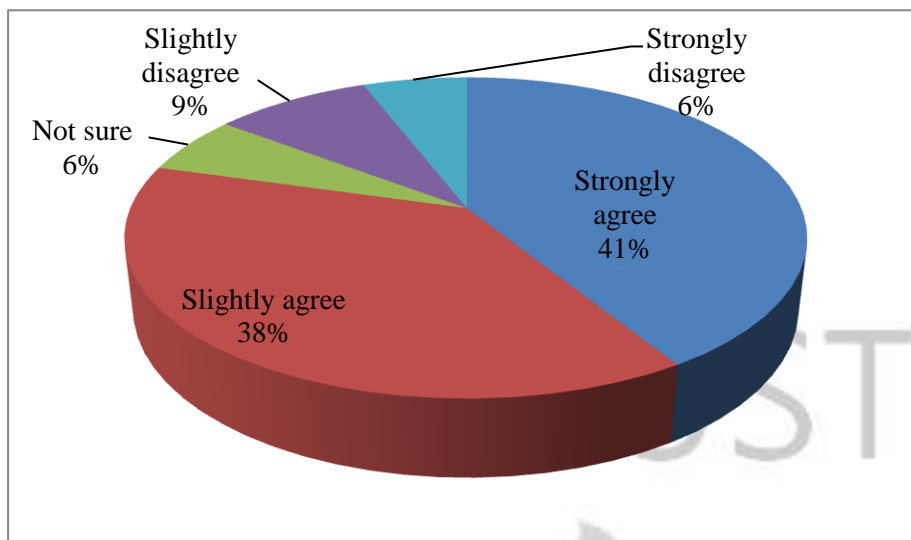


Figure 4.1: Road safety awareness among motorcyclists by stakeholder officials
Source: Field Data, 2015

According to the results 79% of the respondents agreed that the road safety awareness among motorcyclists was good and 6% were not sure. However, 15% of the respondents did not agree that road safety awareness among motorists was good. This implied the stakeholder officials agreed that majority of the motorcyclists had a good awareness of road safety.

According to the results from responses from motorcyclists, out of the 100 respondents, 91% indicated that they were aware of regulations on road safety awareness while the remaining 9% said they were not aware of any regulations on road safety regulations. In this regard, the respondents further indicated the sources of their awareness of road safety regulations. The results are illustrated in Figure 4.2.

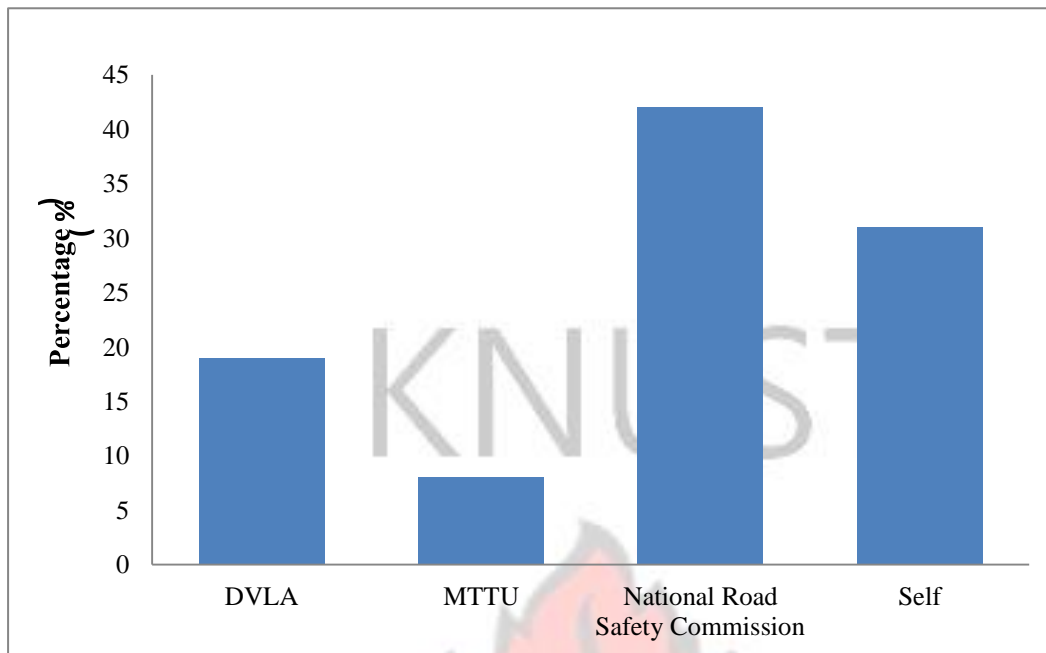


Figure 4.2: Sources of Road Safety Awareness Source: Field Data, 2015

According to Figure 4.2, 69% of the motorcycle respondents learnt about road safety from the stakeholder organisations during their outreach programmes and the remaining 31% said they learnt it themselves. Even though the percentage of those who learnt by themselves was in the minority (31%), it could have serious consequences to other road users. Based on these results, it was expedient to find out whether the motorcyclists really understood road signs as one of the measures of ensuring road safety in the country. In this regard the respondents were asked to identify some road signs, which have been placed within the Bolgatanga Municipality and state their meanings. The results are shown in Fig. 4.3.

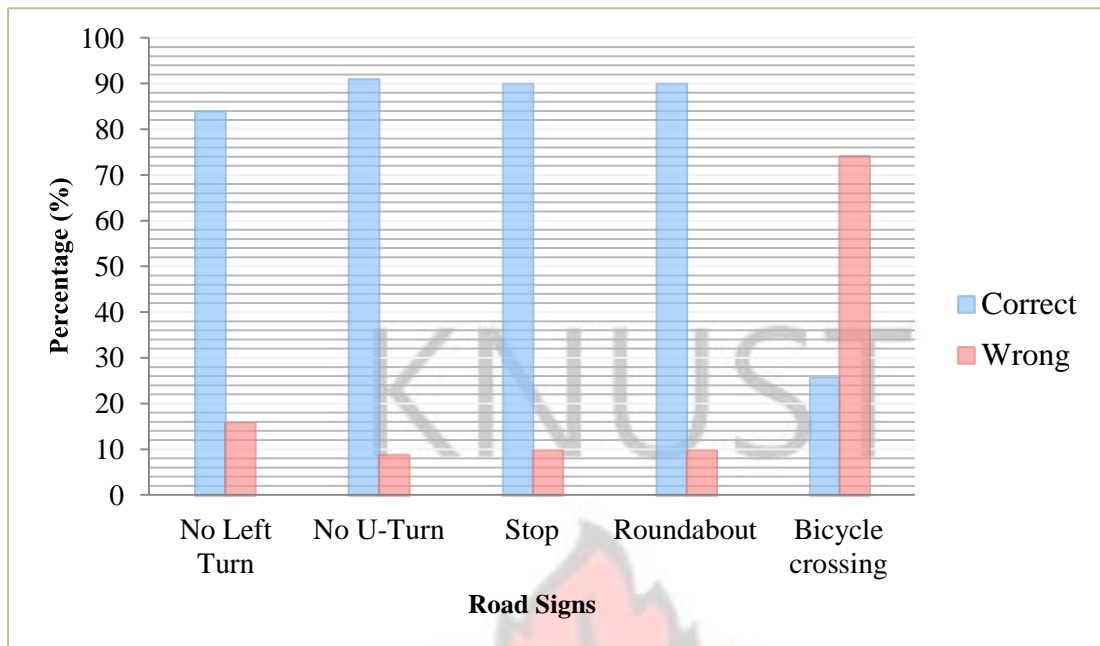


Figure 4.3: Road Signs and meaning

Source: Field Data, 2015

It is seen from Figure 4.3, that majority (86%) of the motorcyclists understood most of the roads signs. According to the secondary data on motorcycle crashes by traffic control type in Figure 4.4 which was analysed indicated that sections without any form of traffic control contributed the highest proportion of motorcycle crashes at 74%. This suggests that crashes could be lower if the sections had some traffic safety devices being present because there was some degree of adherence to these devices and control.

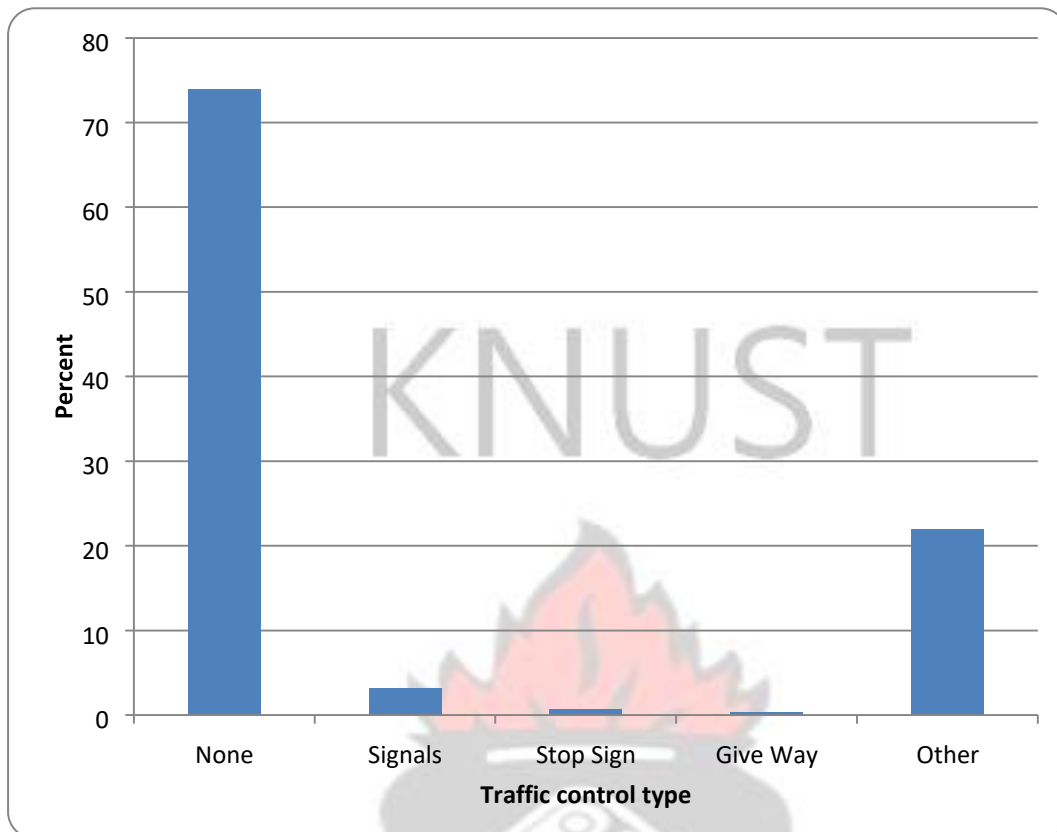


Figure 4.4: Motorcycle Crashes by Traffic Control Type Source: BRR Data, 2015

4.4 Motorcyclists Use of Crash Helmet

In response to use of crash helmet while riding, the survey showed that 73% of the officials of stakeholder organisation did not agree that motorcyclists did always make use of crash helmet as indicated in Fig.4.5. However, 27% of the officials of stakeholder organisations did agree. From these results, it is clear to state that majority of stakeholder officials perceive that motorcyclists in the Municipality do not use crash helmet.

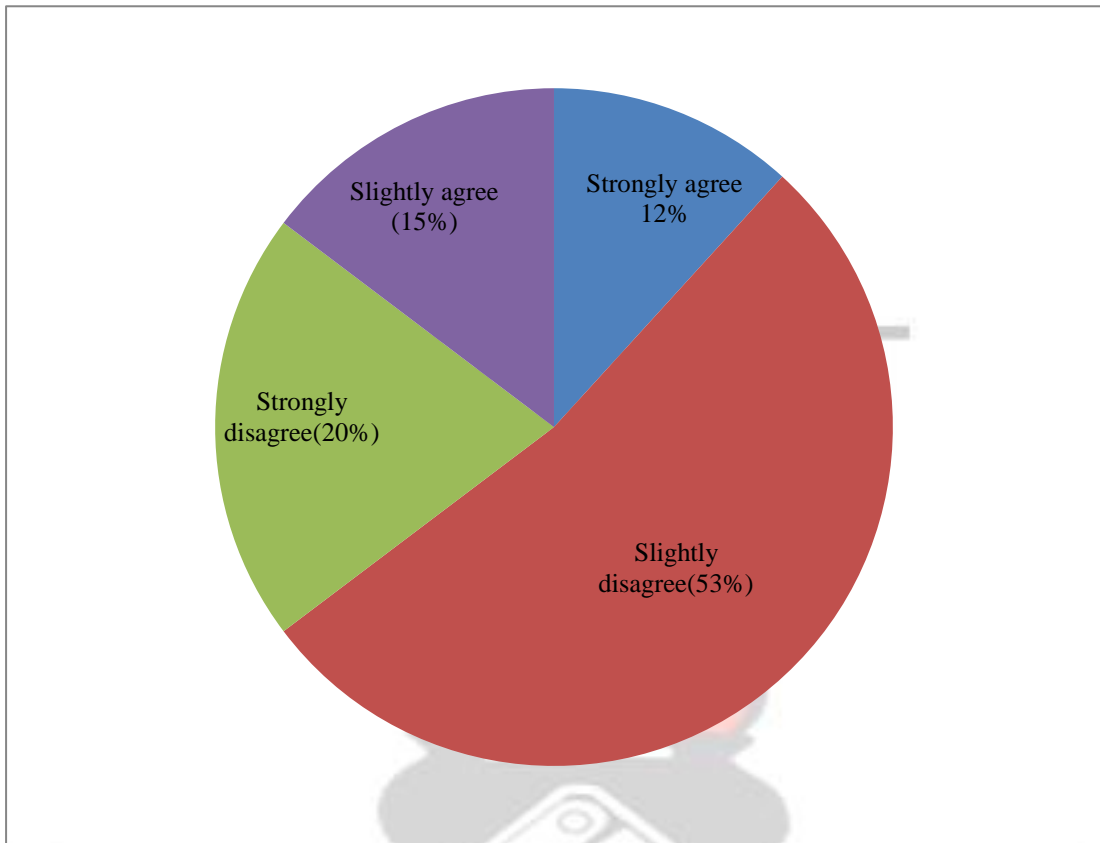


Figure 4.5: Motorcyclists use of helmet while riding

Surprisingly, 91% of the motorcyclists indicated that they use crash helmet while riding. Regarding the frequency of crash helmet use, the results showed that 33% indicated crash helmet use all the time, 55% said most of the time, while 12% said rarely (see Fig. 4.6).

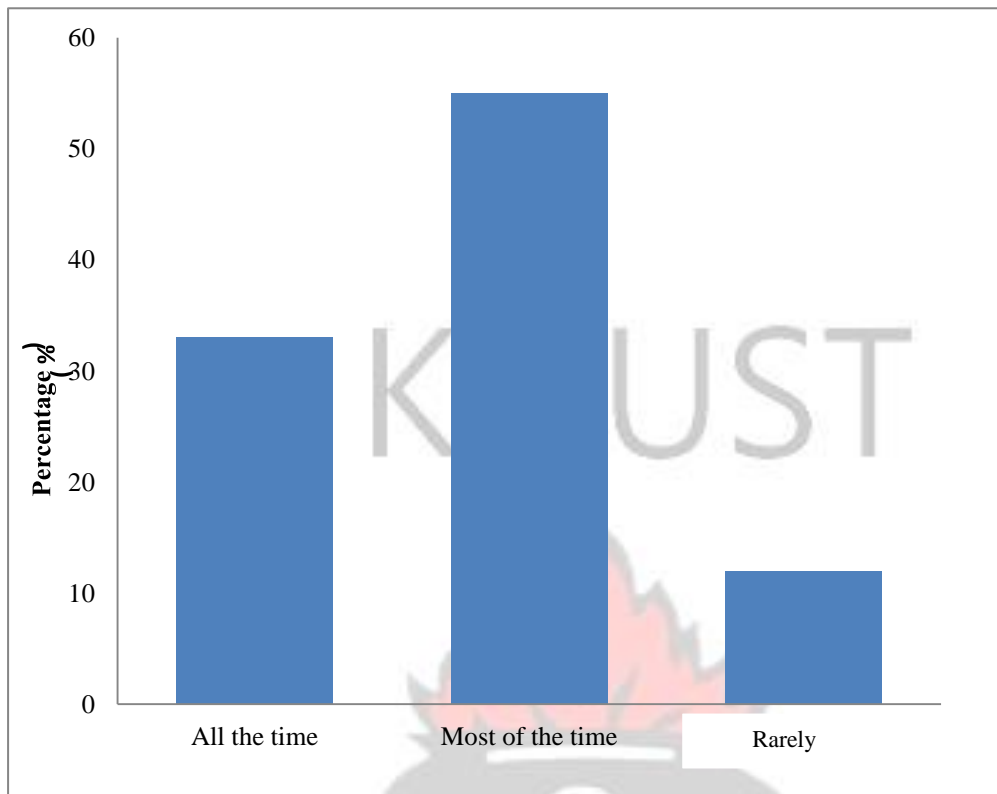


Figure 4.6: Use of crash helmet while riding a motorcycle

Source: Field Data, 2015

4.5 Effectiveness of Road Safety Campaigns

The Sampled respondents were asked to state their opinion on the effectiveness of road safety campaign in the municipality, 3% of the respondents said it was excellent, 35% stated that it was very good while 44% also said it was average. Also, 18% of the respondents indicated that it was poor.

According to the results presented in Figure 4.7, 62% of the stakeholder officials ranked the effectiveness of the road safety in the municipality as very good while 32% said it was average. However, 6% of the respondents said it was poor. This implied the officials of stakeholder organisation did their work well.

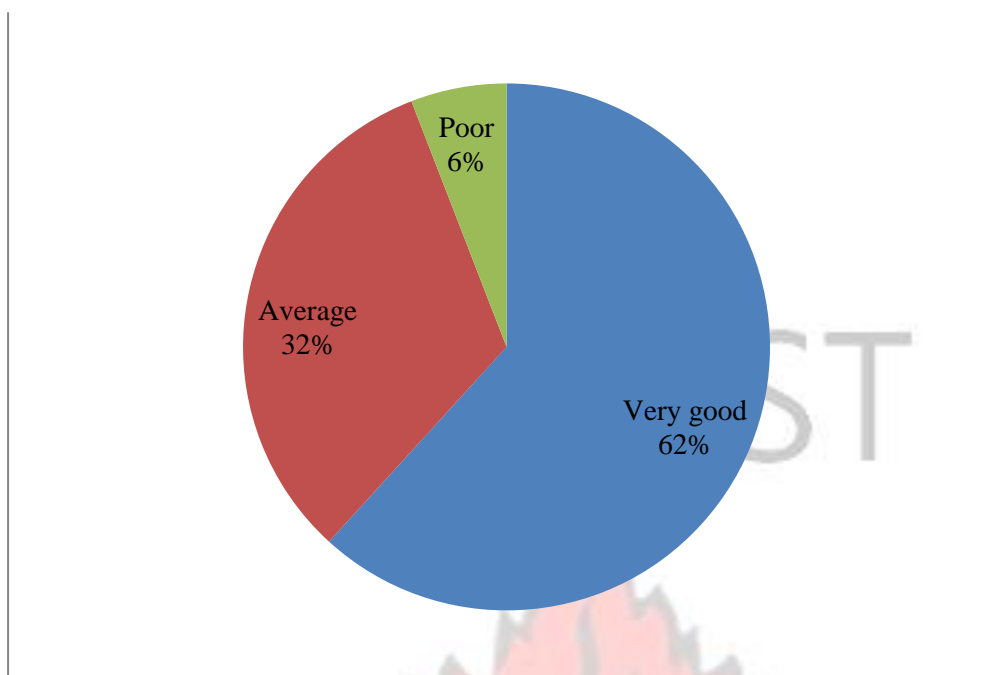


Figure 4.7: Respondents' view on effectiveness of road safety campaigns by officials of stakeholder organisation.

Source: Field Data, 2015

4.6 Causes of Motorcycle Crashes

In this section, the study sought to ascertain the major causes of motorcycle crashes in the Bolgatanga Municipality in the opinion of stakeholder organisations. The responses were analysed using a 5-point Likert scale. The results obtained are shown in Table 4.5.

Table 4.5: Causes of Motorcycle Crashes in the Bolgatanga Municipality as Indicated by Stakeholder Organisation.

Causes of motorcycle crashes/accidents	Weighted Average	Interpretation of Result	Rank
Lack of formal motorcycle riding training	0.97	Extremely High	1 st
Inexperience on the part of motorcyclists	0.92	Extremely High	2 nd
Over-speeding	0.91	Extremely High	3 rd
Rampant violation of road traffic regulations	0.88	Extremely High	4 th
Driving under the influence of alcohol and drugs	0.87	Extremely High	5 th
Ignorance of road safety measures by road users	0.84	Extremely High	6 th

Source: Field Data, 2015

These causes were ranked as extremely high causes of motorcycle crashes in the municipality. In the opinion of motorcyclists, the results obtained on a 5-point Likert scale are shown in Table 4.6.

Table 4.6: Causes of Motorcycle Crashes as Indicated by Sampled Motorcyclist

Causes of motorcycle crashes	Weighted Average	Interpretation	Rank
Over-speeding	0.96	Extremely High	1 st
Driving under the influence of alcohol and drugs	0.94	Extremely High	2 nd
Irregular functioning of traffic lights	0.93	Extremely High	3 rd
Weak Law enforcement	0.91	Extremely High	4 th
Lack of formal motorcycle riding training	0.87	Extremely High	5 th
Rampant violation of road traffic regulations	0.84	Extremely High	6 th
Ignorance of road users	0.83	Extremely High	7 th
Inexperience on the part of motorcyclists	0.81	Extremely High	8 th

Source: Field Data, 2015

The motorcyclists ranked the five main causes of motorcycle crashes in the Municipality as: 1st –Over speeding, 2nd –driving under the influence of alcohol and drugs, 3rd – irregular functioning of traffic signals, 4th – weak law enforcement and 5th- lack of formal training.

Comparing the results obtained from the motorcyclists and the various stakeholders involved in this study, it can be seen that over-speeding, driving under the influence of alcohol and drugs and irregular functioning of traffic lights appeared within the first top three causes of motorcycle crashes.

In validating the views of all the respondents, the secondary data which was sourced from BRRRI were analysed and inferences drawn.

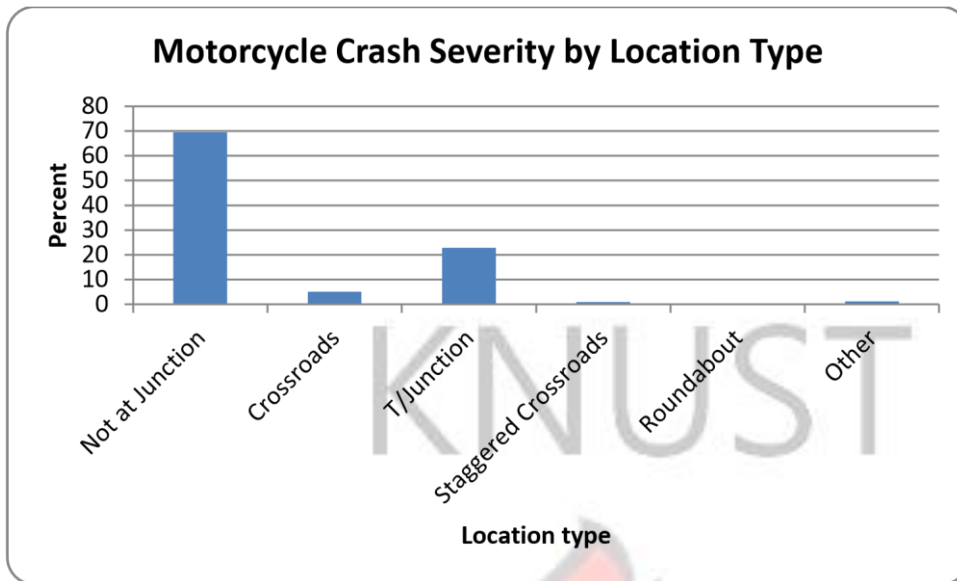


Figure 4.8: Motorcycle Crashes Severity by Location Type (2005-2013) Source: BTRI Data, 2015.

Based on Figure 4.8, majority (70%) of motorcycle crashes probably occurred on sections between intersections where flow interruptions are minimal and as such the motorcycles are able to move close to their desired speeds. However, at intersections motor crashes are minimal.

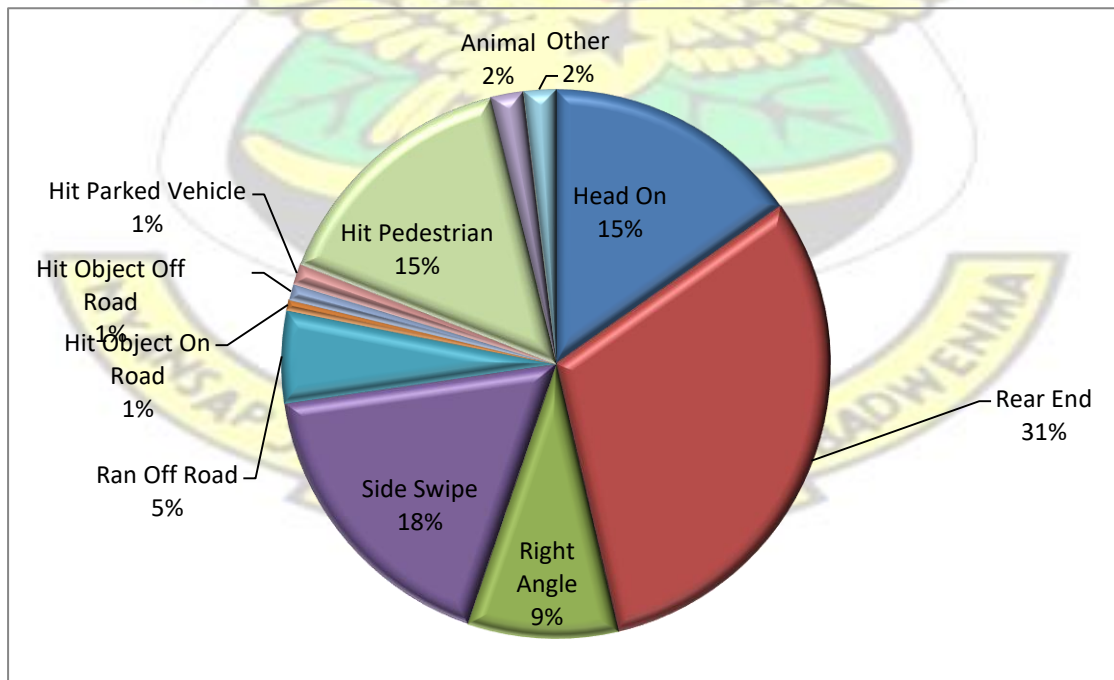


Figure 4.9 Distribution of Crashes by Collision type in Bolgatanga (2005-2013)
Source: BRRI Data, 2015

Based on Figure 4.9, Sudden-Stop Collisions and Side Swipe constituted almost 50% of the various collision types while hitting pedestrian and head on collisions constituted 30%. The probable causes of these crashes could be riders not respecting the following distances, riding on the blind side of vehicles and over speeding. To buttress the point on Head-on collisions, Figure 4.11 shows that 74% of motorcycle crashes occurred on roads with no median separation. This probably indicates that most of the crashes were perhaps head-on collisions as motorists decided to overtake vehicles in their lanes or collision with pedestrians crossing the road.

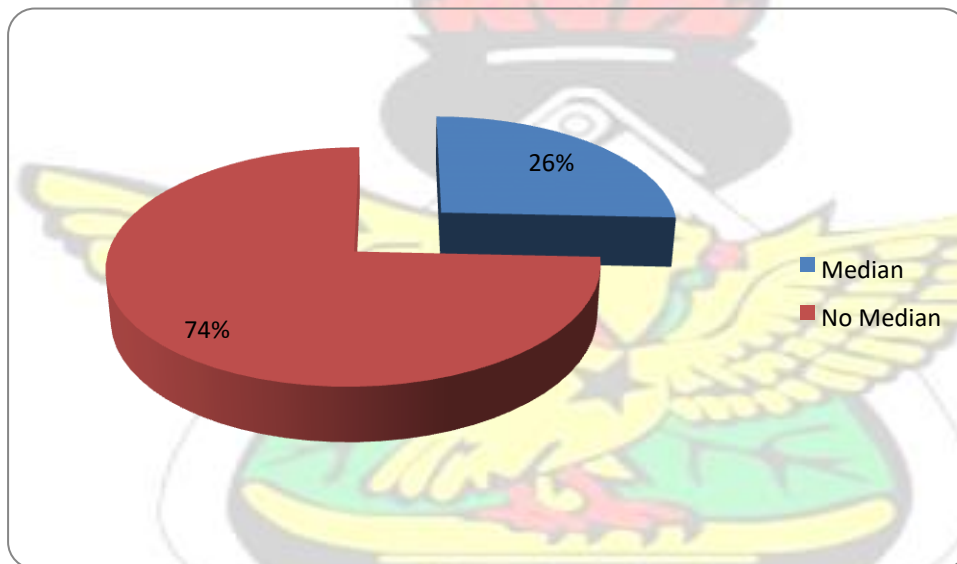


Figure 4.10: Motorcycle Crashes by Road Separation Source: BRRI Data, 2015

Also, about 85% of the motorcycle crashes occurred on bituminous surfaced roads in good condition as shown in Figure 4.11. This could be attributed to over speeding on the part of motorcyclists probably as a result of the good condition of the roads.

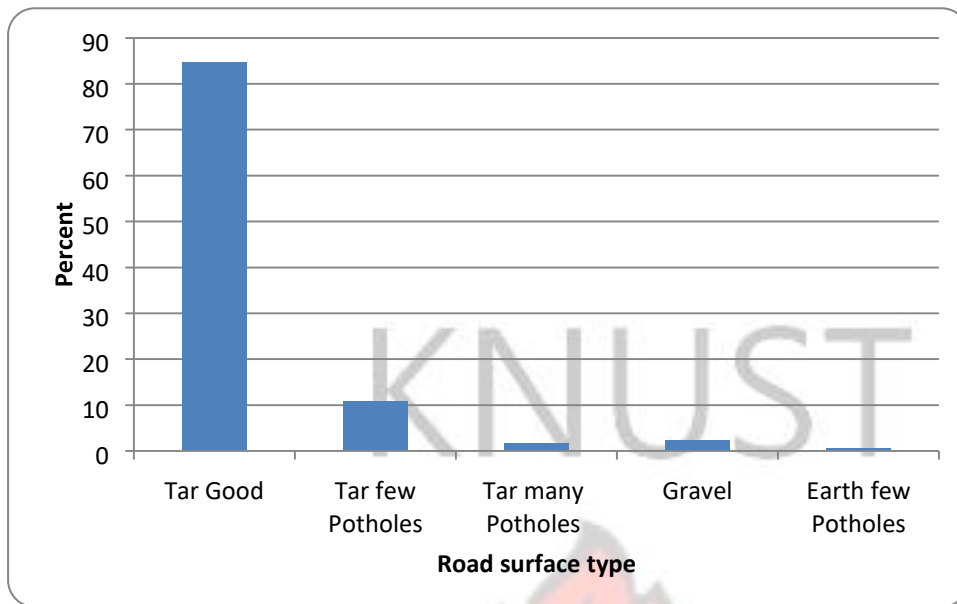


Figure 4.11: Motorcycle Crashes by Road Surface Type Source: BRRI Data, 2015

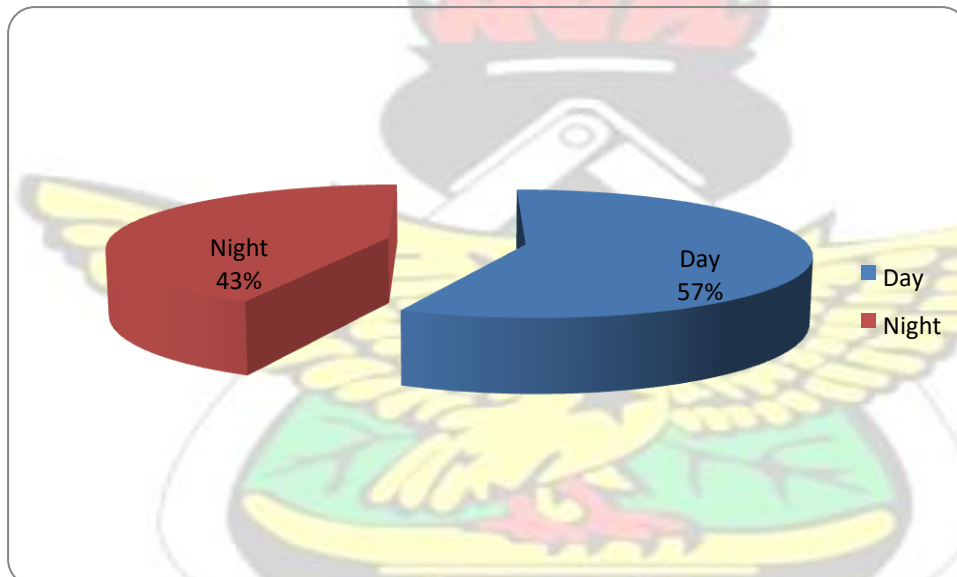


Figure 4.12: Motorcycle Crashes by Light Condition (2005-2013) Source: BRRI Data, 2015

The percent of motorcycle crashes occurring during the day and night are both significant (see Fig. 4.12) as shown in the figure above. The fact that proportion of crashes occurring in the day exceeds that of the night is an indication that poor lighting condition may not be a major contributory factor to motorcycle crashes in the Bolgatanga Municipality.

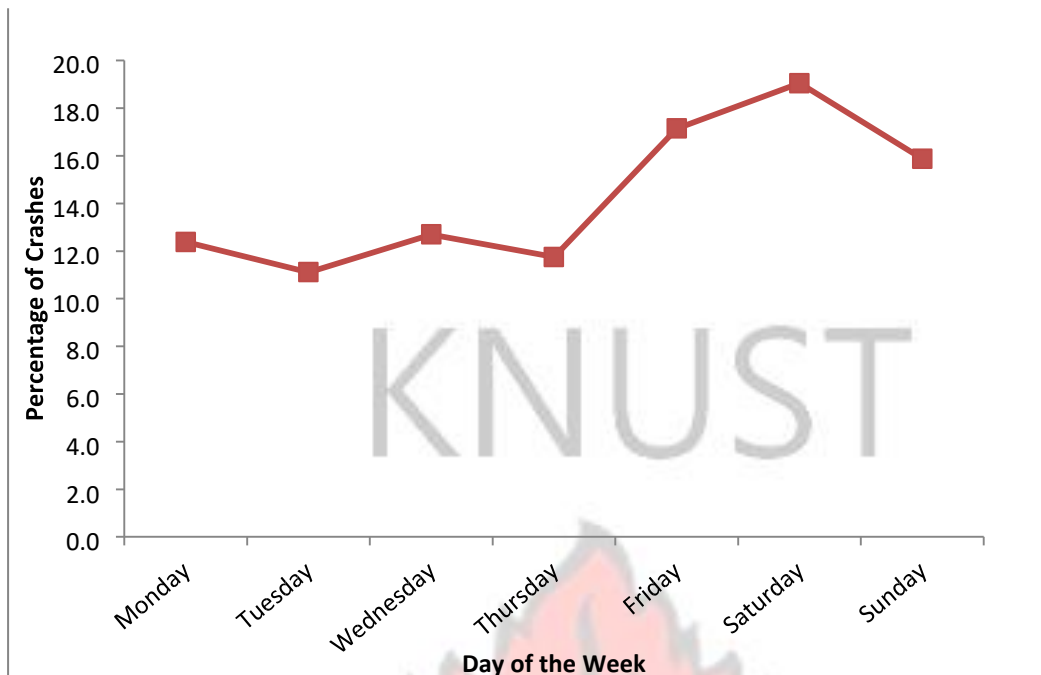


Figure 4.13: Distribution of Crashes by Day of the Week in Bolgatanga (2005-2013)

Source: BRRI Data, 2015

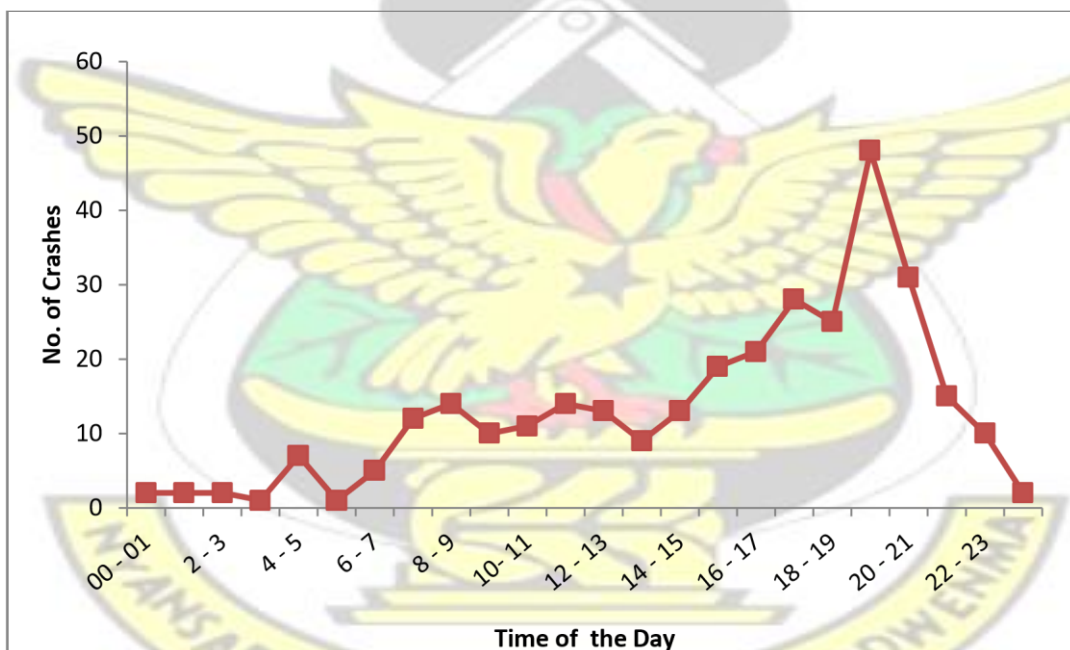


Figure 4.14: Distribution of Crashes by Time of the Day in Bolgatanga (2005-2013)

Source: BRRI Data, 2015

From Figures 4.13 and 4.14, it is seen that the highest crashes occurred on Saturdays and between the hours of 6pm and 9pm. The possible explanation could be that on Saturdays, there is a significant increase in the number social events. At these socials events, quite a number of people take alcohol and drugs therefore their sense of

judgement is affected while riding home. Also on market days, commercial riders, wanting to make more sales probably over speed, ignore traffic conditions, ignore traffic signs, disobeying speed limitations, not utilizing a traffic turn. Another inference made is that the MTTU presence after 5pm is minimal therefore motorcyclists choose to ignore traffic regulations.

From these presentations of results and inferences of the data from BRRI, it suffices to say that the probable causes of these motorcycle crashes are over speeding, lack of formal motorcycle training, riding under the influence of alcohol, weak law enforcement and rampant violation of the road traffic regulations confirms the responses from the study. These also suggests that if the stakeholder officials especially the MTTU were strict at enforcing the law, there could be a possible decrease in these crashes within the Municipality. This results are evident in Wang et al. (1999) and Bray and Timmerman (1985) where it was found that the major causes of motorcycle crashes include over speeding, inexperience, overloading, influence of alcohol consumption, and rider under age.

Apart from these results, observation of the main traffic signals at the market areas and SSNIT junction (one of the major intersections in Bolgatanga) indicated that though there were enough traffic signals, most of them were not functioning.

4.7 Effects of Motorcycle Crashes

The views of the respondents on the effects of motorcycle crashes in the Municipality were analysed using the 5point Likert-Scale. The results are presented in Table 4.7

Table 4.7: Effects of Motorcycle Crashes as indicated stakeholder officials and Sampled Motorcyclist

Effects	Weighted Average	Interpretation	Rank

Loss of lives of dear ones like family members, relatives	1.00	Extremely High	1 st
Serious injuries	0.96	Extremely High	2 nd
Disability	0.94	Extremely High	3 rd
Huge hospital bills	0.91	Extremely High	4 th
Emotional problems	0.87	Extremely High	5 th
Loss of investment and revenue for development	0.84	Extremely High	6 th

Source: Field Data, 2015

Notably, all respondents agreed to the effects of motorcycle crashes within the Municipality. Some of these effects were backed by data obtained from field the observation and BRRI.

Regarding loss of lives as the number one effect of motorcycle crashes, the respondents were asked to express their views on the factors that accounted for the high numbers of serious injuries and death among motorcyclists involved in crashes. According to the study, out of 100 respondents, 71% said that non-usage of crash helmet while riding caused injuries and death among motorcyclists involved in crashes while 29% of the respondents stated that over-speeding also caused serious crashes and death among motorcyclist involved in the crashes.

As indicated in Figure 4.15, fatal motorcycle crashes constitutes about 53% followed by serious injury at 34% which presupposes that the probability of dying from a motorcycle crash is high.

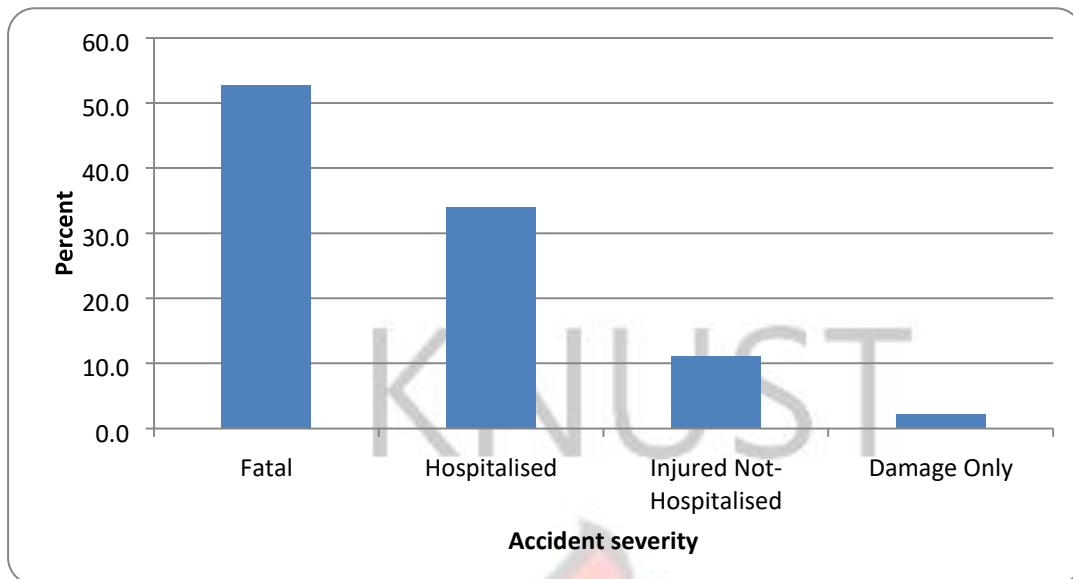


Figure 4.15: Motorcycle Crashes by Accident Severity (2005-2013) Source: BRRI Data, 2015

Based on Figure 4.16, 88% of those involved in motorcycle crashes were male. This perhaps indicates that more males travel by motorcycles than females in the Municipality.

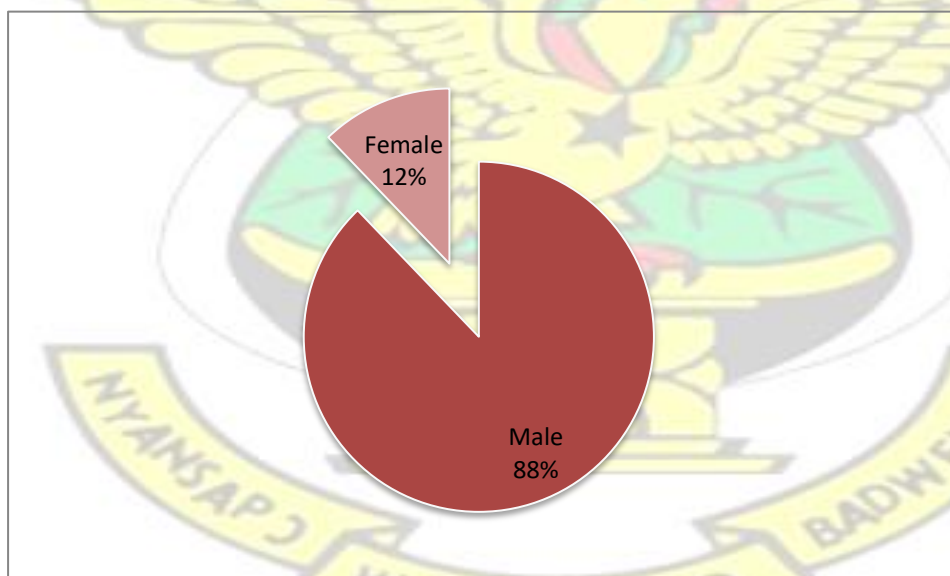


Figure 4.16: Gender Distribution of Motorcyclists (Rider + pillion) involved in motorcycle crashes in Bolgatanga. Source: BRRI Data, 2015

4.8 Economic Benefits of Motorcycle Use

The major benefits of motorcycle uses as ranked by the respondents have been presented in Table 4.8

Table 4.8: Benefits of Motorcycle Uses

Benefits	Weighted Average	Interpretation of Result	Rank
Saves transportation cost – motorcycle offer cheaper and affordable means of transport	0.94	Extremely High	1 st
Increases productivity due to reduced transportation time	0.91	Extremely High	2 nd
Better accessibility to markets	0.87	Extremely High	3 rd
Create employment	0.83	Extremely High	4 th
Improves working hours	0.81	Extremely High	5 th
Source of revenue	0.70	Very High	6 th
Quick accessibility to health facility	0.66	Very High	7 th

Source: Field Data, 2015.

Apart from the above benefits stated in Table 4.8 motorcycle use is a source of employment and a means of supplementary income.

4.9 Summary of Findings

Upon critical analysis and discussion of the data obtained from BRRI and results obtained from the stakeholders and motorcyclists in the Bolgatanga Municipality, the following findings were revealed.

4.9.1 Road Safety Awareness among Motorcyclists

The objective was to find out the level of road awareness among motorcyclists. They were questioned on a number of road safety measures such as road signs, helmet use and traffic signals. It was found that even though the effectiveness of the road safety in the municipality was described as very good which meant that majority of the motorcyclists had good understanding of road signs. However, majority of the

respondents were of the view that motorcyclists did not always make use of crash helmet while riding motorcycle.

4.9.2 Economic Benefits of Motorcycle Uses

The study found that the major benefits of motorcycle provided affordable means of transportation and cheaper transportation cost; increased productivity due to reduced travel time; better accessibility to markets; create employment, improves working hours; source of revenue; and quick accessibility to health facility.

4.9.3 Main Causes of Motorcycle Crashes

Based on data obtained from BRRI and that of the field study, the main factors causing motorcycle crashes in the Bolgatanga Municipality are over speeding; driving under the influence of alcohol and drugs; irregular functioning of traffic light; weak law enforcement; lack of formal motorcycle riding training; rampant violation of road traffic regulations and ignorance of right-of-way by motorcyclists.

4.9.4 Effects of Motorcycle Crashes

The findings indicate that the effects of motorcycle accidents are loss of lives (among which there could have been bread winner), serious injuries, disability, huge hospital bills, emotional problems, loss of investment and revenue for development and there have been a worrying trend in the number of motorcycle crashes in the Municipality as deduced from Figure 4.17.

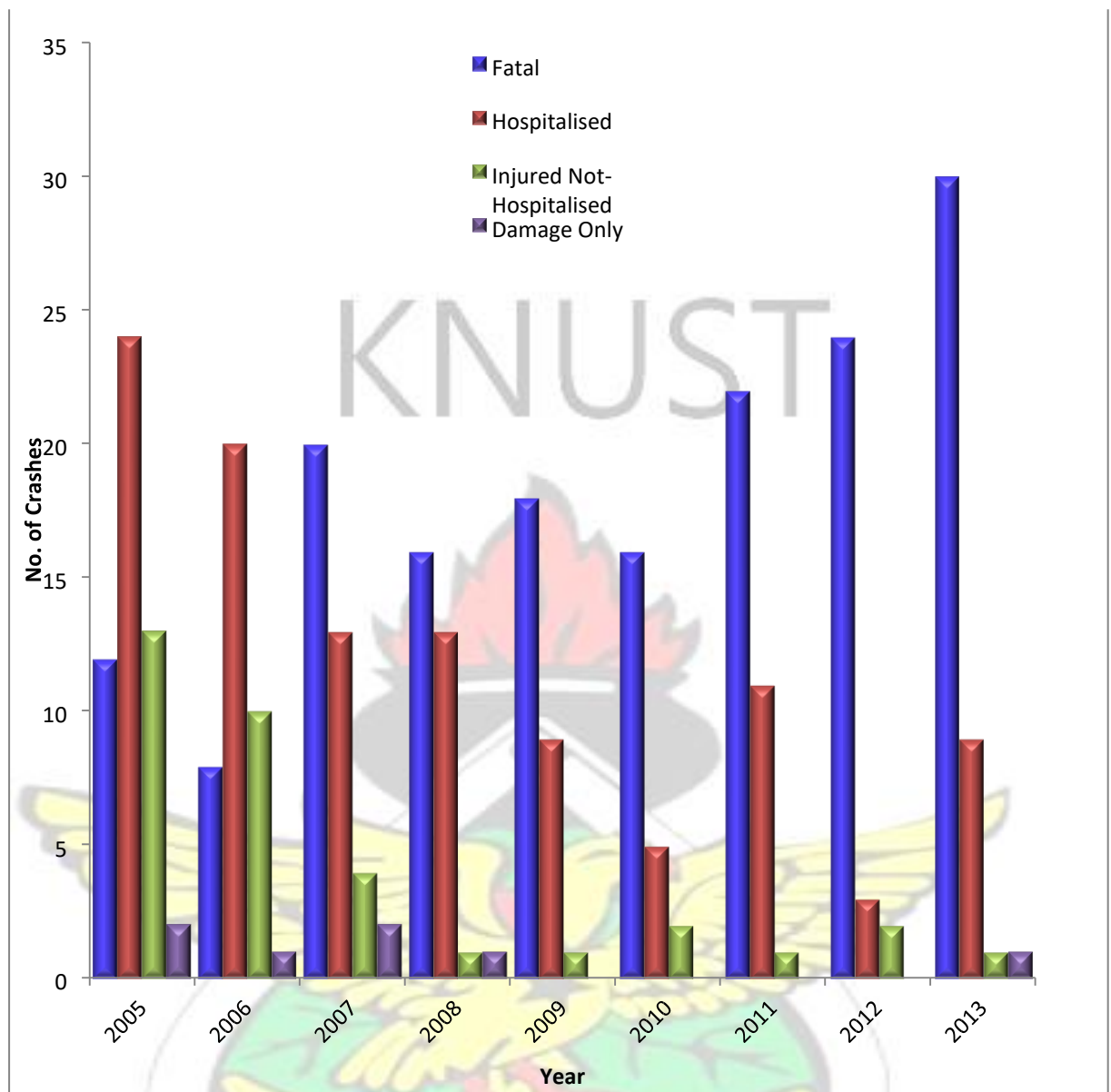


Figure 4.17: Distribution of Crashes by Severity in Bolgatanga (2005-2013)
Source: BRRI Data, 2015

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study sought to access the level of road safety awareness among motorcyclists. Based on the findings, the study concludes that motorcyclists seem not to care about their personal safety considering the low use of helmets.

The study sought to identify the factors causing the high rate of motorcycle crashes in the Bolgatanga Municipality. Based on the findings, the study concludes that the factors

causing the high rate of motorcycle crashes in the Bolgatanga Municipality are over speeding, driving under the influence of alcohol and drugs, irregular functioning of traffic light, weak law enforcement, rampant violation of road traffic regulations, inexperience on the part of motorcyclists.

Regarding the economic benefits of motorcycle uses, the study concludes that it provides easy accessibility, source of employment and revenues.

Finally, the study concludes that the adverse effects of motorcycle crashes include loss of lives, serious injuries, disability, huge hospital bills, emotional problems, loss of investment and revenue for development.

5.2 Recommendations

The following recommendations are suggested in ameliorating the rate of motorcycle crashes in the Bolgatanga Municipality:

- The Municipal Authorities need to erect and maintain more road signs, road markings, crosswalks, speed humps and adequate and functioning traffic signals (which are solar powered) in traffic operations.
- The Driver and Vehicle Licensing Authority (DVLA) in the Municipality needs ensure that all motorcycles in the in the municipality are registered with helmets and that issuance of licenses should be strictly based on mandatory formal training certification.
- The MTTU should be strict on the use of helmets by motorcyclists and prosecute offenders. Also there is the need to ensure all the traffic regulations are enforced.
- The National Road Safety Commission (NRSC) needs to intensify public education on road safety measures for the motorists and all other road users

especially on the right-of-way. Also increase police presence at night where the traffic controls are not available.

- The MTTU should enforce all the laws regarding traffic regulations and this will go a long way to curb over-speeding, over-loading, alcohol use during driving, crossing and parking at unapproved locations.
- It is also recommended further studies should be taken up in other municipalities within the Upper East Region to ascertain whether these findings are applicable.

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APPENDICES

APPENDIX 1

QUESTIONNAIRE FOR STAKEHOLDER OFFICIALS IN THE BOLGATANGA MUNICIPALITY

Dear Respondent,

This thesis is entitled “*Factors causing the High Rate of Motorcycle Crashes and Their Analysis in the Bolgatanga Municipality*”. In this regard, you are kindly requested to respond to the following questionnaire. You are hereby reminded not to write your name as this questionnaire is considered anonymous. You are assured that all information solicited in this regard shall be used for the purpose of academic work only and shall be treated strictly confidential as much as possible.

Thank you very much for your contribution.

Yours faithfully,

David Brown

MSc. Student, KNUST

FOR INTERNAL USE ONLY

Questionnaire Code:..... Date of Administration:.....

Date of Retrieval: Remarks:.....

SECTION A: BACKGROUND INFORMATION

1. Which of the following organisations do you belong?

Bolgatanga Municipality Planning Unit [☐]

DVLA [☐]

MTTU []

BRRI []

RRSC []

2. How many years have you been working with this organisation?

a) Less than 2 years []

b) 2 – 5 years []

c) 6 – 10 years []

d) 11 – 15 years []

e) More than 15 years []

SECTION B: ROAD SAFETY AWARENESS AMONG MOTORCYCLISTS

3. Would you agree that there is adequate awareness of road safety measures among majority of the motorcyclists in the Municipality?

a) Strongly agree

b) Slightly agree

c) Not sure

d) Slightly disagree

e) Strongly disagree

4. Would you agree that majority of motorcyclists within the Municipality understand road signs very well?

a) Strongly agree

b) Slightly agree

c) Not sure

d) Slightly disagree

e) Strongly disagree

5. Would you agree that majority of motorcyclists always make use of crash helmet while riding motorcycle?

- a) Strongly agree
- b) Slightly agree
- c) Not sure
- d) Slightly disagree
- e) Strongly disagree

6. How would you rate the usage of crash helmet among majority of motorcyclists? a)

Excellent []

- b) Very good[]
- c) Average[]
- d) Poor[]
- e) Very poor[]

7. Do you think that majority of motorcyclists head helmet while riding motorcycle?

- a) Yes [] b) No []

8. How would you assess the effectiveness of road safety campaigns in the Municipality?

- f) Excellent []
- g) Very good[]
- h) Average []
- i) Poor []
- j) Very poor []

SECTION C: CAUSES OF MOTORCYCLE CRASHES

9. Which of the following do you think are the major causes of motorcycle crashes (accident) in the Municipality? Please rank the factors in order of importance using the following scale, 5 = strongly agree, 4 = slightly agree, 3 = Not very sure, 2 = Slightly disagree or 1= Strongly disagree.

Causes of motorcycle crashes/accidents	Strongly agree	Slightly agree	Not sure	Slightly disagree	Strongly Disagree
Weak law enforcement	[]	[]	[]	[]	[]
Ignorance of road safety measures by road users	[]	[]	[]	[]	[]
Driving under the influence of alcohol and drugs	[]	[]	[]	[]	[]
Irregular functioning of traffic lights	[]	[]	[]	[]	[]
Rampant violation of road traffic regulations	[]	[]	[]	[]	[]
Ineffective collaboration among key stakeholders such as DVLA, MTTU, City authorities, etc.	[]	[]	[]	[]	[]
Inexperience on the part of motorcyclists	[]	[]	[]	[]	[]
Lack of formal motorcycle riding training	[]	[]	[]	[]	[]
Unrestrained animals carts	[]	[]	[]	[]	[]
Poor weather condition	[]	[]	[]	[]	[]
Traffic congestion on market days	[]	[]	[]	[]	[]
Over-speeding	[]	[]	[]	[]	[]
Over-loading	[]	[]	[]	[]	[]
Poor road conditions	[]	[]	[]	[]	[]
Oil spillage on the road	[]	[]	[]	[]	[]
Animal crossing (Cow, pigs, goats)	[]	[]	[]	[]	[]
Smoke emission from other vehicles	[]	[]	[]	[]	[]
Dangerous Checkpoints	[]	[]	[]	[]	[]
Mechanical Defects	[]	[]	[]	[]	[]
Tyre defect	[]	[]	[]	[]	[]

SECTION D: EFFECTS OF MOTORCYCLE CRASHES

10. Which of the following do you think are the effects of motorcycle crashes/accidents in the Municipality? Please rank the factors in order of importance using the following scale, , 5 = Strongly agree, 4 = Slightly agree, 3 = Not very sure, 2 = Slightly disagree or 1= Strongly disagree.

Effects	Strongly agree	Slightly agree	Not sure	Slightly disagree	Strongly Disagree
Loss of lives	[]	[]	[]	[]	[]

Serious injuries	[]	[]	[]	[]	[]
Disability	[]	[]	[]	[]	[]
Huge hospital bills	[]	[]	[]	[]	[]
Emotional problems	[]	[]	[]	[]	[]
Loss of investment and revenue for development	[]	[]	[]	[]	[]

11. Which of the following factors do you think account for high serious injuries and death among motorcyclists involved in accidents?

- a) Non-usage of crash helmet
- b) Over-speeding
- c) Poor road
- d) Others (please state):.....

12. Is there any other information you would want to share with us regarding causes of motorcycle crashes in the Bolgatanga Municipality? Please write your comments below:

.....

.....

.....

.....

13. What do you think are some of the measures that will be effective in curbing motorcycle crashes in Bolgatanga? Please write your comments below:

.....

.....

.....

.....

APPENDIX 2

QUESTIONNAIRE FOR MOTORCYCLISTS IN THE BOLGATANGA

MUNICIPALITY

Dear Respondent,

This study is being conducted on the topic “*Factors Causing the High Rate of Motorcycle Crashes and their Analysis in the Bolgatanga Municipality*”. In this regard, you are kindly requested to respond to the following questionnaire. You are thereby reminded not to write your name as this questionnaire is considered anonymous. You are assured that all information solicited in this regard shall be used for the purpose of academic work only and shall be treated strictly confidential as much as possible.

Thank you very much for your contribution.

Yours faithfully,

David Brown
MSc. Student, KNUST

FOR INTERNAL USE ONLY

Questionnaire Code:.....Date of Administration:.....

Date of Retrieval: Remarks:.....

SECTION A: BACKGROUND INFORMATION

14. Sex: Male [☐] Female [☐]

15. What is your age group?

- a) Less than 21 years [☐]
- b) 21 – 30 [☐]
- c) 31 – 40 [☐]
- d) 41 – 50 [☐]
- e) 51 – 60 [☐]
- f) 61 and above [☐]

16. What is your highest educational qualification?

- a) No education[]
- b) SSSCE/O'/'A' Level[]
- c) Diploma[]
- d) First Degree[]
- e) Master[]
- f) Doctorate[]
- g) Professional[]

17. How many years have you been riding motorcycle?

- f) Less than 2 years []
- g) 2 – 5 years []
- h) 6 – 10 years []
- i) 11 – 15 years []
- j) More than 15 years []

18. Do you have a driving/riding license? Yes[] No [] **SECTION B:**
ROAD SAFETY AWARENESS AMONG MOTORCYCLISTS


19. As a motorcyclist, are you aware of road safety regulations?

- f) Yes[] b) No []

20. If yes, where did you hear or learn about road safety measures?

- a) DVLA []
- b) MTTU []
- c) National Road Safety Commission []
- d) Self []

21. What is the meaning of the following road signs?

No.	Road Sign	Meaning
1		

2		
3		
4		
5		
6		
7		
8		
9		

22. Do you use your crash helmets while riding?

- a) Yes [☐]
- b) No [☐]

23. If yes, how often do you use crash helmet while riding a motorcycle?

- a) All the time [☐]
- b) Most of the time [☐]
- c) Few of the time [☐]

24. Do you find wearing of crash helmet convenient?

- a) Yes [☐]
- b) No [☐]

25. Why do you use crash helmet while riding a motorcycle?

- k) To prevent or reduce head injury []
- l) When approaching the police []
- m) Prevent air and particles from entry the eye []
- n) To avoid headache []
- o) When travelling long distance[]
- p) To avoid having problem with the Police

26. Do you wear head helmet while riding a motorcycle?

- b) Yes[]
- c) No []

27. Have you ever ignored traffic regulation before (eg. Crossing red traffic light)? a)

Yes[]

- b) No []

SECTION C: ECONOMIC BENEFITS OF MOTORCYCLE USES

28. Which of the following do you think are the major economic benefits of motorcycle use to you? You are expected to rank the factors in order of importance using the following 5-Likert scale, thus, 5 = Strongly agree, 4 = Slightly agree, 3 = Not very sure, 2 = Slightly disagree or 1= Strongly disagree.

Benefits	Strongly agree	Slightly agree	Not sure	Slightly disagree	Strongly Disagree
Saves transportation cost - motorcycle offer cheaper and affordable means of transport	[]	[]	[]	[]	[]
Better accessibility to markets	[]	[]	[]	[]	[]
Improves working hours	[]	[]	[]	[]	[]
Increases productivity due to quickness in getting to destination	[]	[]	[]	[]	[]

Create employment	[]	[]	[]	[]	[]
Source of revenue	[]	[]	[]	[]	[]
Quick accessibility to health facility	[]	[]	[]	[]	[]

SECTION D: CAUSES OF MOTORCYCLE CRASHES

29. Which of the following do you think are the major causes of motorcycle crashes (accident) in the Municipality? You are expected to rank the factors in order of importance using the following 5-Likert scale, thus, 5 = Strongly agree, 4 = Slightly agree, 3 = Not very sure, 2 = Slightly disagree or 1= Strongly disagree.

Causes of motorcycle crashes/accidents	Strongly agree	Slightly agree	Not sure	Slightly disagree	Strongly Disagree
Weak Law enforcement	[]	[]	[]	[]	[]
Ignorance of road users	[]	[]	[]	[]	[]
Poor road conditions					
Driving under the influence of alcohol and drugs	[]	[]	[]	[]	[]
Irregular functioning of traffic lights	[]	[]	[]	[]	[]
Rampant violation of road traffic regulations	[]	[]	[]	[]	[]
Ineffective collaboration among key stakeholders	[]	[]	[]	[]	[]
Inexperience on the part of motorcyclists	[]	[]	[]	[]	[]
Lack of formal motorcycle riding training	[]	[]	[]	[]	[]
Unrestrained animals carts	[]	[]	[]	[]	[]
Poor weather condition	[]	[]	[]	[]	[]
Traffic congestion on market days	[]	[]	[]	[]	[]
Over-speeding	[]	[]	[]	[]	[]
Over-loading	[]	[]	[]	[]	[]

SECTION E: EFFECTS OF MOTORCYCLE CRASHES

30. Which of the following do you think are the effects of motorcycle crashes/accidents in the Municipality? You are expected to rank the factors in order of importance using the following 5-Likert scale, thus, 5 = Strongly agree, 4 = Slightly agree, 3 = Not very sure, 2 = Slightly disagree or 1= Strongly disagree.

Effects	Strongly agree	Slightly agree	Not sure	Slightly disagree	Strongly Disagree
Loss of lives of dear ones like family members, relatives	[]	[]	[]	[]	[]
Serious injuries	[]	[]	[]	[]	[]
Disability	[]	[]	[]	[]	[]
Huge hospital bills	[]	[]	[]	[]	[]
Emotional problems	[]	[]	[]	[]	[]
Loss of investment and revenue for development	[]	[]	[]	[]	[]

THANK YOU VERY MUCH FOR YOUR TIME AND ASSISTANCE

APPENDIX 3

OBSERVATION CHECKLIST

DATE OF VISIT:..... **TIME:**.....

INSTRUCTION GUIDE:










1. Visits to be made at least twice for each observable item.
2. Pictures to be taken

OBSERVATION SHEET

OBSERVABLE ITEM	THINGS TO OBSERVE AND RECORD	OUTCOME (No. of item observed)
1. Traffic Lights	Availability: Yes [] No [] Functioning: Yes [] No [] Adherence by motorists: Yes [] No []	
2. Road signs & markings	Availability: Yes [] No [] Condition: Good [] Fair [] Poor [] Adherence by motorists: Yes [] No []	
3. Riders	Wearing of crash helmet: Yes [] No [] Wearing but not proper: Yes [] No [] Overloading: Yes [] No [] Over speeding: Yes [] No []	
4. Riders with passengers	Rider & passenger wearing what?: Yes [] No [] Rider wearing but not passenger: Yes [] No [] No. of passengers taken: 1 [] 2 [] 3 []	
5. Crashed motorcycles	Place parked: Good [] Poor [] Environmental hazard: Yes [] No []	
6. Pedestrians	Adherence to road safety measures: Yes [] No [] Cross at traffic lights & zebra crossing :Yes [] No [] Assistance to children crossing: Yes [] No [] Assistance to aged crossing: Yes [] No [] Adherence to disabled crossing: Yes [] No []	

APPENDIX 4

QUESTIONNAIRE RESULTS ON ROAD SIGNS

No.	Road Sign	Meaning	Results			
			Correct	Percentage (%)	Wrong	Percentage (%)
1		No left Turning	84	84%	16	16%
2		No U*-Turn	91	91%	9	9%
3		Stopping	90	90%	10	10%
4		Roundabout	90	90%	10	10%
5		Bicycle Crossing	26	26%	74	74%
6		Traffic Light Ahead	91	91%	9	9%
7		No Parking	78	78%	22	22%
8		Animals Crossing	78	78%	22	22%
9		End of Narrow Road	42	42%	58	58%

APPENDIX 5

Causes of Motorcycle Crashes in the Bolgatanga Municipality as Indicated by

Stakeholder Organisation.

Causes of motorcycle crashes/accidents	Weighted Average	Interpretation of Result	Rank
Lack of formal motorcycle riding training	0.97	Extremely High	1 st

Inexperience on the part of motorcyclists	0.92	Extremely High	2 nd
Over-speeding	0.91	Extremely High	3 rd
Rampant violation of road traffic regulations	0.88	Extremely High	4 th
Driving under the influence of alcohol and drugs	0.87	Extremely High	5 th
Ignorance of road safety measures by road users	0.84	Extremely High	6 th
Over-loading	0.71	Very High	7 th
Unrestrained animals carts	0.68	Very High	8 th
Poor road conditions	0.32	Low	9 th
Animal crossing (Cow, pigs, goats)	0.31	Low	10 th
Irregular functioning of traffic lights	0.30	Low	11 th
Mechanical Defects	0.27	Low	12 th
Tyre defect	0.25	Low	13 th
Traffic congestion on market days	0.23	Low	14 th
Weak law enforcement	0.19	Extremely Low	15 th
Poor weather condition	0.09	Extremely Low	16 th
Dangerous Checkpoints	0.07	Extremely Low	17 th
Smoke emission from other vehicles	0.06	Extremely Low	18 th
Ineffective collaboration among key stakeholders such as DVLA, MTTU, City authorities, etc.	0.4	Extremely Low	19 th
Oil spillage on the road	0.01	Extremely Low	20 th

Source: Field Data, 2015

APPENDIX 6

Causes of Motorcycle Crashes as Indicated by Sampled Motorcyclist

Causes of motorcycle crashes	Weighted Average	Interpretation	Rank
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Over-speeding	0.96	Extremely High	1 st
Driving under the influence of alcohol and drugs	0.94	Extremely High	2 nd
Irregular functioning of traffic lights	0.93	Extremely High	3 rd
Weak Law enforcement	0.91	Extremely High	4 th
Lack of formal motorcycle riding Ctraining	0.87	Extremely High	5 th
Rampant violation of road traffic regulations	0.84	Extremely High	6 th
Ignorance of road users	0.83	Extremely High	7 th
Inexperience on the part of motorcyclists	0.81	Extremely High	8 th
Over-loading	0.77	Very High	9 th
Poor road conditions	0.42	Very Low	10 th
Animal crossing(Cow, pigs, goats)	0.39	Very Low	11 th
Unrestrained animals carts	0.39	Very Low	11 th
Dangerous Checkpoints	0.32	Low	12 th
Mechanical Defects	0.21	Extremely Low	13 th
Tyre defect	0.19	Extremely Low	14 th
Smoke emission from other vehicles	0.16	Extremely Low	15 th
Poor weather condition(Heavy rains)	0.11	Extremely Low	16 th
Traffic congestion on market days	0.10	Extremely Low	17 th
Ineffective collaboration among key stakeholders	0.09	Extremely Low	18 th
Oil spillage on the road	0.05	Extremely Low	19 th

Source: Field Data, 2015

APPENDIX 7

The Number of Registered Motorcycles from the period 2010-2013

YEAR	NUMBER OF REGISTERED MOTORCYCLES
2010	10070

2011	8544
2012	10179
2013	6512
TOTAL	35305

Source: DVLA, 2015

