Factors determining level of injury severity among motorcycle crash victims attending Thika level 5 hospital, Kiambu county, 2013

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

Signature……..... Date……

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This thesis has been submitted for examination with our approval as University supervisors.

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DEDICATION

I am grateful to God for grace to carry out this research. I dedicate this work to my husband Patrick and our children Ryan and Tiffany without whose support I would not have succeeded. May God bless you.

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ABBREVIATIONS AND ACRONYMS

AIS Abbreviated Injury Scale

AP Anatomical Profile

APACHE Acute Physiology and Chronic Health Evaluation Scale

CRAMS Circulation, Respiration, Abdominal/Thoracic, Motor and Speech Scale

DALY Disability Adjusted Life Years

DFT Department For Transport, United Kingdom

ERSAP European Road Safety Action Program

ETSC European Transport Safety Council

FELTP Field Epidemiology and Lab Training Program

GCS Glasgow Coma Scale

GDP Gross Domestic Product

GNP Gross National Product

GNRSC Ghana National Road Safety Commission

HIV/AIDS Human Immune deficiency Virus/ Acquired Immune Syndrome

ISS Injury Severity Score

ITROMID Institute of Tropical Medicine and Infectious Diseases

JKUAT Jomo Kenyatta University of Agriculture and Technology

KEMRI Kenya Medical Research Institute

MOPHS	Ministry Of Public Health and Sanitation, Kenya
NHTSA	National Highway Traffic Safety Administration, United States
NRSC	National Road Safety Commission, Kenya
OR	Odds Ratio
RTI	Road Traffic Injuries
RTS	Revised Trauma Score
UK	United Kingdom
WHO	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Fair weather	Atmospheric condition when it is not raining or foggy
Good road condition	A road with no potholes and has an even surface
Guardian	Parent, caregiver or the legally authorized representative of the motorcycle crash victim
Head injury	Damage to structures of the head as a result of trauma
Highway	Any tarmac road where the speed limit for passenger service vehicles is 80 km/hr
Level 5 hospital	A regional hospital with medical specialists and serves as a referral institution for the region
Mild injury	Injury with injury severity score of less than or equals 8
Moderate injury	Injury with an injury severity score of 9 to 15
Motorcycle	A two wheeled motorized vehicle
Motorcycle crash	A fatal or non-fatal injury caused by collisions involving at least one moving motorcycle
Motorcycle rider	A person driving a two wheeled motorized vehicle
Motorcycle passenger	A person driven on a two wheeled motorized vehicle
Night time	Time of day between 6 pm and 6 am
Rural/feeder road	Road which connects/leads to a highway
Severe injury	Injury with an injury severity score of 15 to 75

ABSTRACT

According to the World Health Organization Global status report on road safety 2013, road traffic injuries caused an estimated 1.24 million deaths worldwide every year. Half of these deaths and injuries occur among vulnerable road users, namely motorcyclists (23%), pedestrians (22%) and cyclists (5%). In 2009 there were 3,760 road deaths reported in Kenya, with 34.4 deaths/100,000 persons of whom 9% were riders of motorcycles. Motorcycles are rapidly becoming a major means of public transport and cause of severe injuries and deaths in Kenya. This cross-sectional study sought to determine the factors determining level of severity of motorcycle injuries among patients attending Thika level 5 hospital, Kenya. Three hundred and twelve motorcycle crash victims were recruited into the study. Epidemiological and clinical information was collected using semi structured, interviewer administered questionnaires and from patient medical charts. The mean age of the motorcycle crash victims was 31.6 years (range 3-72 years). Seventy six percent (238) of the crash victims were aged between 20-49 years and 77.2% (241) were male. Motorcycle riders comprised 94(30%) of the motorcycle crash victims. Twenty three percent (71) of the motorcycle crash victims had moderate or severe injury with seventy seven percent (241) sustaining mild injury. On multivariate logistic regression, those who had reflective jackets on (aOR=0.4, P=0.04) and those who were on motorcycles that had their headlights on (aOR-0.52. P=0.03) were less likely to sustain moderate/severe injuries. Analysis of factors associated with severe injuries can form a basis for policies and regulations aimed at promoting safer road practices for motorcycle users.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

An injury is a bodily lesion at the organic level, resulting from acute exposure to energy (mechanical, thermal, electrical, chemical or radiant) in amounts that exceed the threshold of physiological tolerance. Other types of injuries include drowning, strangulation and freezing which result from insufficiency of a vital element (Baker, Neill, Ginsburg & Li, 1992).

A road traffic injury (RTI) is a fatal or non-fatal injury incurred as a result of a collision on a public road involving at least one moving vehicle. Road traffic injuries are an important cause of morbidity and mortality worldwide, especially in low and middle-income countries. Globally RTIs are ranked 9th among the leading causes of disability adjusted life years (DALYs) lost and is expected to be the 3rd cause of lost DALY by 2020 (World Health Organisation, 2002; 2009).

According to the World Health Organization Global status report on road safety 2013, road traffic injuries caused an estimated 1.24 million deaths worldwide every year, and another 20-50 million sustain a form of minor to major road traffic injury. Half of these deaths and injuries occur among vulnerable road users, namely motorcyclists (23%), pedestrians (22%) and cyclists (5%). Ninety percent of the RTIs occurred in low and middle income countries (WHO, 2002). The African region has the highest road fatality rates, (24.1 deaths per 100,000 population), well above the global average of 18.0 deaths per 100,000, in spite of the region being the least motorized (2% of the world's vehicles) of the six world regions (WHO, 2013).

According to the U.S. Department of Transportation one is "over 30 times more likely to die" in a motorcycle accident than a car accident – and five times more

likely to become injured while riding a motorcycle than while driving a car (National Highway Traffic Safety Administration, 2011).

In developing countries, motorcycles are increasingly the most common form of motor transport with an average annual growth rate of 11% in countries like Indonesia (Wedagama & Dissayake, 2010), but little is being done to make their use safer. Some of the factors that increase the risk of motorcycle crashes, injuries and fatality are lack of certified driver training and valid licensing, speed and reckless driving, poor regulation and law enforcement, non helmet use by riders and their passengers, non use of conspicuity measures (wearing of reflectors, day time headlights), overloading and possible use of alcohol and drugs (Odero, Khayesi & Heda, 2003).

Motorcycles were introduced in Kenya in the 1960s when they were commonly used to ferry goods and people across the Kenya-Uganda border, giving them the nickname "boda boda" which means from one border to the other. The popularity of the motorcycle has fast spread through Africa mainly due to its lower cost compared with an automobile. Motorcycles can also more easily traverse and manoeuvre over all types of roads. Taxi stands in Kenya's largest cities, Nairobi and Mombasa, now host scores of motorcycle taxi riders. A significant number of people prefer the use of motorcycles since one could manoeuvre easily through heavy traffic; however rider safety is lacking, in that most of them ride without wearing helmets, especially when riding within the cities and towns (Duku, 2010). There has been a fivefold increase in motorcycle deaths reported by police; from 33 in 2004 to 152 in 2008 (Odero, 2009).

According to an economic survey in Nairobi, the number of registered motorcycles increased from 16,293 in 2007 to 125,058 in 2013 representing an over 600 percent rise in six years (Kenya National Bureau of Statistics, 2014).

This abrupt increase in motorcycles is due to the fact that importers have drastically lowered prices and the government waived the import duty. Purchase prices and maintenance costs have fallen as much as 50 percent in the last five years. For as little as 45,000 shillings ($556 USD), one can purchase a brand new motorcycle (Dorah, 2010).

1.2 Problem Statement

Kenya is facing challenges of a complex epidemiological transition marked by persisting infectious diseases and a rising burden of non-communicable diseases (WHO, 2009). Acute respiratory tract infections, HIV/AIDS, malaria and pulmonary tuberculosis in adults continue to be major public health problems. However, non-communicable conditions such as cardiovascular diseases, cancer, diabetes and injuries are emerging as important public health problems (WHO, 2009).

Injuries and particularly those arising from motorcycle crashes are still not appreciated as a public health problem by many health professionals and public policy experts and there are general perceptions that motorcycle crashes are not a health sector concern, but rather a police or transport sector issue. Further, in the absence of reliable national epidemiological and economic data for injuries, there is limited understanding of the magnitude of the problem (Nantulya & Reich, 2002).

Kenya has one of the highest road fatality rates in Africa at 68 deaths per 10,000 registered vehicles (Odero *et al*., 2003) with 1% of road traffic accident victims in Kenya being riders of motorcycles (WHO, 2009). A study done in Thika level 5 Hospital showed that 18% of RTI victims were motorcyclists and eighty percent of the vulnerable road users sustained head injuries (Osoro, Ng'ang'a, Oundo, Omolo & Luman, 2011).

The occurrence and health impact of motorcycle injuries in Kenya has not been adequately addressed, just like in many developing countries. No surveillance

systems are in place and this has led to lack of awareness about the magnitude of the problem because of under reporting and the information is often scanty and unreliable.

Research on motorcycle crashes and injuries in Kenya is scarce and inconsistent with the size of the problem. A motorcycle injuries surveillance system is lacking in Kenya and most publications are based on police data or medical records which are not standardized and are often incomplete affecting the validity and generalization of the reports.

1.3 Justification

In a systematic approach to public health problems, initial steps involve identifying the magnitude and the modifiable factors associated with the problem followed by appropriate strategies geared to address the modifiable factors (Peden, Scurfield & Sleet, 2004). Motorcycles are rapidly becoming a major means of public transport and cause of severe injuries and deaths in Kenya. Current road safety strategies do not effectively address this growing use of motorcycles for public transport and taxis.

This hospital based survey will provide accurate and detailed information on injury location, severity and associated factors. The results will provide local evidence to key policy makers in Kenya on motorcycle crash risk factors that can lead to improved policies and interventions to improve road safety for motorcyclists and minimize modifiable risk factors for injury severity.

1.4 Research Questions

1. What are the body locations of injuries sustained by motorcycle crash victims attending Thika Level 5 hospital?

2. What is the level of severity of injuries sustained by motorcycle crash victims attending Thika Level 5 hospital?

3. What are the factors that determine level of injury severity among motorcycle crash victims attending Thika Level 5 hospital?

1.5 Objectives

1.5.1 General Objective

To determine the factors determining level of severity of motorcycle injuries among patients attending Thika level 5 hospital, Kiambu County 2013.

1.5.2 Specific Objectives

1. To describe the body locations of injuries sustained by motorcycle crash victims attending Thika Level 5 hospital.

2. To determine the level of severity using anatomical scoring system, of injuries sustained by motorcycle crash victims attending Thika Level 5 hospital.

3. To determine factors associated with injury severity among motorcycle crash victims attending Thika Level 5 hospital.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Burden of Motorcycle Injuries

2.1.1 Global Burden of Motorcycle Injuries

Globally RTIs are ranked 9th among the leading causes of disability adjusted life years (DALYs) lost and is expected to be the 3rd cause of lost DALY by 2020 (WHO, 2002; 2009). According to the World Health Organization Global status report on road safety 2013, road traffic injuries caused an estimated 1.24 million deaths worldwide every year, and another 20-50 million sustain a form of minor to major road traffic injury. Half of these deaths and injuries occur among vulnerable road users, namely motorcyclists (23%), pedestrians (22%) and cyclists (5%). Ninety percent of the RTIs occurred in low and middle income countries (WHO, 2002). The African region has the highest road fatality rates, (24.1 deaths per 100,000 population), well above the global average of 18.0 deaths per 100,000, in spite of the region being the least motorized (2% of the world's vehicles) of the six world regions (WHO, 2013).

Motorcycle injuries are an important cause of disability and deaths and the main victims are the motorcyclists and passengers in their young reproductive age group (Peden *et al*., 2004; Solagberu *et al.*, 2006). The problem is increasing at a fast rate in developing countries due to rapid motorization and other factors (Galukande, VonSchreeb & Wladis, 2010). Of all road traffic accident victims in Malaysia in 2012, approximately 70 % involved motorcyclists and motorcyclist related fatalities accounted for 60 % of all road fatalities. Of those who died, 58.7 % involved the motorcycle riders and passengers (Rahman, Baharuddin & Mohamad, 2015). In 1998, in Britain, motorcycle riders accounted for less than 1% of total road users but

contributed to 15% of those killed or seriously injured on the roads (Department for Transport, UK, 1998).

Motorcycle users are vulnerable on the road and represent an important group to target for reducing road traffic injuries (Solagberu *et al.*, 2006). Even in developed countries with low morbidity and mortality rates from motorcycle injuries, the risk of dying from a motorcycle crash is 20 times higher than from a motor vehicle crash (Peden *et al*., 2004; Solagberu *et al.*, 2006).

2.1.2 Burden of Motorcycle Injuries in Africa

Nigeria has the highest road injury death rate (52.4 per 100,000 people) of any country globally while Mozambique has the third highest death rate (46.7 per 100,000). These rates are more than 15 times the death rates in Sweden, UK, and the Netherlands, which have among the lowest death rates globally (Bhalla *et al.*, 2013). Motorcyclists constituted 67% of all road crash injury victims in a study at a Nigerian referral hospital (Adoga & Ozoilo 2014). In Tanzania, injuries related to motorcycles contribute significantly to the number of road traffic injuries and a study done in Mwanza city found that motorcycle traffic injuries accounted for 37.2% of all traffic injuries (Phillipo *et al*., 2010).

Kenya has a road fatality rate of 68 deaths per 10,000 registered vehicles and between 45-60% of admissions to surgical wards in public hospitals are as a result of road traffic injuries (Odero *et al*., 2003). The only nationally available RTI data in Kenya are collected by the police who attend to road traffic crashes. However, some road crashes are not reported to the police. The injuries related to motorcycles contribute significantly to the number of road traffic injuries in Kenya, taking out significant resources including consumables and health worker time.

There has been a fivefold increase in motorcycle deaths in Kenya reported by police; from 33 in 2004 to 152 in 2008 (Odero, 2009). In 2009 road deaths reported were

3760, with 34.4 deaths/100,000 people with 9% being riders of motorcycles (WHO, 2009). A study done in a district hospital in Thika showed that 18% of RTI victims were motorcyclists and 80% of the vulnerable road users sustained head injuries (Osoro *et al.*, 2011).

2.1.3 Health Impact of Motorcycle Injuries

Motorcycles are one of the most dangerous forms of motorized transportation (Branas & Knudson, 2001). Due to the small size of their vehicles, motorcycle riders represent a vulnerable group of road users. Pedestrians and motorcyclists suffer the most severe injuries as a result of motor vehicle collisions, report more continuing medical problems and require more assistance, compared with other types of road user (European Road Safety Action Programme, 2003).

Motorcyclists were about 26 times more likely than passenger car occupants to die in a crash per vehicle mile travelled in 2013 and five times more likely to be injured, according to the American Department for Transport. The fatality rate per registered vehicle for motorcyclists in 2013 was six times the fatality rate for passenger car occupants (National Highway Traffic Safety Administration, 2013).

Contrary to a car crash, in a motorcycle crash, the riders often absorb all kinetic and compressive energy resulting from the crash (Janmohammadi, Pourhossein & Hashemi, 2009). In addition to this, some studies have noted that riders often do not practise safety measures, making them more vulnerable to accidents (Rahman *et al.*, 2015; Okeniyi *et al.*, 2005).

In a recent study, 80.4% of those attending an accident and emergency unit following a road traffic crash reported not having fully recovered with 13.4% of them reporting deterioration in health status (Hoang *et al.*, 2011). Reports of continuing physical problems one year on, largely musculoskeletal in nature, have

been found to be considerably more common than would be expected from the nature of injuries sustained (European Transport Safety Council, 1993).

In Kenya, 45-60% of admissions to surgical wards were due to RTIs (Odero *et al.*, 2003). Eighty percent of vulnerable road users admitted in Thika Level 5 hospital in 2009 were found to have sustained head injuries (Osoro *et al*., 2011).

2.1.4 Economic Impact of Motorcycle Injuries

The annual costs of road traffic crashes in low and middle-income countries are estimated to be between US$65-100 billion, more than the total annual amount received in development aid (United Nations, 2013). The estimated costs as a percentage of the Gross National Product (GNP) in most African countries range from 0.8% in Ethiopia and 1% in South Africa to 2.3% in Zambia and 2.7% in Botswana to almost 5% in Kenya (Odero, 2009) In 2007, the National Road Safety Commission of Ghana estimated road traffic accidents to cost 1.6% of Gross Domestic Product (GDP) which translated to US$ 165 million. However, the contribution of the various vehicles including motorcycle was not indicated in the report. The report also noted that motorcycle accidents accounted for 4% of all road traffic accidents in the country (Ghana National Road Safety Commission, 2007).

In many low and middle-income countries and sometimes in high-income countries, the cost of prolonged care, loss of the primary breadwinner, funeral costs, and the loss of income due to disability can push a family into poverty (Ross, 1991; Wegman & Elsenaar, 1997). In a study in Thailand, it was found that families with low socio economic status are at a higher risk of becoming poorer after involvement of a family member in a road crash than those of high socioeconomic status (Phyu, Kunnawee & Piyapong, 2013).

2.1.5 Psychological Impact of Motorcycle Injuries

Majority of road crash adult survivors experience considerable psychological distress and disruption to their lives. Some suffer from post-traumatic stress disorder , driving phobias and related anxiety or affective disorders. A link has been documented between surviving a serious road traffic accident and poor mental health outcomes, especially post-traumatic stress disorder and major depressive disorder (Blanchard & Hickling, 2004). Compared to adolescents, the rate of post-traumatic stress disorder among adults tends to be higher, with as many as 39.2% of adults meeting criteria for current post-traumatic stress disorder (Blanchard & Hickling, 2004).

Epidemiological data from the National Comorbidity Survey Replication Adolescent Supplement suggests that approximately 13% of adolescents who report surviving a road traffic accident meet lifetime criteria for post-traumatic stress disorder (McLaughlin *et al.*, 2013). Having a road traffic accident among older adolescents, was associated with alcohol abuse (Williams, Rheingold, Knowlton, Saunders & Kilpatrick, 2015).

2.2 Factors Associated with Motorcycle Injuries

Motorcyclists face a number of risk factors that do not affect car drivers. The main risk factors are decreased stability and a much lower level of occupant protection than is provided by a car. In addition, a motorcycle is less visible to other road users than a car or a truck. These factors together give motorcycling a higher level of risk per kilometre travelled than other modes of transport (New Zealand Motorcycle Crash Fact Sheet, 2014).

Some of the factors that increase the risk of motorcycle crashes, injuries and fatality are lack of certified driver training and valid licensing, speed and reckless driving, poor regulation and law enforcement, non helmet use by riders and their passengers,

non use of conspicuity measures (wearing of reflectors, day time headlights), overloading and possible use of alcohol and drugs (Odero *et al.*, 2003).

A study in the UK based on regression models to assess the influence of the environment on the occurrence of child pedestrian and cyclist casualties established that road layout, traffic volumes, and other engineering and safety factors have a significant impact on accident and casualty risk (Petch & Henson, 2000).

2.2.1 Number of Motorcycles and Motorcycle Crashes in Kenya

The rising number of motor vehicles in poor countries is an important reason for the increase in fatalities and injuries from traffic crashes in these countries (Peden *et al*., 2004). Economic growth is associated with expanded mobility and increased demand for transportation services although the road infrastructure often lags behind. The popularity of the motorcycle has fast spread through Africa mainly due to its lower cost compared with an automobile. Motorcycles can also more easily traverse and manoeuvre over all types of roads. Registered motorcycles in Kenya have increased by over 600 percent rise in six years (Kenya National Bureau of Statistics, 2014). Consequently, there has been increase in motorcycle deaths reported in Kenya (WHO, 2013).

2.2.2 Motorcycle Rider Training and Motorcycle Crashes

The lack of experience and training of many motorcycle riders has been cited as a potential cause of motorcycle crashes (Winn, 1987). A study carried out in Kakamega County found that motorcycle taxi operators who had not received road safety training were at higher risk of involvement in motorcycle crashes (Luchidio, Kahuthia-Gathu & Gatebe, 2013). Training of motorcycle riders has therefore been suggested as an important countermeasure for reducing both the number of crashes and the severity of injury (Vis, 1995; Noordzij, Forke & Brendicke, 2001). Riders need to learn how to ride a motorcycle but there is conflicting evidence about the

right type of training. The findings suggest that mandatory pre-license training may be an impediment to completing a motorcycle licensing process, possibly indirectly reducing crashes through a reduction in exposure. However, it is not clear if training (or what type) reduces the risk of crashes, injuries or offences in motorcyclists, and a best rider training practice can therefore not be recommended (Rebecca, 2011).

2.2.3 Motorcycle Helmet Use and Motorcycle Injuries

Motorcycle helmets provide the best protection from head injury for motorcyclists involved in traffic crashes. Wearing a helmet lowers a motorcycle rider's risk of traumatic brain injury by 67 % (NHTSA, 1996). Studies indicate that wearing helmets reduces fatalities by more than 25% (Baker *et al*., 1992; Offner, Rivera & Maier, 1992; Rutledge & Stutts, 1993). A study done in the United States found that non-helmeted motorcyclists involved in crashes were over three times more likely to die than were helmet users (Braddock, Schwartz, Lapidus, Banco & Jacobs, 1992). Over the past three decades the use of motorcycle safety helmets has become more common in many countries throughout the world. There are few studies in Kenya on use of motorcycle helmets and factors associated with their use. One study showed the prevalence of helmet use among motorcycle riders in Nairobi, Kenya to be 46% (Ngunu, Obonyo & Oketch, 2011).

2.2.4 Motorcycle Conspicuity and Motorcycle Injuries

Low motorcycle conspicuity and consequently the inability of the motorcyclist to be seen by other road users, has been identified as an important factor associated with risk of motorcycle crashes (Haque, Chin & Debnath, 2012). This may result from several factors, including size of motorcycle, irregular outline, low luminance or contrast with the background environment, and the ability to travel in unexpected places in the traffic stream. Inexpensive measures can potentially enhance conspicuity for example, adding a light source and the use of light, bright, reflective,

or fluorescent colours (Vaughn, 1977). Bright colours worn by motorcyclists during the day, daytime use of headlight, and reflective or fluorescent clothing are thought to enhance conspicuity by increasing the brightness contrast between the surface or object it is on and the background environment (Hurt, Ouellet & Thom, 1981; Bragg, Dawson & Jonah, 1980). Wearing reflective or fluorescent clothing and white or light coloured helmets and using headlights during daytime could reduce serious injuries or death from motorcycle crashes by up to one third. Voluntary use of headlight during daytime is associated with a 27% lower risk of crash related injury and the population attributable risk associated with not wearing fluorescent or reflective clothing is approximately 33% (Wells *et al*., 2004).

2.2.5 Geographic Factors Associated with Motorcycle Injuries

Urban and rural areas experience different patterns of motorcycle accidents. In 2010, there were 30,196 fatal crashes resulting in 32,885 deaths. Rural areas accounted for 54 percent (16,292) of these crashes and 55 percent (18,026) of the deaths as compared to urban areas which accounted for 45 percent (13,608) of the crashes and 44 percent (14,546) of the fatalities (National Highway Traffic Safety Administration, 2011). The severity of these accidents tends to vary with the kinds of hazards encountered, and the impact speed of the vehicles involved. While the rural accident involvement rate (per 100 million km ridden) was 38% lower than for urban roads in Britain in 2005, the motorcycle user fatality rate was three times higher on rural roads (Department for transport, 2006). In another study, the adjusted odds ratio (OR) of rural to urban roads having a greater level of injury severity was 1.64 (Lin, Chang, Huang, Hwang & Pai, 2003).In rural areas a significant proportion of motorcycles are involved in single vehicle accidents with speed and lack of rider skill playing a major role (DFT, 2006). Intersections and junctions are the most likely place for motorcycle accidents and contribute to 66% of motorcycle crashes (DFT, 2006). Roadway defects like ridges and potholes have also been found to contribute to 2% of motorcycle accidents (Hurt *et al*., 1981).

2.2.6 Relationship Between Sex and Motorcycle Injuries

Motorcycle casualties in low and middle income countries are predominantly male. From a young age, males are more likely to be involved in road traffic crashes than females. More than three-quarters (77%) of all road traffic deaths occur among men. Men account for 91% of motorcyclist deaths and serious injuries and 89% of total motorcyclist casualties. (WHO 2013). Data collected by the NHTSA in United States between 1995 to 2004 also indicated that about 90 percent of the motorcycle riders killed were male. The number of female riders killed more than doubled in the ten years, but the proportion remained at about 10 percent (NHTSA, 2011).

2.2.7 Relationship Between Age and Motorcycle Injuries

The largest number of motorcycle rider fatalities per 100,000 population in the United States has been found to be in the 21 - 24 years age group, and persons 16 to 20 years old and 21 to 24 years old had the highest injury rate. Children 5 to 9 years old had the lowest fatality rate, and children under 5 years old had the lowest injury rate per 100,000 population (NHTSA, 2011). Other studies in United Kingdom have found that there are two peak age groups for motorcyclist casualties namely 16 - 20 years and 35 - 39 years (DFT, 2006). Increasing age has been found to be protective from motorcycle crashes (Lin *et al*., 2003).

2.2.8 Relationship Between Alcohol Use and Motorcycle Injuries

Alcohol is a significant contributor to crashes and injuries that affect all road users, including drivers, occupants, cyclists, and pedestrians (Lin *et al*., 2003). Almost half of the fatal motorcycle accidents in low and medium income countries show alcohol involvement (Hurt *et al*., 1981). Enforcement of legal limits on the blood alcohol concentration is effective in reducing motorcycle deaths (Lin & Kraus, 2009).

2.2.9 Evacuation of motorcycle crash victims

The prompt and safe evacuation of motorcycle crash victims to a health care facility is critical in management of injuries (Mock, Jurkovich, Nii-Amon-Kotei, Arreola-Risa & Maier, 1998). The evacuation of crash victims from the crash scene is mostly by a private vehicle in Kenya (Hazen & Ehiri, *2006*) and Uganda (Andrews, Kobusincye & Lett, 1999).

2.3 Measures of Severity of Motorcycle Crash Injury

Injury severity generally describes the impact of an injury in terms of the extent of tissue (that is the pathologic evidence of trauma) and/or the physiologic response of the body to that damage. The appropriate classification of injuries by type and severity is fundamental to the study of injury severity. Scales of categorizing injuries are grouped into two; scales which assess the patient's physiologic status, which may change over the duration of the injury's treatment period, and those which describe the injury in terms of its anatomical location, specific lesion and severity (Buckly, Gotschall & Robertson, 1994).

Anatomical scoring systems include the Abbreviated Injury Scale (AIS), Injury Severity Score (ISS) and the Anatomical Profile (AP). The physiological trauma severity scoring systems include the Glasgow Coma scale (GCS), the Trauma Score and Revised Trauma Score (RTS), the Circulation, respiration, Abdominal/Thoracic, Motor and Speech Scale (CRAMS) and the Acute Physiology and Chronic Health Evaluation (APACHE) scale (Mohammed, Totten & Terezakis, 1999).

The Glasgow Coma Scale (GCS) was published in 1974 and is widely used for the assessment of a patient's level of consciousness (Appendix 5). It provides a more accurate estimation of severity for patients with serious head injuries and enables reliable predictions of outcome. The Glasgow Coma Scale is scored between 3 and 15, 3 being the worst and 15 the best. A Glasgow Coma Scale of 13 or higher

correlates with a mild brain injury; 9 to 12, a moderate injury and 8 or less a severe brain injury (Sharma, 2005).

The Abbreviated Injury Scale (AIS) is a specialized trauma classification of injuries based mainly on anatomical descriptors of the tissue damage caused by the injury (Appendix 6). It was originally developed for use by multidisciplinary vehicular crash investigators in the 1970s as a standardized injury severity assessment tool (Sharma, 2005). The Abbreviated Injury Scale has two components; the first being the injury descriptor which is a unique numerical identifier for each injury description; and the second being the severity score. The severity score ranges from 1(relatively minor) to 6 (currently untreatable), and is assigned to each injury descriptor. The severity scores are consensus assessments assigned by a group of experts and implicitly based on four criteria: threat to life, permanent impairment, treatment period and energy dissipation (Yates, 1990). The ISS is the most widely used anatomical scoring system in the world and provides an overall score for patients with multiple injuries. The ISS is based on the AIS and the two measures have been used widely in trauma centers to predict the probability of death, urgency of treatment and use of resources (Rosman, Matthew & Anthony, 1996).

Calculation of ISS Score ; Each specific injury is assigned an Abbreviated Injury Scale (AIS) score and allocated to one of six body regions (head, face, chest, abdomen & pelvis, extremities , external) (Sharma, 2005). Only the highest AIS score in each body region is used. The three most severely injured body regions have their AIS score each squared and added together to produce the ISS. The ISS score takes values from 0 to 75. If an injury is assigned AIS score of 6 (unsurvivable injury), the ISS score is automatically assigned to 75. Injury severity is graded as severe, moderate or mild based on the Injury Severity Score (ISS). Severe injury is defined as an ISS > 15, moderate injury as an ISS from 9-15 and mild injury an ISS $\leq$ 8 (Saidi, 2003).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study Site

This study was carried out at Thika Level 5 Hospital located in Thika Sub county, Kiambu County, 45 km north-east of Nairobi. Thika Level 5 Hospital is a public regional referral hospital with a bed capacity of 265 beds (Figure 3.1). The Hospital is situated between two busy major highways; Nairobi-Nyeri and Nairobi-Garissa and attends to most of the road crash victims on these roads. Thika Sub county measures 1,960.2 square kilometers and borders Ruiru sub county to the south, Kiambu East Sub county to the west, Muranga County to the north and Machakos County to the east (NCAPD, 2005).

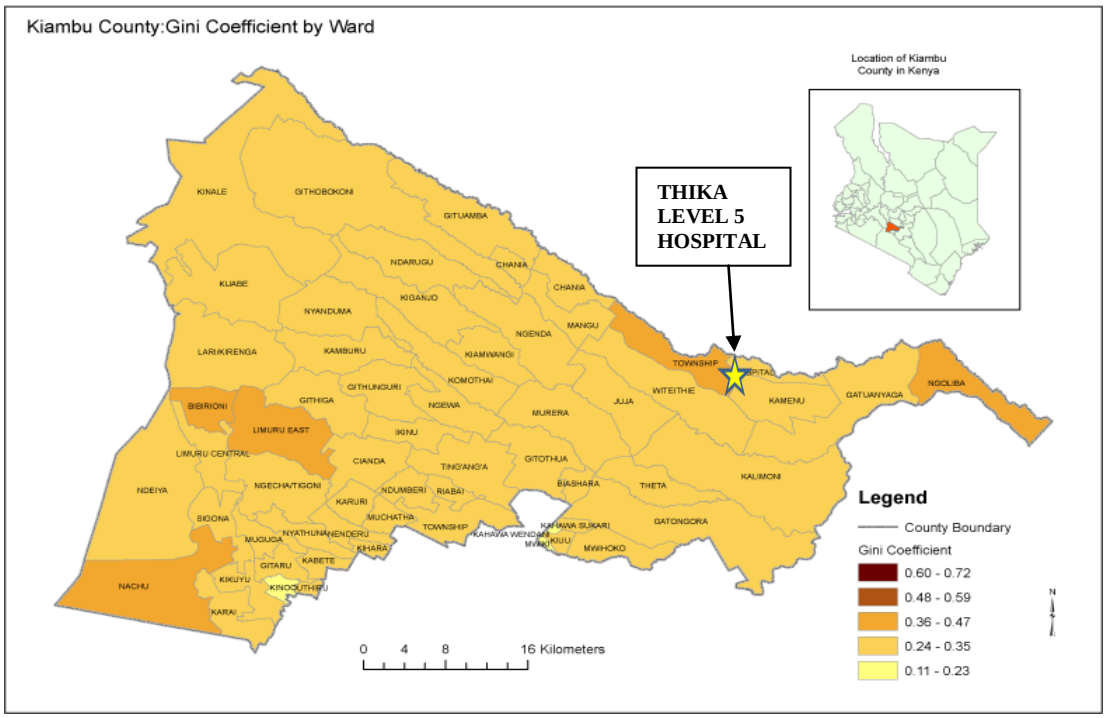

Figure 3.1 Map of Kiambu County showing location of Thika Level 5 Hospital

3.2 Study Design

This was a cross-sectional study to determine the factors determining level of severity of motorcycle injuries among patients attending Thika level 5 hospital, Kiambu County 2013.

3.3 Study Population

The study population consisted of patients injured in motorcycle crashes who presented for medical services to Thika Level 5 hospital in 2013.

3.4 Inclusion and Exclusion Criteria

3.4.1 Inclusion criteria

Any motorcycle crash victim presented for medical services at Thika level 5 hospital and who gave informed consent either by him/herself or by a guardian.

3.4.2 Exclusion criteria

Any motorcycle crash victim presented for medical services at Thika level 5 hospital and who did not consent either by him/herself or by a guardian and motorcycle crash victims who were declared dead before arrival at Thika level 5 hospital.

3.5 Sample Size Determination

The sample size for the study was determined using Cochran's formula (1963).

$n=z^2 *p*(1-p)/d^2$

n= minimum sample size

Assumptions considered:

z=value of the standard distribution corresponding to a significance level of alpha (1.96 for a 2 sided test at the 0.05 level)

p= 23.6% - proportion of severe injuries among motorcycle crash victims (Phillipo *et al.*, 2010)

d=absolute desired precision (5%) =0.05

q=1-p

$n=1.96^2*0.236*0.764/0.05^2$

n=277

A 10% non response rate was factored in, so final sample size was

277 + (277*10/100) = 305

Minimum sample size required was 305.

3.6 Sampling

A records desk review at the Thika Level 5 Hospital showed that the hospital attended on average to 100 motorcycle crash victims every month. To achieve the minimum sample size of 305 persons, all motorcycle crash victims presented to the hospital for treatment were consecutively recruited into the study. The recruitment sites were the outpatient and inpatient departments.

3.7 Data Collection Tools

3.7.1 Semi-structured questionnaire

A semi-structured questionnaire was used for data collection (Appendix 3). The questionnaire was interviewer administered and data was collected for all motorcycle

crash victims attended at the hospital. Pre-testing of the questionnaire to remove ambiguity and clarify response categories was carried out two weeks before the study began. Data collected included demographic, clinical and exposure variables. The independent variables were age, sex, education, marital status, helmet use, time of crash, road safety training, presence of driving license, reflective riding jacket use, use of headlights, alcohol use, weather conditions, road type, overloading and speed. The dependent variables were injury location and severity. Injury severity scoring and time of arrival were recorded from the medical charts and also through examination of the patients and review of patient tests. Data on exposure variables was obtained from the motorcycle crash victims, the police or the people who brought the motorcycle crash victim to hospital, where he/she was unable to give the information. Injury severity was coded by the principal investigator.

Informed consent/assent was obtained from the motorcycle crash victim or their guardians/attendants before enrollment. The patients were interviewed after they had received initial medical care.

3.7.2 Measurement of injury severity

Injury severity was measured based on the Injury Severity Score (ISS) which provided an overall score for patients with multiple injuries (Rosman *et al.*, 1996). Each specific injury was assigned an Abbreviated Injury Scale (AIS) score and allocated to one of six body regions (head, face , chest, abdomen, extremities and pelvis) (Sharma, 2005). Only the highest AIS score in each body region was used. The three most severely injured body regions had their AIS score each squared and added together to produce the ISS. The ISS score takes values from 0 to 75. If an injury was assigned AIS score of 6 (unsurvivable injury), the ISS score was automatically assigned to 75. Injury severity was graded as severe, moderate or mild based on the Injury Severity Score (ISS). Severe injury was defined as an ISS > 15, moderate injury as an ISS from 9-15 and mild injury an ISS $\leq$ 8 (Saidi, 2003).

3.8 Data Analysis

Data was validated, cleaned and analyzed using Epi- info version 7 statistical software. Univariate analysis of frequencies and proportions was carried out for descriptive statistics. Categorical variables were compared using Chi-square test and Fishers exact test. Continuous variables were compared using the Student t-test.

The motorcycle crash victims were divided into those with moderate/severe injury and those with mild injury for the analysis of factors associated with injury severity. The odds ratio (OR) was used as a measure of association with OR of more than 1 indicating risk and less than indicating it is protective. Confidence Interval of 95% was used to assess the variability and significance of the OR. Multivariate analysis was done by subjecting the significant factors from bivariate analysis to unconditional logistic regression. A variable with a P value of 0.05 or less was taken to be statistically significant.

3.9 Ethical Considerations

Only motorcycle crash victims presented for medical services at Thika level 5 hospital and who gave informed consent either by him/herself or by a guardian after having received emergency care and were recuperating were recruited into the study. The consent was obtained in written form. Confidentiality of the motorcycle crash victim was observed and no personal identifiers were used during the study.

Information obtained was stored in password protected computers at the principal investigators office. Only the principal investigator had the passwords and access to the data. There were no direct benefits to individuals who participated in the study. There were no risks for participating or any penalty for refusal to participate. Informed consent was obtained from the eligible participant or a responsible adult, attendant or guardian for motorcycle crash victims who were minors. In the case of a critically ill patient with no relative or guardian available at arrival to hospital, we

waited for the patient's condition to improve or for their relative or guardian to arrive and then sought informed consent. Informed assent was obtained from motorcycle crash victims who were less than 18 years of age (Appendix 4). There were no incentives or coercion to participate. The respondents were free to withdraw from the study if they changed their mind during the study. Study approval was sought from Jomo Kenyatta University of Agriculture and Technology and scientific and ethical clearance obtained from KEMRI Scientific Steering Committee and Ethics Review Board (Appendix 5).

3.10 Dissemination and application of results

The findings of this study were disseminated through a final report that was shared with the management of Thika Level 5 Hospital, policy makers and program managers from the Ministry of Public Health and Sanitation, Kenya Traffic Police and National Road Safety Council of Kenya. It was also published in the African Journal of Health Sciences, March 23, 2015, ISSN 2306-1987 Volume 28, No.1(Issue No.51). The results will lead to improved policies and interventions to improve road safety for motorcyclists and minimize risk factors for injury severity.

CHAPTER FOUR

4.0 RESULTS

4.1 Characteristics of motorcycle crash victims

4.1.1 Socio-demographic characteristics of motorcycle crash victims at Thika Level 5 Hospital

The demographic characteristics of the motorcycle crash victims enrolled and interviewed during the study period are presented in Table 4.1. Majority of the motorcycle crash victims were male (77.2%). The mean age of the motorcycle crash victims was 31.6 years (range 3-72 years) with 124 (40%) of them aged between 20-29 years. Thirty (10%) of the motorcycle crash victims were minors (< 18 years).

Most of the motorcycle crash victims were in some form of employment (83%), with those in informal employment constituting the highest percentage (45.2%). There was a higher percentage of women being unemployed (10%) than men (3%). The difference in proportions in occupation between males and females was statistically significant (χ^2=22.3, df=4, P=0.0002).

Ninety six percent of the motorcycle crash victims had obtained some level of formal education with majority having attained primary level of education (46.2%). The difference in levels of formal education between males and females was not statistically significant (χ^2 =0.5,df=3,P=0.9). Of the motorcycle crash victims, 190(60.9%) were married/cohabiting with the lowest percentage (1.3%) being those widowed.

Table 4.1 Demographic characteristics of motorcycle crash victims at Thika Level 5 Hospital in 2013

Characteristic	Female(n=71) No. (%)	Male(n=241) No. (%)	Total(n=312) No. (%)
Age in years, mean (S.D; Range)	30.2(15.2;3-72)	32(13.8;3-72)	31.6(14.1;3-72)
Age group(years)			
<20	9(12.7)	26(10.8)	35(11.2)
20-29	32(45.1)	92(38.2)	124(39.7)
30-39	16(22.5)	60(24.9)	76(24.4)
40-49	5(7)	33(13.7)	38(12.2)
>49	9(12.7)	30(12.4)	39(12.5)
Occupation			
Motorcycle taxi rider	3(4)	67(27.8)	70(22.4)
Formal Employment	11(15.5)	37(15.4)	48(15.4)
Informal Employment	38(53.5)	103(42.7)	141(45.2)
Student/child	12(16.9)	27(11.2)	39(12.5)
Unemployed	7(9.9)	7(2.9)	14(4.5)
Education			
Non-formal	3(4.2)	10(4.1)	13(4.2)
Primary	31(43.7)	113(46.9)	144(46.2)
Secondary	24(33.8)	82(34)	106(34)
Post-Secondary	13(18.3)	36(14.9)	49(15.7)
Marital Status			
Single	23(32.4)	88(36.5)	111(35.6)
Married/Cohabiting	42(59.2)	148(61.4)	190(60.9)
Separated/Divorced	2(2.8)	4(1.7)	6(1.9)
Widowed	4(5.6)	0(0)	4(1.3)

4.1.2 Category of road users among motorcycle crash victims

Most (46%) of the motorcycle crash victims were travelling as passengers at the time of the crash, pedestrians comprised 24% while the motorcycle riders comprised 30% (Figure 4.1)

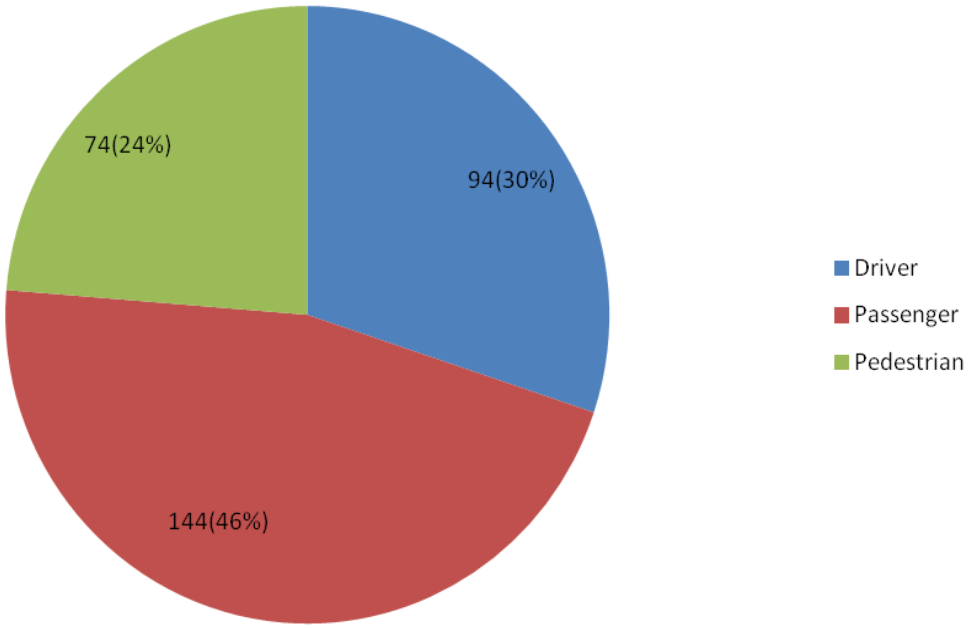

Figure 4.1 Road user category of motorcycle crash victims, Thika Level 5 Hospital, 2013

Motorcycle riders were compared to motorcycle passengers on some socio-demographic characteristics. The differences in proportions of sex and occupation between the riders and passengers were significant (Table 4.2). The mean age of riders was lower at 32.5 years compared to the passengers at 33.7 years. However the difference in means of age was not statistically significant (T statistic= -0.69, P=0.48).

Table 4.2 Demographic characteristics of motorcycle riders and passengers at Thika Level 5 Hospital in 2013

Characteristic	Riders(n=94) No. (%)	Passengers(n=144) No. (%)	P-value
Age in years, mean (S.D; Range)	32.5(10.7;16-59)	33.7(14.2;3-70)	0.48
Sex			
Male	90(95.7)	100(69.4)	
Female	4(4.3)	44(30.6)	**0.0001***
Occupation			
Motorcycle rider	61(64.9)	7(4.7)	
Formal Employment	12(12.8)	20(13.9)	
Informal Employment	6(6.4)	92(63.9)	
Students	9(4)	20(13.9)	
Unemployed	6(6.4)	5(3.5)	**0.0001***
Education			
Non formal	1(1.1)	5(3.5)	
Primary	47(50)	60(41.7)	
Secondary	34(36.2)	48(33.3)	
Post-secondary	12(12.8)	31(25)	0.19
Marital Status			
Single	30(31.9)	44(30.6)	
Married/Cohabiting	62(66)	95(66)	
Separated/Divorced	2(2.1)	2(1.4)	
Widowed	0	3(2.1)	0.5

*Significant P values

4.1.3 Use of protective gear by motorcycle crash victims

Self-reported data on the use of helmets indicated that 34% (n=82) of the motorcyclists were wearing helmets at the time of the crash. Eighty two (34%) of the motorcyclists had reflective jackets on and approximately a quarter (n= 62) of the motorcyclists were on a motorcycle that had its headlights on during the time of the crash. Only sixty seven (28%) of the motorcyclists were wearing the helmets and reflective jackets and were on a motorcycle that had its headlights on during the time of the crash.

4.1.4 Day of week and time of day of motorcycle crash

Majority (73%) of the motorcycle crash victims were involved in a motorcycle crash between Monday and Friday with the days recording the highest number of crashes being Monday (18%) and Friday (16%) (Figure 4.2). Involvement in a motorcycle crash during the weekend was not found to be significantly associated with level of injury severity (cOR=1.48 P=0.09).

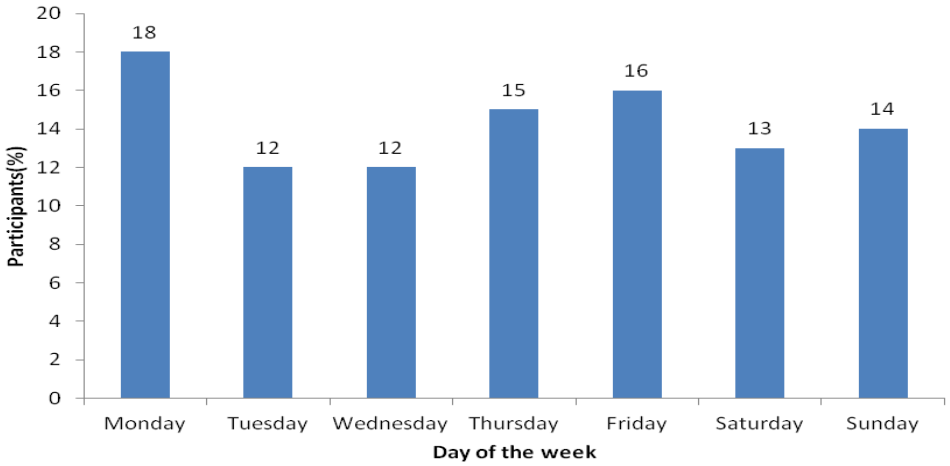

Figure 4.2 Day of the week when patients attending Thika Level 5 Hospital were involved in a motorcycle crash, Thika, 2013

Figure 4.3 shows the time of day when the motorcycle crash occurred. Majority (69%) of the motorcycle crash victims were involved in a motorcycle crash in the afternoon or evening, 23% were involved in the morning while 9% were involved in the early morning. Involvement in a motorcycle crash in the evening was not found to be significantly associated with level of injury severity (cOR=0.66 P=0.12).

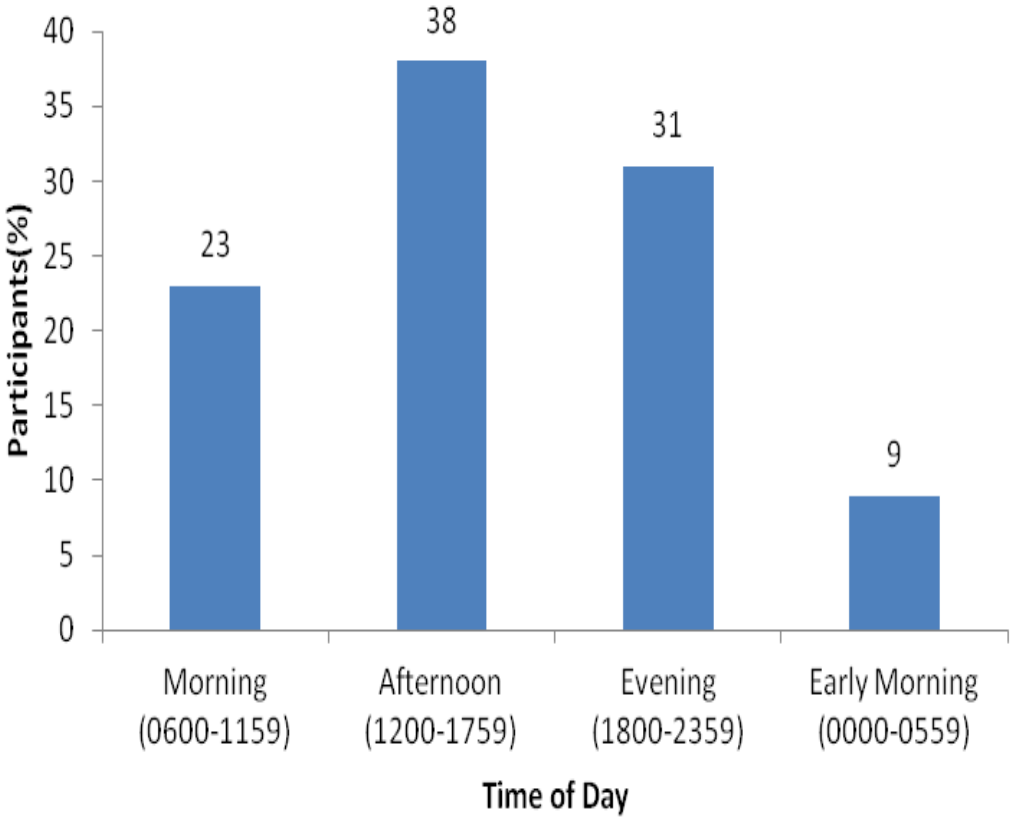

Figure 4.3 Time of day when patients attending Thika Level 5 Hospital were involved in motorcycle crash, Thika 2013

4.1.5 Suspected alcohol and other drug use among motorcycle crash victims

Among all the motorcycle crash victims, 33(11%) reported use of alcohol and 22(7%) reported use of other drugs six hours prior to the accident. Twenty nine (31%) of the motorcycle riders reported use of alcohol or drugs six hours prior to the accident while 15% and 7% of the passengers and pedestrians respectively reported use of alcohol or drugs six hours prior to the accident. Blood alcohol level and toxicology screen was not carried out to establish actual levels.

4.1.6 Characteristics of the motorcycle crashes

Approximately half (152) of the motorcycle crash victims were involved in the motorcycle crashes while on urban roads in residential areas. Twenty two percent of the crashes occurred while on a highway and 27% on rural roads. The commonest types of collision were: the motorcycle was run off the road by other vehicles (24%), head on collision (14%) and hit a pedestrian (14%). Ninety percent of the collisions occurred on a dry road with 13(4%) occurring on sections of the road where road works were ongoing. The road crash victims reported weather conditions as good in 87% of the motorcycle crash cases.

Slightly over half (52%) of the motorcycle crash victims were involved in a crash on a straight and flat section of the road, with 17% crashes occurring at a corner junction (Figure 4.4). Thirty three percent (104) of the crashes occurred on a damaged or potholed section of the road.

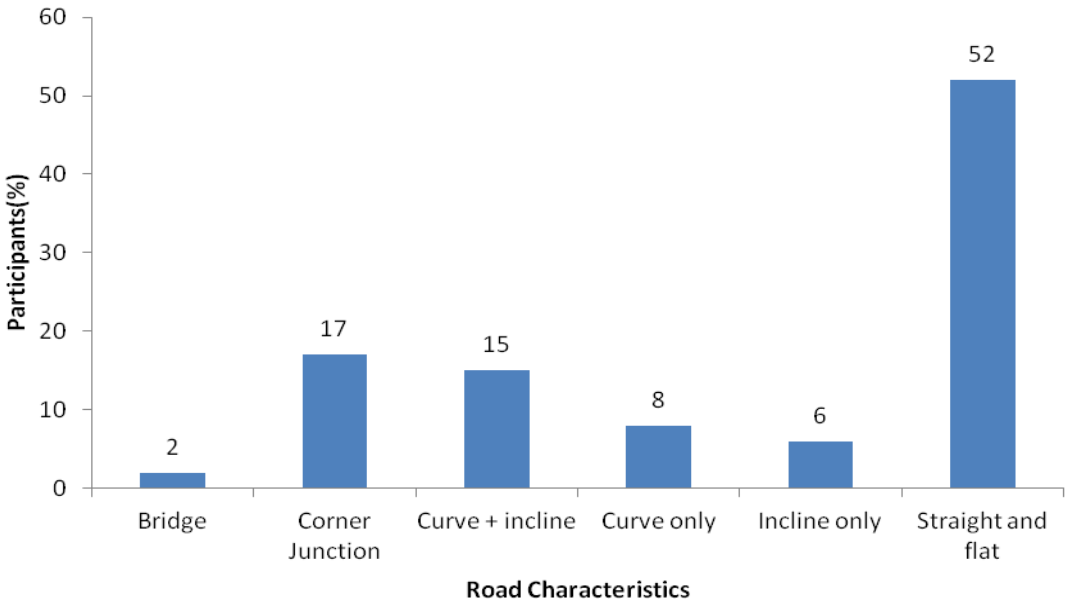

Figure 4.4 Road characteristic where motorcycle crash occurred

4.1.7 Evacuation and disposition of motorcycle crash victims

Evacuation of the injured to hospital was by cabs or other private vehicle (54%), self (39%), ambulance (5%) and police vehicle (2%). Sixty three (20%) of all motorcycle crash victims were admitted following the injuries sustained with six (2%) of them dying at the hospital.

4.2 Injuries sustained by motorcycle crash victims

4.2.1 Pattern of injuries by body region

Most of the injuries sustained by the motorcycle crash victims were to the extremities (203) and head and neck region (122). Table 4.3 summarizes the injuries sustained by the motorcycle crash victims according to body region using the AIS scoring system.

Table 4.3 Injuries sustained by body region of motorcycle crash victims atThika Level 5 Hospital, 2013

Body region injured*	Severity	Riders	Passengers	Pedestrians	Total
Head or neck	Minor	11	36	17	64
	Moderate	21	12	11	44
	Serious	5	4	3	12
	Severe	2	0	0	2
Extremities/Pelvic girdle	Minor	21	28	13	62
	Moderate	25	53	22	100
	Serious	14	11	13	38
	Severe	0	2	1	3
External	Minor	13	34	19	66
	Moderate	11	18	8	37
	Serious	0	1	0	1
	Severe	0	1	0	1
Face	Minor	18	41	19	78
	Moderate	23	10	3	36
	Serious	0	1	1	2
	Severe	0	0	0	0
Chest	Minor	14	25	11	50
	Moderate	1	8	4	13
	Serious	0	3	0	3
	Severe	0	0	0	0
Abdomen/Pelvic contents	Minor	3	12	6	21
	Moderate	1	1	6	8
	Serious	1	1	1	3
	Severe	0	0	0	0

*Not mutually exclusive

4.2.2 Severity of injury

Seventy seven percent of the motorcycle crash victims sustained mild injury with 17% sustaining moderate injuries. Most of the severe injuries occurred among riders (7%) (Table 4.4).

Table 4.4 Assessment of severity of injury using the Injury Severity Score among victims of motorcycle crashes at Thika Level 5 Hospital, 2013

Injury Severity Score	Riders No. (%)	Passengers No. (%)	Pedestrians No. (%)	Total
1-8	70(75)	117(81)	54(73)	241(77)
>8-15	17(18)	20(14)	16(22)	53(17)
>15	7(7)	7(5)	4(5)	18(6)

4.3 Factors associated with level of injury severity

The severity of injury was not significantly associated with the motorcycle crash victim ' sex, mean age or occupation (Table 4.5). However, it was significantly associated with the motorcycle crash victim level of education (cOR 2.07, P =0.005). Thus, the motorcycle crashes affected all forms of people irrespective of their gender, age or occupation. However, low educational background of the motorcycle users significantly influenced how they perceived their personal safety on the roads in turn affecting the severity of injuries suffered in the crashes.

Table 4.5 Comparison of socio-demographic characteristics of victims of motorcycle crashes with moderate/severe injury and mild injury at Thika Level 5 Hospital, 2013

Variable	Moderate/severe injury(n=71) No.(%)	Mild injury (n=241) No.(%)	P-value
Sex			
Male	58(82)	183(76)	0.16
Female	13(18)	58(24)	
Mean Age (SD)	31.9	31.5	
Occupation			
Motorcycle rider	23(33)	47(19)	
Formal Employment	8(11)	40(17)	
Informal Employment	29(41)	112(46)	0.23
Students	8(11)	31(13)	
Unemployed	3(4)	11(5)	
Education			
Primary	41(58)	103(43)	**0. 005***
Tertiary	25(35)	130(54)	

*Significant P values

Factors associated with injury severity were analyzed and results are presented in Table 4.6. Four factors were significant at P value < 0.05. Use of reflective jackets was protective from likelihood to sustain moderate/severe injury (cOR=0.59, P=0.02). Travelling on motorcycles that had their headlights on was a protective factor (cOR=0.46, P=0.03). Road crash victims who were involved in crashes that occurred in foggy or wet weather was a protective factor from sustaining moderate/severe injuries (cOR=0.4, P=0.03). Road crash victims that were involved in crashes that occurred on damaged/potholed roads were 0.56 times as likely to sustain moderate/severe injuries (cOR=0.56, P=0.03) as compared to those on roads without potholes.

Table 4.6 Bivariate analysis of factors associated with injury severity in victims of road crashes at Thika Level 5 Hospital, 2013

Variable	Yes/ No	Moderate /Severe Injury No.(%)	Mild injury No.(%)	cOR (95% CI)	P-value
Motorcycle rider	Yes	24(34)	70(29)	1.25(0.7-2.2)	0.2
	No	47(66)	171(71)		
Helmet Use	Yes	18(35)	64(34)	1.04(0.5-2.0)	0.4
	No	33(65)	123(66)		
Reflective jacket use	Yes	13(25)	69(37)	0.59(0.1-0.9)	**0.02***
	No	38(75)	118(63)		
Head lights On	Yes	8(16)	54(29)	0.46(0.2-1.0)	**0.03***
	No	43(84)	133(71)		
Weekend	Yes	23(32)	59(24)	1.48(0.8-2.6)	0.09
	No	48(68)	182(76)		
Highway	Yes	20(28)	49(20)	1.53(0.8-2.8)	0.09
	No	51(72)	192(80)		
Foggy/Wet Weather	Yes	5(7)	38(16)	0.4(0.1-1.1)	**0.03***
	No	66(93)	203(84)		
Night time crash	Yes	12(17)	57(24)	0.66(0.3-1.3)	0.12
	No	59(83)	184(76)		
Suspected alcohol use	Yes	5(7)	28(12)	0.58(0.2-1.5)	0.14
	No	66(93)	213(88)		
Damaged/Potholed road	Yes	17(24)	87(36)	0.56(0.3-1.0)	**0.03***
	No	54(76)	154(64)		
Motorcycle overloaded	Yes	31(44)	106(44)	1.0(0.6-1.7	0.48
	No	40(56)	135(56)		
Valid driving license	Yes	9(38)	32(46)	0.72(0.3-1.9)	0.25
	No	15(62)	38(54)		

*Significant P values

Multivariate logistic regression was carried out and two factors were statistically significant in the final model. Motorcycle crash victims who had on reflective jackets (aOR=0.4,P=0.04) and those who were on motorcycles that had their headlights on (aOR-0.52. P=0.03) were unlikely to sustain moderate/severe injuries (Table 4.7).

The findings imply that motorcyclists' use of reflective jackets, headlights, nature of weather and nature of the roads determined the likelihood of sustaining moderate to severe injuries. The other factors that influenced the injury severity of the victims of motorcycle crashes but were not statistically significant included; use of helmet use, alcohol use, day of the week and time of the day when the crash occurs.

Table 4.7 Final model of logistic regression of factors associated with injury severity among road crash victims, Thika Level 5 Hospital, 2013

Variable	Adjusted Odds Ratio	95% CI	P value
Head lights On	0.4	0.18-0.95	**0.04***
Reflective jacket use	0.52	0.09-0.86	**0.03***

*Significant P values

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Characteristics of motorcycle crash victims

5.1.1 Socio-demographic characteristics of motorcycle crash victims

Seventy seven per cent of the motorcycle crash victims in this study were males with a male to female ratio of 3.4:1. This is consistent with findings from other studies in Kenya (Osoro *et al.*, 2011) and in other low-income and middle-income countries (Odero *et al.*, 2003). According to Osoro *et al*,. (2011) and Odero *et al.*, (2003) a higher proportion of males was reported to be involved in motorcycle crash due to their greater exposure to traffic as riders. Also due to the design of the motorcycle it is more suited to ride while wearing trousers thus more men as opposed to women ride on them.

In this study, three-quarters of the motorcycle crash victims were aged 20-49 years. Similar age distribution of motorcycle crash victims was observed by Peden *et al*., (2004) and Solagberu *et al*., (2006) who noted that motorcycle injuries are an important cause of disability and deaths and the main victims are the motorcyclists and passengers in their young reproductive age 21-50 years. According to NHTSA (2011) the largest number of motorcycle rider fatalities has been found to be in the 20 - 29 years age group while other studies have found out that there are two peak age groups for motorcyclist casualties namely 16 - 20 years and 35 - 39 years (DFT, 2006).

In this study, most of the motorcycle crash victims were in some form of employment (83%). This findings is in line with a study conducted by Osoro, *et al*., (2011) in which the proportion of road crash victims in any form of employment was at 80%. This could be because those who go to work are more exposed to the risk of being involved in a crash on their way to work.

The findings of this study showed that majority of the road crash victims had attained primary level of education (46.2%) which is consistent with findings of a study conducted in Kitale District Hospital (Sisimwo, Mwaniki, Bii, 2014). According to a study done in Nigeria, the low level of formal education of the respondents may account for a higher level of ignorance among them thus poor interpretation of road traffic regulations and signs (Ogunmodede, Adio, Ebijuwa, Oyetola, Akinol, 2012).

5.1.2 Category of road users among motorcycle crash victims

The study findings revealed that 46% of the motorcycle crash victims were passengers and 30% were motorcycle riders and that the difference in their age means was not significant. This is inconsistent with study findings in Iran by Janmohammadi *et al.,* (2009) which found that most of the crash victims were riders. This could be due to the fact that almost half (44%) of the motorcycle crash victims were travelling on overloaded motorcycles thus the ratio of the injured passengers to the riders was higher.

5.1.3 Use of protective gear by motorcycle crash victims

The study findings revealed that there was low use of protective gear [helmets and reflective jackets] by the motorcycle crash victims as only 34% reported to have had their helmets and reflective jackets on at the time of the crash. The findings are in line with Odero *et al*. (2003) who noted that some of the factors that increase the risk of motorcycle crashes, injuries and fatality are lack of certified driver training and valid licensing, speed and reckless driving, poor regulation and law enforcement, non helmet use by riders and their passengers, non use of conspicuity measures (wearing of reflectors, day time headlights), overloading and possible use of alcohol and drugs. The findings are also in agreement with Duku (2010) who observed that a significant number of people prefer the use of motorcycles since one could manoeuvre easily through heavy traffic; however rider safety is lacking, in that most

of them ride without wearing helmets, especially when riding within the cities and towns. Further, a study by Braddock *et al*. (1992) found that non-helmeted motorcyclists involved in crashes were over three times more likely to die than were helmet users while low motorcycle conspicuity and consequently the inability of the motorcyclist to be seen by other road users, has been identified as an important factor associated with risk of motorcycle crashes (Haque *et al.*, 2012).

5.1.4 Day of week and time of day of motorcycle crash

The findings of this study revealed that majority (73%) of the motorcycle crash victims were involved in a motorcycle crashes between Monday to Friday with most of the crashes occurring on Monday (18%) and Friday (16%). Further, the study findings reveal that majority (69%) of the motorcycle crash victims were involved in a road crash in the afternoon or evening. The findings are consistent with Peden *et al*. (2004) who observed that an important factor that is associated with road traffic crashes is the day of the week. This could be because Monday to Friday are the main working days in Kenya and therefore high levels of traffic occur during these days, thus a higher risk of road crashes. More crashes also occurred in the afternoons and evening and could be as a result of fatigue by motorcycle riders towards the end of the day.

5.1.5 Suspected alcohol and other drug use among motorcycle crash victims

The study findings revealed that of all the motorcycle crash victims, 11% were suspected to have used alcohol while 7% reported use of other drugs six hours prior to the accident. Further, 31% of the motorcycle riders were suspected to have used alcohol or drugs six hours prior to the accident whereas 15% and 7% of the passengers and pedestrians respectively were suspected to have been used alcohol or drugs six hours prior to the accident. This suggests that substance abuse appeared to be a major cause of the motorcycle crashes. The findings are in agreement with those

of other studies that observed that alcohol is a significant contributor to crashes and injuries that affect all road users, including drivers, passengers, cyclists, and pedestrians (Lin *et al*., 2003), almost half of the fatal motorcycle accidents show alcohol involvement (Hurt *et al*., 1981). Possible use of alcohol and drugs was also cited by Odero *et al*. (2003) as one of the factors that increase the risk of motorcycle crashes, injuries and fatality. It has been observed that enforcement of legal limits on the blood alcohol concentration is effective in reducing motorcycle deaths (Lin *et al*., 2009).

5.1.6 Characteristics of the motorcycle crashes

The study findings revealed that half of the motorcycle crash victims were involved in the motorcycle crashes while on urban roads in residential areas, 22% of the crashes occurred while on a highway and 27% on rural roads. The findings further revealed that the common types of crashes involved the motor cycles being ran off the road by other vehicles (24%), head on collisions (14%) and the motorcycles hitting the pedestrians (14%). Further, the findings indicate that majority of the motorcycle crashes occurred on a dry road (90%) and during a fair weather (87%). Thus, road crashes between the motorcycles and other vehicles on one hand and between the motorcycles and the pedestrians on the other were a lead cause of the motorcycle crashes on the roads. The findings are in line with Department for transportation, UK (2006) who observed that urban and rural areas see different patterns of motorcycle accidents. The severity of these accidents tends to vary with the kinds of hazards encountered and the impact speed of the vehicles involved and intersections and junctions are the most likely place for motorcycle accidents and contribute to 66% of motorcycle crashes. Hurt *et al*., (1981) observed that roadway defects like ridges and potholes have also been found to contribute to 2% of motorcycle accidents in California. Further, a study in the UK based on regression models to assess the influence of the environment on the occurrence of child pedestrian and cyclist casualties established that road layout, traffic volumes, and

other engineering and safety factors have a significant impact on accident and casualty risk (Petch & Henson, 2000).

5.1.7 Evacuation and disposition of motorcycle crash victims

The study findings showed that majority (54%) of the motorcycle crash victims used private means to get to the hospitals after the crash and most were admitted following the injuries sustained with a minority (2%) succumbing to the injuries.

The prompt and safe evacuation of motorcycle crash victims to a health care facility is critical in management of injuries (Mock *et al*., 1998). The evacuation of crash victims from the crash scene in this study was mostly by a private vehicle (54%) which is similar to findings elsewhere in Kenya (Hazen & Ehiri, 2006) and Uganda (Andrews *et al.,* 1999).

5.2 Injuries sustained by motorcycle crash victims

5.2.1 Pattern of injuries by body region

The study found that most of the injuries sustained by the motorcycle crash victims were to the extremities (203) and head and neck region (122) and the injuries were moderate and minor in severity. The findings further revealed that other body regions of the victims that suffered injuries included external, face, chest and the abdomen with majority of the injuries to these regions being minor in severity. These findings are collaborated by a study done in Malaysia that found that the commonest body regions injured as a result of motorcycle crash were the head, followed by the lower extremities (Rahman et al.,2015). Reports of continuing physical problems one year on, largely musculoskeletal in nature, have been observed to be considerably more common than would be expected from the nature of injuries sustained in Brussels (ETSC, 1993).

5.2.2 Severity of injury

The present study findings showed that 77% of the motorcycle crash victims sustained mild injury with 17% sustaining moderate injuries. The findings further indicated that the category of motorcycle crash victims with the highest number of people sustaining severe injuries were the riders. The findings are corroborated by various other studies which observed that motorcycle riders and pedestrians suffer the most severe injuries as a result of motor vehicle collisions, report more continuing medical problems and require more assistance compared with other types of road users (ERSAP, 2003); in 1994 in Malaysia, 57% of all road deaths were riders of motorcycles and the number of road fatalities attributed to motorcycles in industrialized countries, where four-wheeled private vehicles are more prevalent,was also disproportionately high (Mohan, 2002) and in 1998, in Britain, motorcycle riders accounted for less than 1% of total road users but contributed to 15% of those killed or seriously injured on the roads (DFT, 1998).

5.3 Factors associated with injury severity

The study findings showed that severity of injury was not significantly associated with the motorcycle crash victim ' sex, mean age or occupation which contradicts Solagberu *et al*. (2006) who observed that severity of injury was significantly associated with the motorcycle crash victim ' sex, mean age and occupation. However injury severity was significantly associated with the motorcycle crash victim education (Chi-square =72.6, df=3 P =0.0000001), which is consistent with a study done in a hospital in Brazil (Zabeu, Zovico, Pereira, Wilton & Tucci, 2013).

The study findings established that motorcyclists' use of reflective jackets (aOR=0.4, P=0.04), crash victims who were on motorcycles that had their headlights on (aOR-0.52. P=0.03), crashes that occurred in foggy or wet weather (cOR=0.4, P=0.03) and crashes that occurred on damaged/potholed roads (cOR=0.56, P=0.03) are the factors that made them to be less likely to sustain moderate/severe injuries. Thus use of

reflective jackets, motorcycles having their headlights on, kind of weather and nature of the road are significant factors that influence the injury severity of the motorcycle crash victims. The findings are consistent with Haque who observed that low motorcycle conspicuity and consequently the inability of the motorcyclist to be seen by other road users, has been identified as an important factor associated with risk of motorcycle crashes (Haque et al., 2012). According to Vaughn *et al*. (1977) inexpensive measures can potentially enhance conspicuity for example, adding a light source and the use of light, bright, reflective or fluorescent colours. The bright colours worn by motorcyclists during the day, daytime use of headlight, and reflective or fluorescent clothing are thought to enhance conspicuity by increasing the brightness contrast between the surface or object it is on and the background environment (Hurt *et al*., 1981; Bragg *et al*., 1980*);* wearing reflective or fluorescent clothing and white or light coloured helmets and using headlights during daytime could reduce serious injuries or death from motorcycle crashes by up to one third; voluntary use of headlight during daytime is associated with a 27% lower risk of crash related injury and the population attributable risk associated with not wearing fluorescent or reflective clothing is approximately 33% (Wells *et al*., 2004).

5.4 Study limitations

The study was limited by lack of smooth flow of data collection as most of the crash victims were in pain and could not therefore easily respond to the questionnaire.

The data collection was slowed down as more attention was given to the treatment of the victims than to data collection.

5.5 Conclusions

- Majority of the motorcycle crash victims were male, young (20 to 29 years) and were engaged in informal employment
- Most of the injuries sustained were to the extremities and head and neck regions of their bodies and the injuries were moderate and minor in severity
- A quarter of the motorcycle crash victims sustained moderate /severe injuries
- The motorcycle riders were at the greatest risk of suffering severe injuries
- There was low use of protective gear by the motorcycle users
- Majority of the motorcycle crashes occurred during the weekdays and in the afternoon or evening
- Significant factors that influence injury severity were use of reflective jackets and motorcycles having their headlights on

5.6 Recommendations

- Enforcement of the laws on road safety for the motorcyclists that requires the motorcycle riders to possess proper training and possess all the requisite equipments such as helmets and reflective jackets for the trade
- Further studies should be carried out using actual blood alcohol level measures to conclusively ascertain the contribution of alcohol to motorcycle crashes

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APPENDICES

Appendix 1: Questionnaire

1. Questionnaire Number_____ 2. IP/OP Number_____

3. Date on interview (dd/mm/yy) ____/___/___4. Interviewer initials_____

Demographic data

5. Sex Male ☐ Female☐ 6. Date of Birth (dd/mm/yy)_____

7. Age of patient (indicate months for < 1year)_____

8. Marital Status

☐ Single ☐ Married ☐ Cohabiting

☐Separated ☐ Divorced ☐ Widowed

9. Occupation of patient

☐Farmer ☐ Casual laborer ☐Salaried employment_____

☐Informal employment_____☐Other (specify)_____

10. Highest level of formal education attained

☐No Formal ☐Primary ☐Secondary

☐Post-Secondary ☐Other (Specify)_____

Injury Related Factors

11. Category of motorcyclist ☐Driver ☐Passenger

12. Were you wearing a helmet at the time of accident?

☐ Yes ☐ No ☐ Not established

13. How was the patient transported to hospital?

☐ Ambulance ☐ Police vehicle ☐ Cab/other vehicle ☐ Self

☐ Not established ☐ Other (Specify)_____

14. What was the duration between the time of accident and arrival at casualty_

Road Crash Related Factors (Obtain from patient and police/clinician records where available)

15. Date when crash occurred_____

16. At what time did the crash occur?_____

17. On which day of the week did the crash occur? _____

18. On which road did the accident occur?

☐ Highway ☐ Urban road/Residential area ☐ Rural/feeder road

☐ Not established ☐ Other (specify)_____

19. How did the accident/collision happen?

☐ Head on ☐ Rear end ☐ Angled collision

☐ Ran off Road ☐ Hit object on Road ☐ Hit object off Road

☐ Hit Parked Vehicles ☐ Hit Pedestrian ☐ Hit Animal

☐ Not Established ☐ Other (specify)_____

20. How were the weather conditions at the time of accident?

☐ Fair ☐ Rain ☐ Foggy ☐ Smoke/Dust ☐ Not established ☐ Other

21. What were the road characteristics where the accident occurred?

☐ Straight and Flat ☐ Curve only ☐ Incline only
☐ Curve + incline ☐ Bridge ☐ Corner/Junction
☐ Not established ☐ Other (specify)_____

22.How was the road condition?

☐ Good ☐ Damaged (pot-holed) ☐ Not established

23. Were there road-works around the scene of accident?_____

24. What was the surface type of the road?

☐ Tarmac ☐ Gravel ☐ Earth/Murram ☐ Not established

25. How were the surface conditions of the road

☐ Dry ☐ Wet ☐ Muddy ☐ Flooded ☐ Not established
☐ Other (specify)_____

26. Did you have a reflective riding jacket on at the time of the accident?

☐ Yes ☐ No ☐ Not established

27. Were the motorcycle headlights on at the time of the accident?

☐ Yes ☐ No ☐ Not established

28. Did the motorcycle have more than two people at the time of the accident?

☐ Yes ☐ No ☐ Not established

29. Where did you learn how to drive a motorcycle? (**motorcycle drivers only**)

☐ Driving school ☐ Other (specify)_____

30. Do you have a valid driving license? (**motorcycle drivers only**)_____

31. Had you taken/used alcohol in the last 6 hours before the accident?_____

32. Had you taken/used any other drugs in the last 6 hours before the accident?

☐ Yes ☐ No ☐ Not esablished

33. Period of time driving before accident(**motorcycle drivers only**) _____ Hrs

34. What time do you normally drive the motorcycle? (**motorcycle drivers only)**

☐ Mostly daytime ☐ Mostly at night ☐ Both day and night

☐ Not established ☐ Not applicable

35. What is the main purpose of the motorcycle? (**motorcycle drivers only)**

☐ personal use ☐ taxi ☐ company use

36. For how long did you rest /sleep before today's duties?

(**motorcycle drivers only)**_____ Hrs

Specific Injuries

BP _____ HR _____ RR _____Temp. _____G.C.S _____

History of Loss of consciousness_____

History of ( ) Hypertension ( ) Diabetes ( ) Cancer ( )Visual deficiency/defect

1. Head /Neck _____
2. Face _____
3. Chest _____
4. Abdomen /Pelvis _____
5. Extremities (Upper and Lower limbs _____
6. Bony Pelvis _____
7. External / S.T.I _____

Patient disposition

☐ Treated & Discharged ☐ Admitted to Ward ☐ Transferred /referred ☐ Died

Injury Severity Score Table

ISS Body Region	Highest AIS score	(Highest AIS score) ^{2}
Head or Neck		
Face		
Chest		
Abdomen /pelvic contents		
Extremities /pelvic girdle		
External		
ISS		

Appendix 2: Consent forms

Consent Form A. Informed Consent Form For Patients Aged 18 Years And Above

My name is Caroline Njeri Ngunu. I am a student at JKUAT undertaking a Master of Science Degree in Applied Epidemiology. I am conducting a study on characteristics of motorcycle injuries and factors associated with their severity in patients attending Thika level 5 hospital, Kenya 2013.

Purpose of the study

The purpose of the study is to determine the factors associated with severity of motorcycle injuries in patients attending Thika level 5 hospital, 2013.

Investigators

Dr. C.Ngunu- FELTP(PI); Prof Z.Ng'ang'a-JKUAT; Dr. P.Wanzala-KEMRI

Procedure

I am going to give you information about the study and then invite you to participate in the study. I intend to ask you questions about yourself, the accident and circumstances around its occurrence.

Risk/Benefits

The benefit of this study to the community is that it shall help us know the risk factors of severe motorcycle injuries. This will help when sharing the outcomes of the study with stakeholders in the division of non communicable diseases and traffic police so as to help in formulation of policy that will lead to the minimization of these factors. There shall be no financial reward or pay for participating in the study. Participants will have no risk involved but only to sacrifice a few minutes of their time**.**

Voluntary Participation

Your decision to participate in this study is entirely voluntary and you are free to choose not to consent or opt out at any stage of the study. You are also free to choose not to answer any question you feel uncomfortable with. The entire interview is expected to take about 20 minutes of your time.

Confidentiality

The information that I collect from this research will be kept confidential. We shall assign your questionnaire a number instead of your name to ensure the information you provide cannot be traced back to you and the questionnaires will be kept in a locked drawer in the principal investigator's office and will be destroyed on completion of the study. Data from the questionnaires will be stored in password protected computers at the principal investigators office. Only the principal investigator will have the passwords and access to the data.

If you have any questions or clarifications about the research or in the event of a study related injury, please contact Dr. Caroline Ngunu – 0721328912, P.O. Box 63024-00200 Nairobi.

For any questions pertaining to rights as a research participant, the contact person is The Secretary, KEMRI Ethics Review Committee, P.O. BOX 54840-00200 Nairobi; Telephone +254 (0)20 2722541, 0722205901,0733400003; Email address: erc@kemri.org

Declaration

I…….. having been given information and time to ask questions, have understood the consent I am giving and by my signature or thumb print below give consent for the study to be carried out on me.

Interviewee signature/ thumbprint…….

Witness signature/ thumbprint……. Date…….

Interviewer Name : ……Sign…….. Date ……

Consent Form B. Informed Assent Form for Patients less than 18 years of age

My name is Caroline Njeri Ngunu. I am a student at JKUAT undertaking a Master of Science Degree in Applied Epidemiology. I am conducting a study on characteristics of motorcycle injuries and factors associated with their severity in patients attending Thika level 5 hospital, Kenya 2013.

Purpose of the study

The purpose of the study is to determine the factors associated with severity of motorcycle injuries in patients attending Thika level 5 hospital, 2013.

Investigators

Dr. C.Ngunu- FELTP(PI); Prof Z.Ng'ang'a-JKUAT; Dr. P.Wanzala-KEMRI

Procedure

I am going to give you information about the study and then invite you to participate in the study. I intend to ask you questions about yourself, the accident and circumstances around its occurrence.

Risk/Benefits

The benefit of this study to the community is that it shall help us know the risk factors of severe motorcycle injuries. This will help when sharing the outcomes of

the study with stakeholders in the division of non communicable diseases and traffic police so as to help in formulation of policy that will lead to the minimization of these factors. There shall be no financial reward or pay for participating in the study. Participants will have no risk involved but only to sacrifice a few minute of their time.

Voluntary Participation

Your decision to participate in this study is entirely voluntary and you are free to choose not to consent or opt out at any stage of the study. You are also free to choose not to answer any question you feel uncomfortable with. We have discussed this research with your parent(s)/ guardian and they know that we are also asking you for your agreement. If you are going to participate in the research, your parent(s) /guardian also have to agree. But if you do not wish to take part in the research, you do not have to, even if your parents have agreed. The entire interview is expected to take about 20 minutes of your time.

Confidentiality

The information that I collect from this research will be kept confidential. We shall assign your questionnaire a number instead of your name to ensure the information you provide cannot be traced back to you and the questionnaires will be kept in a locked drawer in the principal investigator's office and will be destroyed on completion of the study. Data from the questionnaires will be stored in password protected computers at the principal investigators office. Only the principal investigator will have the passwords and access to the data.

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If you have any questions or clarifications about the research or in the event of a study related injury, please contact Dr. Caroline Ngunu – 0721328912, P.O. Box 63024-00200 Nairobi.

For any questions pertaining to rights as a research participant, the contact person is The Secretary, KEMRI Ethics Review Committee, P.O. BOX 54840-00200 Nairobi; Telephone +254 (0)20 2722541, 0722205901,0733400003; Email address: erc@kemri.org

Declaration

I…….. having been given information and time to ask questions, have understood the assent I am giving and by my signature or thumb print below give assent for the study to be carried out on me

Interviewee signature/ thumbprint…….

Witness signature/ thumbprint…….
Date…….

Interviewer Name : ……Sign…….....
Date …….....

Consent Form C. Informed Consent Form for Parents/Guardians/Caretakers of Minors

My name is Caroline Njeri Ngunu. I am a student at JKUAT undertaking a Master of Science Degree in Applied Epidemiology. I am conducting a study on characteristics of motorcycle injuries and factors associated with their severity in patients attending Thika level 5 hospital, Kenya 2013.

Purpose of the study

The purpose of the study is to determine the factors associated with severity of motorcycle injuries in patients attending Thika level 5 hospital,2013.

Investigators

Dr. C.Ngunu- FELTP(PI); Prof Z.Ng'ang'a-JKUAT; Dr. P.Wanzala-KEMRI

Procedure

I am going to give you information about the study and then invite your child/ the injured to participate in the study. I intend to ask your child/ the injured questions about him/her, the accident and circumstances around its occurrence.

Risk/Benefits

The benefit of this study to the community is that it shall help us know the risk factors of severe motorcycle injuries. This will help when sharing the outcomes of the study with stakeholders in the division of non communicable diseases and traffic police so as to help in formulation of policy that will lead to the minimization of these factors. There shall be no financial reward or pay for participating in the study. Participants will have no risk involved but only to sacrifice a few minutes of their time.

Voluntary Participation

Your decision to have your child/the injured participate in this study is entirely voluntary and you are free to choose not to consent or opt out at any stage of the study**.** You are also free to choose that the child/the injured does not answer any question you feel uncomfortable with. The entire interview is expected to take about 20 minutes.

Confidentiality

The information that I collect from this research will be kept confidential. We shall assign your child's/ the injured's questionnaire a number instead of their name to ensure the information they provide cannot be traced back to them and the questionnaires will be kept in a locked drawer in the principal investigator's office and will be destroyed on completion of the study. Data from the questionnaires will be stored in password protected computers at the principal investigators office. Only the principal investigator will have the passwords and access to the data.

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If you have any questions or clarifications about the research or in the event of a study related injury, please contact Dr. Caroline Ngunu – 0721328912, P.O. Box 63024-00200 Nairobi.

For any questions pertaining to rights as a research participant, the contact person is The Secretary, KEMRI Ethics Review Committee, P.O. BOX 54840-00200 Nairobi; Telephone +254 (0)20 2722541, 0722205901,0733400003;

Email address: erc@kemri.org

Declaration

I…….. having been given information and time to ask questions, have understood the consent I am giving and by my signature or thumb print below give consent for the study to be carried out on my child.

Interviewee signature/ thumbprint…….

Witness signature/ thumbprint…….

Date…….

Interviewer Name : ……Sign…….....

Date ……

Appendix 3: Published Manuscript

FACTORS ASSOCIATED WITH SEVERITY OF MOTORCYCLE INJURIES IN PATIENTS ATTENDING THIKA LEVEL 5 HOSPITAL, KENYA 2013

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Abstract

According to the World Health Organization, road traffic injuries caused an estimated 1.26 million deaths worldwide in the year 2000. Nearly half (46%) of the deaths were vulnerable road users comprising pedestrians, pedal cyclists and motorcycle riders. In 2009 there were 3,760 road deaths reported in Kenya, with 34.4 deaths/100,000 person of whom 9% were riders of motorcycles, and there has been a fivefold increase in motorcycle deaths reported by police. Motorcycles are rapidly becoming a major means of public transport and cause of severe injuries and deaths in Kenya. This cross-sectional study set out to determine the factors associated with severity of motorcycle injuries among patients attending Thika level 5 hospital, Kenya. Three hundred and twelve participants were recruited into the study.

Epidemiological and clinical information was collected using semi structured, interviewer administered questionnaires and from patient medical charts. The mean age of the participants was 31.6 years (range 3-72 years). Seventy six % (238) of the participants were aged between 20-49 years and 77.2% (241) were male. Motorcycle riders comprised 94(30%) of the motorcycle crash victims. Twenty three percent (71) of the motorcycle crash victims had moderate or severe injury with 77% (241) sustaining mild injury. On multivariate logistic regression, those who had reflective jackets on (aOR=0.4, P=0.04) and those who were on motorcycles that had headlights on (aOR-0.52. P=0.03) were less likely to sustain moderate/severe injuries. Analysis of factors associated with severe injuries will form a basis for policies and regulations aimed at promoting safer road practices for motorcycle users.

Background

A road traffic injury (RTI) is a fatal or non-fatal injury incurred as a result of a collision on a public road involving at least one moving vehicle. Globally RTIs are ranked 9th among the leading causes of disability adjusted life years (DALYs) lost and is expected to be the 3rd cause of lost DALY by 2020 (1,2). According to the World Health Organization, road traffic injuries caused an estimated 1.26 million deaths worldwide in the year 2000. The average rate of deaths was 20.8 per 100,000 people, 30.8 for males, and 11.0 for females. Ninety percent of the deaths occurred in low and middle income countries, with South-East Asia and Africa having the highest death rates (1). Nearly half (46%) of the deaths were among vulnerable road users comprising pedestrians, pedal cyclists and motorcycle riders (2). According to the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA), you are "37 times more likely to die" in a motorcycle accident than a car accident – and nine times more likely to become injured while riding a motorcycle than while driving a car (3).

Kenya has one of the highest road fatality rates in Africa at 68 deaths per 10,000 registered vehicles (4) with 9% being riders of motorcycles (2). There has been a fivefold increase in motorcycle deaths reported by police; from 33 in 2004 to 152 in 2008 (5). In 2009 road deaths reported were 3760, with 34.4 deaths/100,000 people with 9% being riders of motorcycles (2). A study carried out in the district hospital in Thika showed that 18% of RTI victims were motorcyclists yet motorcycles comprised only 7.7% of all licensed vehicles in 2005 (GOK data). Eighty percent of the vulnerable road users sustained head injuries (6).

The occurrence and health impact of motorcycle injuries in Kenya has not been adequately addressed, just like in many developing countries. There are no surveillance systems in place and this has led to lack of awareness on the magnitude of the problem due to under reporting and scanty ,unreliable information. This hospital based survey was carried out to provide accurate and detailed information on injury location, severity and associated factors of motorcycle injuries. The results provide local evidence to key policy makers in Kenya on motorcycle crash risk factors that can lead to improved policies and interventions to improve road safety for motorcyclists and minimize modifiable risk factors for injury severity.

Methods

This study was carried out at the Accident & Emergency(A & E) Department Thika Level 5 Hospital located in Thika district , Kiambu county ,45 km north-east of Nairobi. The hospital is a public regional referral hospital with a bed capacity of 265 beds (Figure 3.1). It is situated between two busy major highways; Nairobi-Nyeri and Nairobi-Garissa and handles most of the road crash victims on these roads. Thika District measures 1,960.2 square kilometers and borders Ruiru district to the south, Kiambu East District to the west, Maragua district to the north and Machakos district to the east (7).

The study population comprised of motorcycle crash victims presenting for medical services at Thika level 5 hospital between January and March 2013 and who gave informed consent.

A minimum sample of 277 was determined to detect differences in proportions between victims with severe and non severe injury. Assumptions made in determining the sample size included a prevalence of severe injury among the motorcycle crash victims of 23.6%, precision of 5% and confidence level of 95%. A motorcycle crash was defined as one which took place on a road that involved a moving motorcycle. A motorcycle was defined as a two wheeled motorized vehicle. Motorcycle crash victims were consecutively recruited and data was collected using pretested, standardized, interviewer administered semi-structured questionnaires after the participants´ initial medical care. The interviewers were clinical officers and the questionnaire was in English with a Swahili translation.

For the motorcycle crash victims who were unconscious, informed consent was obtained from the patients' guardian. For those under 18 years of age, consent was obtained from both the participant and their guardian. A guardian was deemed to be a parent, caregiver or the legally authorized representative of the motorcycle crash victim.

Information about the circumstances surrounding the crash was ascertained based on the perception of the victim. Alcohol use was assessed based on self report and breath odor, as assessed by the interviewer.

Clinical information on injury type and severity was recorded from the medical charts. Additional details were also obtained from police and medical staff when available. Injury severity was measured based on the Injury Severity Score (ISS) with each specific injury being assigned an Abbreviated Injury Scale(AIS) score and allocated to one of six body regions (head ,face, chest, abdomen, extremities and pelvis) (8,9,10). Injury severity was categorized for this study as severe (ISS>9) and

non-severe (ISS ≤ 8). Data was validated, cleaned, analyzed using Epi-info (version 3.5.1, CDC, Atlanta, GA, USA). Chi-square and Fishers exact tests (for cells <5) were used to assess differences in proportions for categorical variables, with $p<0.05$ considered statistically significant. Multivariate logistic regression with stepwise backward elimination process was used to determine independent factors associated with severe injury among hospital patients. Scientific and ethical clearance for the study was obtained from the Kenya Medical Research Institute and the Thika District Hospital ethical committee.

Results

A total of 312 motorcycle crash victims were recruited, consented and interviewed; 98% of those recruited agreed to participate. Approximately 23% (71) of the road crash victims sustained severe injury. Most road crash victims were male (77%), and 46% had at least primary level education. The mean age was 31.6 years (range 3-72 years), with 76% (238) aged 20-49 years and 13% aged >49 years.

Majority (46%) of the participants were travelling as passengers at the time of the crash, pedestrians comprised 24% while the motorcycle riders comprised 30% of the participants. Approximately half (152) of the motorcycle crash victims were involved in the motorcycle crashes while on urban roads in residential areas. Twenty two percent of the crashes occurred while on a highway and 27% on rural roads. The commonest types of collision were, the motorcycle was ran off the road by other vehicles (24%), was involved in a head on collision (14%) and the motorcycle hit a pedestrian (14%). Among all the participants, 33(11%) were reported to have used alcohol and 22(7%) reported other drug use six hours prior to the accident. Twenty nine (31%) of the motorcycle riders were reported to have been intoxicated six hours prior to the accident, whereas 15% and 7% of the passengers and pedestrians respectively were reported to have been intoxicated six hours prior to the accident.

Evacuation of the injured to hospital was by cab or other private vehicle (54%), self (39%), ambulance (3%) and police vehicle (2%).Sixty three (20%) of all motorcycle crash victims were admitted following the injuries sustained with six (2%) of them dying at the hospital. The commonest injuries sustained by the motorcycle crash victim were to the extremities (65%, 203) and to the head and neck region (32%,122). Majority (43%,52) of those who sustained head injury were passengers (Table 1).

Twenty three percent of the motorcycle crash victims sustained severe injury. The category of motorcycle crash victims with the highest number of people sustaining severe injuries, were the riders (7%).

Severity of injury was not significantly associated with the participants' sex, mean age or occupation. However it was significantly associated with the participants education (χ^2 =72.6, df=3 P value =0.0000001)(Table 2).

On bivariate analysis, motorcyclists who used reflective jackets were found to be less likely to sustain severe injury (cOR=0.59, P=0.02). Similarly crash victims who were on motorcycles that had their headlights on were less likely to sustain severe injury (cOR=0.46, P=0.03).

Participants that were involved in crashes that occurred in foggy or wet weather were less likely to sustain severe injuries (cOR=0.4, P=0.03) than those in fair weather and the same was observed in those crashes that occurred on damaged/potholed roads (cOR=0.56, P=0.03) as compared to those on good roads(Table 3).

Multivariate logistic regression was carried out and two factors were statistically significant in the final model. Motorcycle crash victims who wore reflective jackets (aOR=0.4,P=0.04) and those who were on motorcycles that had their headlights on (aOR-0.52. P=0.03) were less likely to sustain severe injuries (Table 4).

Discussion

Majority of the motorcycle crash victims were males which is consistent with studies in Kenya and other low-income and middle-income countries (6,8) This could possibly be due to the greater exposure to traffic of the males compared to females as riders and passengers in motorcycles for work-related activities. Three-quarters of the road crash victims in this study were aged 20-49 years. Similar age distribution of road crash victims was reported in other studies in Kampala as well as in Kenyan and global epidemiologic reports (9,10,11). The involvement of this economically active and productive age group can result in significant economic loss at individual, family and societal levels.

Approximately a quarter of those involved in motorcycle crashes suffered severe injury, with a fifth of all crash victims requiring admission. Motorcycle passengers were found to have been at increased risk of getting injured when involved in motorcycle crashes than riders and pedestrians. These findings are consistent with other studies in Africa and Asia (12). On further analysis by motorcyclist category, motorcycle riders were found to have the highest occurrence of severe injuries. The most common region of the body injured among the victims was the extremities followed by the head and neck region. This is consistent with findings in Hyderabad, India where the most common type of injuries were those of the extremities (56%) (12). The commonest collisions occurring were due to the motorcycles being run off the road by other motor vehicles.

Motorcycle crashes during rainy weather were found to be associated with less severe injury. Driving on damaged/potholed roads was also found to be a protective factor for injury severity. This finding is similar to those of a review done in Tasmania (13). This could be due to the difficulty in manouvering of motorcyclists during wet weather and on damaged roads thus leading to decreased speed.

Reflective jacket use and use of headlights throughout the day were found to be associated with non-severe injury. Helmet use was also found to be protective against severe injuries though this was not significant when subjected to statistical analysis. This differs from findings in Taiwan (14) and could be as a result of lack of standardization of helmets by regulatory bodies in Kenya leading to supply of poor quality helmets to riders and poor practice of wearing the helmets unbuckled by users thus diminishing their protective role.

Alcohol and other drug use among participants in this study was reported in almost a fifth of them with a third of motorcycle riders suspected to be inebriated. This is consistent with a survey of motorcycle riders in Ife-Ife, Nigeria (15,16)that reported alcohol use to be 30%. However, it is likely that alcohol played a greater role than was found in this study and the differences could be due variability in methods of determining alcohol use.

Evacuation of motorcycle crash victims was mainly through private vehicles which is consistent with a study carried out by Osoro et al.(2011) in Thika and other studies in east Africa(9,17) . This is expected because there is no organized pre-hospital emergency medical service in Thika district. Although the hospital has ambulances they mainly serve to transport patients between hospitals and are rarely involved in evacuating the injured from accident scenes. Quick and safe evacuation practices are critical in the management of injuries and affect their outcomes (18)

Limitations in this study included the fact that only motorcycle crash victims who sought medical care at this facility were included and also that information on the nature and circumstances of the motorcycle crash was based on the victims´ perception. Bias was minimized by corroborating the patient´s account with that of other patients involved in the same road crash at the hospital and the police.

Conclusion

In this study, injuries sustained by motor cycle riders were 1.25 times more likely to be severe compared to passengers and pedestrians. Provision of protected lanes for motorcyclists may help protect them from being hit and run off the roads by other motor vehicles which was the commonest cause of crashes. Severe injuries were also less likely(cOR 0.59) to occur among those with reflective jackets and on motorcycles with headlights. Therefore prevention efforts should be expanded from the current helmet use messages to also promote use of reflective jackets and headlights at all times, so as to help reduce the severity of motorcycle crash injuries.

Competing interests

The authors declare no competing interest.

Authors´ contributions

All the authors listed in this article made contributions during the design of the study, data collection and interpretation, provided critique for intellectual content and gave final approval of the version submitted

Tables and figures

Table 1: Injuries sustained by victims of motorcycle crash victims, Thika Level 5 Hospital, Kenya, 2013.

Body region injured	Severity	Riders	Passengers	Pedestrians	Total
Head or neck	Minor	11	36	17	64
	Moderate	21	12	11	44
	Serious	5	4	3	12
	Severe	2	0	0	2
Extremities/Pelvic girdle	Minor	21	28	13	62
	Moderate	25	53	22	100
	Serious	14	11	13	38
	Severe	0	2	1	3
External	Minor	13	34	19	66
	Moderate	11	18	8	37
	Serious	0	1	0	1
	Severe	0	1	0	1
Face	Minor	18	41	19	78
	Moderate	23	10	3	36
	Serious	0	1	1	2
	Severe	0	0	0	0
Chest	Minor	14	25	11	50
	Moderate	1	8	4	13
	Serious	0	3	0	3
	Severe	0	0	0	0
Abdomen/Pelvic contents	Minor	3	12	6	21
	Moderate	1	1	6	8
	Serious	1	1	1	3
	Severe	0	0	0	0

Table 2: Assessment of severity of injury using the ISS among victims of motorcycle crashes, Thika Level 5 Hospital, Kenya, 2013

Injury Severity Score	Riders No. (%)	Passengers No. (%)	Pedestrians No. (%)	Total
1-8	70(75)	117(81)	54(73)	241(77)
>8-15	17(18)	20(14)	16(22)	53(17)
>15	7(7)	7(5)	4(5)	18(6)

Table 3: Bivariate analysis of factors associated with injury severity in victims of motorcycle crashes, Thika Level 5 Hospital, 2013

Variable	Yes/No	Moderate /Severe Injury No.(%)	Mild injury No.(%)	cOR(95% CI)	P-value
Motorcycle Rider	Yes	24(34)	70(29)	1.25(0.7-2.2)	0.2
	No	47(66)	171(71)		
Helmet Use	Yes	18(35)	64(34)	1.04(0.5-2.0)	0.4
	No	33(65)	123(66)		
Reflective jacket use	Yes	13(25)	69(37)	0.59(0.1-0.9)	0.02*
	No	38(75)	118(63)		
Head lights On	Yes	8(16)	54(29)	0.46(0.2-1.0)	0.03*
	No	43(84)	133(71)		
Weekend	Yes	23(32)	59(24)	1.48(0.8-2.6)	0.09
	No	48(68)	182(76)		
Highway	Yes	20(28)	49(20)	1.53(0.8-2.8)	0.09
	No	51(72)	192(80)		
Foggy/Wet Weather	Yes	5(7)	38(16)	0.4(0.1-1.1)	0.03*
	No	66(93)	203(84)		

Night time crash	Yes	12(17)	57(24)	0.66(0.3-1.3)	0.12
	No	59(83)	184(76)		
Suspected alcohol use	Yes	5(7)	28(12)	0.58(0.2-1.5)	0.14
	No	66(93)	213(88)		
Damaged/ Potholed road	Yes	17(24)	87(36)	0.56(0.3-1.0)	0.03*
	No	54(76)	154(64)		
Road works	Yes	2(3)	11(5)	0.61(0.1-2.5)	0.28
	No	69(97)	230(95)		
Motorcycle overloaded	Yes	31(44)	106(44)	1.0(0.6-1.7	0.48
	No	40(56)	135(56)		
Valid driving license	Yes	9(38)	32(46)	0.72(0.3-1.9)	0.25
	No	15(62)	38(54)		
Period of time less than 6 hours	Yes	5(21)	24(34)	0.51(0.2-1.5)	0.12
	No	19(79)	46(66)		

*Significant p values

Table 4: Multivariate logistic regression of factors associated with injury severity among motorcycle crash victims, Thika Level 5 Hospital, Kenya, 2013

Variable	Adjusted Odds Ratio	95% CI	P value
Head lights On	0.4	0.18-0.95	0.04*
Reflective jacket use	0.52	0.09-0.86	0.03*

*Significant p values

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Appendix 4: Glasgow Coma Scale

Assessed Response	Score
Best eye response	
Spontaneously	4
To verbal stimulation or to touch	3
To pain	2
No response	1
Best verbal response	
Smiles, oriented to sounds, follows objects, interacts	5
Cries but is consolable, inappropriate interactions	4
Inconsistently consolable, moaning	3
Inconsolable, agitated	2
No vocal response	1
Motor	
Normal spontaneous movement	6
Withdraws to touch	5
Withdraws to pain	4
Flexion abnormal	3
Extension, either spontaneous or to painful stimuli	2
Flaccid	1

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Appendix 5: Abbreviated Injury Scale

Injury	AIS Score
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Unsurvivable

Appendix 6: KEMRI Ethical Approval Letter