Characteristics and Factors Associated with Road Traffic Injuries in Patients Attending Thika Level 5 Hospital, Kenya, 2009

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DECLARATION

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

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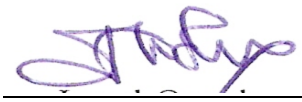
2. Signature:  Date_____

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LIST OF ABBREVIATIONS AND ACRONYMS

AIS	Abbreviated Injury Score
aOR	Adjusted Odds Ratio
AP	Anatomical Profile
APACHE	Acute Physiology and Chronic Health Evaluation
BAC	Blood Alcohol Concentration
CDC	Centers for Disease Control and Prevention
CRAMS	Circulation, Respiration, Abdominal/Thoracic, Motor and Speech Scale
cOR	Crude Odds Ratio
DALY	Disability Adjusted Life Years
ED	Emergency Department
FELTP	Field Epidemiology and Laboratory Training Programme
GBD	Global Burden of Disease
GCS	Glasgow Comma Scale
GNP	Gross National Product
GRSP	Global Road Safety Project

HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
ISS	Injury Severity Score
JKUAT	Jomo Kenyatta University of Agriculture and Technology
NCAPD	National Coordinating Agency for Population and Development
OR	Odds Ratio
RTI	Road Traffic Injuries
RTS	Revised Trauma Score
TRL	Transport Research Laboratory
UK	United Kingdom
USA	United States of America
WHO	World Health Organization

OPERATIONAL DEFINITION OF TERMS

Fair weather	Atmospheric condition when it is not raining or foggy
Four-wheeled vehicle	A vehicle with four or more wheels
Head injury	Any person with a GCS $\leq$ 12
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
Matatu	A public service vehicle with a capacity of between 7 and 14 seated passengers
Mild injury	Injury severity score of $\leq$ 8
Moderate injury	Injury severity score of 9 to 15
Night time	Time of day between 6 pm and 6 am
Passenger	Any user of a vehicle (both two and four wheeled vehicles) other than the driver
Pedestrian	A person involved in a road crash who was not, at the time of the road crash, riding in a vehicle
Road traffic crash	An accident which takes place on a road between two or more objects, one of which is a moving vehicle

Rural/feeder road	Road which connects/leads to a highway
Severe injury	Injury severity score above 15
Suspected use of alcohol	Road crash victim who had an obvious odor of alcohol in his breathe
Three-wheeled vehicle	A vehicle with three wheels
Two-wheeled vehicle	A motorcycle, bicycle or handcart involved in a road crash
Urban/residential area road	A road in a built up place where the speed limit is 50 km/hr
Vehicle occupants	Road crash victims who were travelling in three or four wheel vehicles at the time of crash
Vulnerable road users	Road crash victims who were either using two wheeled vehicles or were pedestrians at the time of road crash (Toroyan *et al.*, 2009)

ABSTRACT

Road traffic injuries present an important public health problem in Kenya and are responsible for a heavy burden on the health care system. This cross-sectional study was carried out to determine the characteristics of injuries and factors associated with injury severity in victims of road traffic crashes attending Thika Level 5 hospital from August to November 2009. Epidemiologic and clinical information was recorded by interview and from medical charts. Vulnerable road users were defined as pedestrians and two-wheeled vehicle users. Road crash victims with moderate or severe and those with mild injury were compared to determine factors associated with injury severity. A total of 300 road crash victims were interviewed. The mean age of the participants was 32.4 years, three quarters of participants were aged between 20-49 years and 72% (218) were male. Vulnerable road users comprised 33% (99) of the road crash victims. Nineteen percent (56) of the road crash victims had moderate or severe injury with 81% sustaining mild injury. On multivariate logistic regression, vulnerable road users (OR=2.0, 95%CI=1.02-3.92), road crashes in rainy weather (OR=2.9, 95%CI=1.33-6.51) and night time crashes (OR=2.0, 95%CI=1.10-3.92) were risk factors for sustaining moderate or severe injury. In this study, vulnerable road users were more likely to sustain moderate or severe injury as has been shown in other studies. Analysis of factors associated with severe injury can form a basis for policies and regulations aimed at promoting safer roads.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

An injury may be defined as "the physical damage that results when the human body is suddenly or briefly subjected to intolerable levels of energy". Injuries are traditionally grouped according to two broad categories: intentional and unintentional. Conventionally, intentional injuries include interpersonal violence (spousal abuse, child abuse, other assaults), self-inflicted injuries (attempted and completed suicides), as well as collective violence and war-related injuries. Motor vehicle injuries, burns, falls, drowning, and other injury classifications in which intentionality is understood to be absent constitute the broad unintentional injuries category (Holder *et al.*, 2001).

At the inquest into the worlds' first road traffic death on 17th August 1896, the coroner was reported to have said, "This must never happen again". The victim, a 44 year old mother of two, was a pedestrian who was struck down by a motor vehicle (WHO, 2004). After more than 100 years, an estimated 1.2 million people are killed and up to 50 million injured in road crashes every year worldwide (Toroyan *et al.*, 2009).

Road traffic injuries are an important cause of morbidity and mortality worldwide, but especially in low and middle-income countries. Road traffic injuries are currently ranked

9th globally among the leading causes of disease burden, in terms of disability adjusted life years (DALY) lost. Road traffic injuries are projected to become the 3rd largest cause of disabilities in the world in 2020 (Peden *et al.*, 2004). Developing countries bear the greatest burden of the fatalities and disabilities from road traffic crashes accounting for more than 85% of the world's road fatalities and about 90% of the total DALY lost due to road traffic injuries (Nantulya & Reich, 2003). The problem is increasing in developing countries at a fast rate while it is declining in all industrialized nations. However, estimates of the annual number of road deaths vary, as a result of the limitations of injury data collection and analysis, problems of underreporting and differences in interpretation of injury severity (Nantulya & Reich, 2003).

Sub-Saharan Africa bears the highest road traffic injury and mortality rates in the world at 28.3 per 100,000 people, when corrected for under-reporting, compared with 11.0 per 100,000 in Europe. In some African countries, up to half of all hospital surgical beds are occupied by patients injured on roads. In some countries, deaths from road traffic crashes come second only to HIV and AIDS for males aged 15 to 44 years. In addition to the health impact, traffic crashes come at a high cost to African countries. For example, traffic crashes cost Uganda and Malawi an estimated 2.3% and 5% of their Gross Domestic Product (GDP) respectively in 2002 (Peden *et al.*, 2004).

1.2 Problem statement

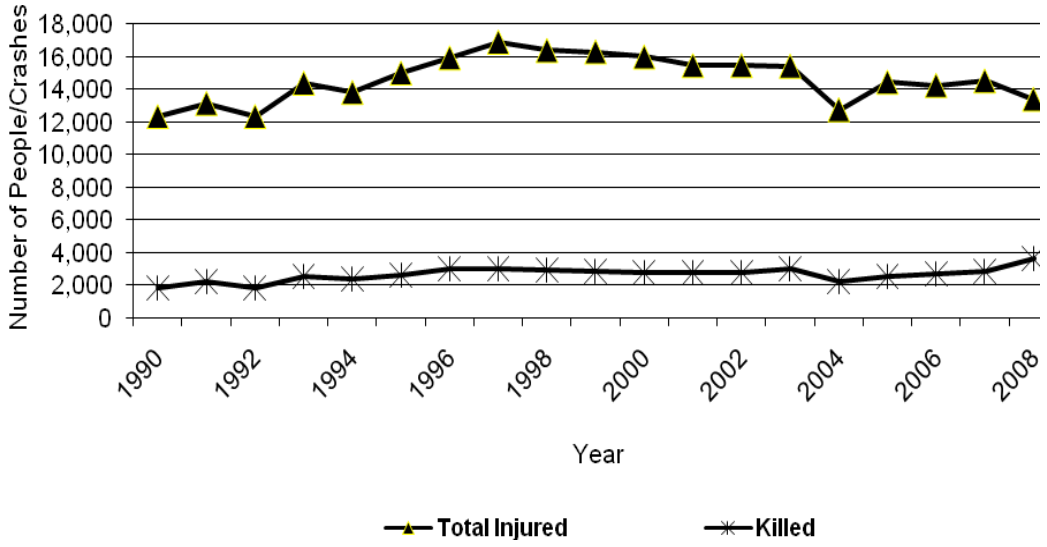
Kenya is facing challenges of a complex epidemiological transition marked by persisting infectious diseases and a rising burden of non-communicable diseases (WHO, 2009). Acute respiratory tract infections, HIV/AIDS, malaria, and pulmonary tuberculosis in adults continue to be major public health problems.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

Injuries, and particularly motor vehicle crashes, are still not appreciated as a public health problem by many health professionals and public policy experts and there are general perceptions that motor vehicle 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).

In Kenya, road traffic injuries exert a heavy burden on the country's economy and health care services. Over 3,000 people are killed on Kenyan roads every year, most of them between the ages of 15 and 44 years. The cost to the economy from these road crashes in Kenya is estimated to be in excess of US$ 50 million exclusive of the actual loss of life (Peden *et al.*, 2004).

Unfortunately, road safety trends in Kenya are worsening with more than 75% of road traffic casualties occurring among economically productive young adults. Pedestrians and passengers are the most vulnerable and they account for 80% of the deaths. Pedestrians are more likely to be killed in urban areas, whereas passengers are the majority killed on intercity highways that traverse the rural settings (Odero *et al.*, 2003). Figure 1.1 illustrates the trends in the number of people killed or injured in Kenya between 1990 and 2008 based on unadjusted data from Government of Kenya statistical abstracts. There was a 39% increase in the number of road traffic injuries between 1990 and 1998. The number of people killed was fairly constant during the period.

The occurrence and health impact of road traffic injuries in Kenya has not been adequately addressed, just like in many developing countries. Currently, the only nationally available road crash figures are based on data collected by the police who attend to road traffic crashes or have details reported to them. However, some accidents and casualties are not reported to the police, particularly accidents involving 'vulnerable road users' such as pedestrians, pedal cyclists, motorcyclists and casualties who sustain mild injuries (Odero *et al.*, 2003). In addition, a large majority of police officers are not medically trained and so within the police reported data, injury severity is classified into one of three broad categories (fatal, serious or slight). This has led to lack of awareness about the magnitude of the problem because of underreporting and the information is often scanty and unreliable.



Source: Government of Kenya Statistical abstracts

Figure 1.1 Trends in reported road crashes and number of people killed in Kenya, 1990-2008

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 *et al.*, 2004). Research on road traffic injuries in Kenya is scarce and inconsistent with the size of the problem. 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.

A hospital-based survey supplements information on the number of road crash casualties and provides more accurate and detailed information on injury type, severity and location. Most published hospital surveys on road traffic injuries have been carried out in Nairobi and majority of them are retrospective. This study sought to describe the characteristics and factors associated with road traffic injuries by consecutively interviewing road crash victims attending Thika Level 5 Hospital.

1.4 Research questions

- What were the characteristics of road crash victims attending Thika Level 5 hospital?
- What injuries were sustained by road crash victims attending Thika Level 5 hospital?
- What were the factors associated with injury severity among road crash victims attending Thika Level 5 hospital?

1.5 Hypotheses

N_O There is no association between road user category and severity of injuries among road crash victims attending Thika Level 5 hospital, 2009

N_A There is an association between road user category and severity of injuries among road crash victims attending Thika Level 5 hospital, 2009

N_O There is no association between use of protective equipment and severity of injuries among road crash victims attending Thika Level 5 hospital, 2009

N_A There is an association between use of protective equipment and severity of injuries among road crash victims attending Thika Level 5 hospital, 2009

N_O There is no association between time of day and severity of injuries among road crash victims attending Thika Level 5 hospital, 2009

N_A There is an association between time of day and severity of injuries among road crash victims attending Thika Level 5 hospital, 2009

N_O There is no association between road crash circumstances and severity of injuries among road crash victims attending Thika Level 5 hospital, 2009

N_A There is an association between road crash circumstances and severity of injuries among road crash victims attending Thika Level 5 hospital, 2009

1.6 Objectives

1.6.1 General objective

To determine the characteristics and factors associated with road traffic injuries in patients attending Thika level 5 Hospital.

1.6.2 Specific objectives:

i. To determine the characteristics of road traffic crash victims attending Thika Level 5 Hospital.

ii. To determine the injuries sustained by road traffic crash victims attending Thika Level 5 Hospital.

iii. To determine factors associated with injury severity among road traffic crash victims attending Thika Level 5 Hospital.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Burden of road traffic injuries

2.1.1 Global burden of road traffic injuries

A review of road traffic injuries based on WHO data reported that deaths from road traffic injuries account for approximately 25% of all deaths from injury (Peden *et al*., 2002). In 2002, road traffic injuries accounted for over 38 million disability-adjusted life years (DALY) lost or 2.6% of the global burden of disease. Low-income and middle-income countries account for 91.8% of the DALY lost to road traffic injuries worldwide. Low-income and middle-income countries had a rate slightly greater than the global average, while that for high-income countries was considerably lower. About 90% of road traffic deaths were in low-income and middle-income countries (Peden *et al.*, 2004).

In 1999, Sub-Saharan Africa recorded about 10% of global road deaths where only 4% of global vehicles are registered. Conversely, in the entire developed world, with 60% of all globally registered vehicles, only 14% of road deaths occurred (Jacobs & Aeron-Thomas, 2000). However, traditional reliance in Sub-Saharan Africa has always been on the use of officially published statistics based on police reports whose shortcomings include data unreliability and underreporting. According to a Global Road Safety Project

(GRSP) study, the adjusted true estimate of total road deaths for all Sub-Saharan African countries for the year 2000, based on police departments' records, ranged between 68,500 and 82,200. Based on health care data, the estimated fatalities were 190,191 in Sub-Saharan Africa as presented in the world health report on road traffic injuries of 2004 (Peden *et al*., 2004).

From a public health perspective and for the purpose of making comparisons the use of rates per 100,000 persons is a more useful measure of the size of a problem and for assessing performance over time (Toroyan *et al.*, 2009). Table 2.1 shows that the magnitude of road crashes in developing countries is several times higher than in developed countries as demonstrated by annual mortality rates of 13.4/100,000 people in Europe compared with Africa at 32.2/100,000 people (Toroyan *et al.*, 2009).

2.1.2 Regional burden of road traffic injuries

A study focused on describing the prevalence and magnitude of road crash fatalities in Kenya reported that the country had a road fatality rate of 68 deaths per 10,000 registered vehicles in 1992, one of the highest in the world (Odero et al., 2003).

Table 2.1 Modeled annual road traffic injury fatality rates (per 100,000 people) by WHO region and income group

WHO Region	High-Income	Middle- Income	Low-Income	Total
African[a]	----	32.2	32.3	32.2
The Americas[b]	13.4	17.3	----	15.8
South-East Asia[a]	----	16.7	16.5	16.6
Eastern Mediterranean	28.5	35.8	27.5	32.2
European	7.9	19.3	12.2	13.4
Western Pacific	7.2	16.9	15.6	15.6
Global	**10.3**	**19.5**	**21.5**	**18.8**

[a]No high income country [b]No low income country

Source: Toroyan *et al.*, 2009

A population survey in a rural district in Kenya found that road traffic injuries (RTI) comprised 3.6% of all injuries (Nordberg *et al.*, 2000). An injury epidemiological study conducted in Tanzania revealed that RTI were the leading cause of injury in Dar-es-Salaam, Hai, and Morogoro (Moshiro *et al.*, 2000). A study at a referral hospital in Uganda reported that road traffic injuries were the leading cause of trauma in patients attending the hospital. (Andrews *et al.*, 1999)

2.1.3 Health and economic impact of road traffic injuries

A review of studies in low-income and middle-income countries showed that RTI accounted for 30-86% of trauma admissions in these countries (Odero *et al.*, 1997). Eleven of the 15 studies that included data on hospital utilization examined the length of hospital stay. The overall mean length of hospital stay was 20 days, ranging from 3.8 days in Jordan to 44.6 days in Sharjah, United Arab Emirates. Patients who sustained spinal injury had the longest duration of hospital stay. The review further found that RTI patients comprised between 13 and 31% of all injury-related attendees in hospitals and 48% of bed occupancy in surgical wards in some countries (Odero *et al.*, 1997). In Nigeria, out of a total of 2913 trauma patients who had attended the University of Ilorin teaching hospital over a period of 15 months, 1816 (62.3%) had suffered RTI (Solagberu, 2002). A study in Tanzania based on retrospective data over three years found that road traffic crashes accounted for 18% of all patients who presented with injuries (Rutta *et al.,* 2001). In Kenya, a survey on the perceived capacity of healthcare facilities to handle more than 10 injured persons simultaneously showed that only 40% of health administrators thought that their facilities were well prepared. Of the hospitals that were least prepared, 74% were public hospitals that were the facilities of choice for the majority of the population (Nantulya & Reich, 2002).

Road traffic crashes can place a heavy burden on the family and friends of the injured person, many of whom also experience adverse social, physical and psychological

effects, in the short-term or long-term. In many low-income and middle-income countries, and sometimes in high-income countries as well, the cost of prolonged care, the loss of the primary breadwinner, funeral costs and the loss of income due to disability can push a family into poverty (Peden *et al.*, 2004).

Road traffic injuries place enormous economic strain at the national, local and individual levels. Males are consistently more likely to be injured or killed compared to females, thus increasing the number of economically disadvantaged widows and orphans (Nantulya & Reich, 2003). A study conducted by the UK Transport Research Laboratory (TRL) found that the average annual direct cost of road crashes was about 1% of GNP in developing countries, 1.5% in countries in economic transition and 2% in developed countries. The study further reports that the total annual costs of road crashes to low-income and middle-income countries are estimated to be about US$ 65 billion, exceeding the total annual amount received in development assistance (Jacobs *et al*., 2000). Direct costs include hospitalization fees, long-term medical care for the injured and loss of productivity. In reality, these costs are likely to be considerably higher than reported especially when indirect and social costs are factored into the estimates.

Road traffic injuries mainly affect the economically active age group of 15-44 years and the economic impact of injuries in this age group is especially damaging. Injuries to individuals in this age group tend to affect productivity severely particularly among the

lowest-income groups whose exposure to risk is greatest and whose earning capacity is most likely to rely on physical activity (WHO, 2001).

2.2 Global trends in road traffic injuries

Although the number of road traffic injuries has continued to rise in the world as a whole, road traffic mortality rates show clear differences in the pattern of growth between high-income countries, on the one hand, and low-income and middle-income countries on the other (Peden *et al.,* 2004). While a decrease in deaths has been recorded in high-income countries, current and projected trends in low-income and middle-income countries foreshadow a large escalation in global road traffic mortality over the next 20 years and possibly beyond (Peden *et al.,* 2004). The Global Burden of Disease (GBD) model predicts that in the year 2020 compared with 1990, road traffic deaths will increase worldwide from 990,000 to 2.34 million (representing 3.4% of all deaths). Road traffic deaths will also increase on average by over 80% in low-income and middle-income countries and decrease by almost 30% in high-income countries (Murray & Lopez., 1996). Furthermore, on current trends, by 2020, road crash injury is likely to be the third leading cause of disability-adjusted life years lost (Murray & Lopez, 1996).

2.3 Factors associated with road traffic injuries

Motor vehicle crashes result from a variety of factors, including poor road design; hazardous conditions; failure to use safety devices such as helmets and seat belts; poor vehicle maintenance; unskilled or inexperienced drivers; inattention to pedestrians and cyclists; problems related to road sharing and impairment due to alcohol, drug use and fatigue among others. All these factors are amenable to prevention, or can be abated, as evidenced by trends in high-income countries (Vinand *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, vehicle design and other engineering and safety factors have a significant impact on accident and casualty risk (Petch & Henson, 2000).

2.3.1 Number of motor vehicles and road traffic crashes

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. India, China and Vietnam, whose economies grew during the past 10-15 years, have seen rapid increases in their number of motor vehicles (Peden *et al.*, 2004).

In Vietnam, from 1992 to 2001, the number of motorcycles increased from less than 2 million to >8 million. In addition, in just one year, the number of motor vehicles in Vietnam increased by 14%, while deaths and injuries rose by 31% and 16%, respectively (Nantulya & Reich, 2003).

2.3.2 Motor vehicle speeds and road crashes

Speed has been determined to be an important contributing factor in vehicle crashes (Aljanahi *et al.,* 1999).Although the relationship between speed and road traffic crashes is a complex one, in general, the higher the speed of a vehicle, the higher the probability of becoming involved in a crash and the greater the likelihood of more severe injuries sustained. The energy dissipated during a collision of a vehicle is directly proportional to the vehicle's weight and to the square of its speed (Afukaar, 2003).

The probability that a crash will result in injury is proportional to the square of the speed; for serious injury, proportional to the cube of the speed; and for fatal injury, proportional to the fourth power of the speed (Mohan, 2002). Vulnerable road users outside motor vehicles are at especially high risk of injury from speeding motor vehicles. The probability of a pedestrian dying as a result of a car crash increases exponentially as the speed of the car increases. Older pedestrians are more vulnerable than younger ones. The probability that a pedestrian aged 65 years or more will be killed by a car moving at 75 km/h is more than 60% versus 20% for a pedestrian younger than

age 15 years (Mohan, 2002). In Ghana, speed alone was responsible for half of all traffic crashes between 1998 and 2000. In Kenya speed contributed to 44% of all police-reported crashes (Odero *et al.,* 2003).

2.3.3 Socioeconomic status and road traffic injuries

Individuals from disadvantaged socioeconomic groups or living in poorer areas are at greater risk of being killed or injured as a result of road traffic crashes (Hippisley-Cox *et al.,* 2002). Even in industrialized countries, road traffic injuries as a cause of mortality show a social class gradient, particularly in the case of children and young adults (Hippisley-Cox *et al.,* 2002). Occupation and education level and are some of the most common indicators used to assess socioeconomic status. In a cohort study carried out in New Zealand, it was found that drivers with low-status occupations and lower levels of education had a higher risk of injury, even after adjusting for confounding variables such as driving exposure levels (Whitlock *et al.,* 2003).

The choice of transport in developing countries is often influenced by socioeconomic factors, especially income. In Kenya, for example, 27% of commuters who had had no formal education were found to travel on foot, 65% used buses or minibuses and 8% travelled in private cars. By contrast, 81% of those with secondary-level education usually travelled in private cars, 19% by bus and none walked (Nantulya & Reich, 2003).

2.3.4 Geographic factors associated with road traffic injuries

A retrospective review of medical records at a medium size private hospital in Nairobi found that 53% of the road traffic injuries occurred on major city roads or highways, 16% on highways and 31% occurred on roads outside the city (Saidi & Kahoro, 2001). In a prospective study conducted at Kenyatta National Hospital, 38.2% of RTI occurred along highways, 35.2% occurred in city centre streets and other roads while 26.6% occurred in built-up residential areas (Saidi, 2003). In Colombia, traffic crashes are almost entirely an urban phenomenon, with only 10% of crashes occurring on rural highways. As a result, pedestrians made up nearly 68% of victims from traffic crashes in Bogota in 2000 (Rodriguez *et al.*, 2003).

2.3.5 Road user profile and road traffic injuries

Although all types of road users are at risk of being injured or killed in a road traffic crash, there are notable differences in fatality rates between the different categories of road users. In particular, the "vulnerable" road users such as pedestrians and two-wheeler users are at greater risk than vehicle occupants and usually bear the greatest burden of injury. This is true in low-income and middle-income countries, because of the greater variety and the lack of separation from other road users. In low-income countries and regions – in Africa, Asia, the Caribbean and Latin America – the majority of road deaths are among pedestrians, passengers, cyclists and users of motorized two wheelers (Nantulya & Reich, 2003).

A review of 38 epidemiological studies in developing countries found that pedestrian fatalities were highest in 75% of the studies, accounting for between 41 and 75% of all fatalities. Passengers were the second largest group of road users killed, accounting for between 38 and 51% of fatalities (Odero *et al.*, 1997). In Kenya, between 1971 and 1990 on average, pedestrians represented 42%, passengers 38%, drivers 12% and pedal cyclists 8% of all crash fatalities (Odero *et al*., 2003).

2.3.6 Sex and road traffic injuries

In 2002, males constituted 73% of all road traffic deaths worldwide with an overall rate almost three times that for females: 27.6 and 10.4 per 100,000 persons, respectively. A comprehensive review of 46 studies in low-income and middle-income countries found that in terms of involvement in road traffic crashes, there was a consistent predominance of males over females: males were involved in a mean of 80% of crashes, and 87% of drivers were male (Odero *et al*., 1997).

2.3.7 Age and road traffic injuries

Over 50% of the global mortality due to road traffic injury occurs among people aged 15 to 44 years and the rates are higher in low and middle income countries (Peden *et al.*, 2002). In a study conducted on road traffic crash victims attending a Nairobi hospital, it was found that the mean age was 32 years with a peak incidence in the 21-30 years age group. Males comprised 63.1% of the injured (Saidi & Kahoro, 2001).

2.3.8 Type of vehicle involved in road crashes

There is frequently an increased reliance on public transport in less developed countries. The public transportation systems are not well developed in many resource-poor countries, thus allowing informal and unregulated fare-based systems to proliferate. Commercial vehicles-taxis, trucks, buses and minibuses-are therefore disproportionately involved in traffic crashes in these countries and inflict substantial morbidity and mortality (Mock *et al.*, 1999a).

Transportation of high volumes of passengers has an impact on the safety not only of passengers themselves but also on vulnerable road users. In New Delhi, buses and trucks are involved in almost two thirds of crashes involving vulnerable road users, and these people make up over 75% of all road traffic deaths (Mohan & Tiwari, 1998*)*. In south-east Asia, there are several countries with a large proportion of two-wheeled and three-wheeled vehicles whose growth in numbers has been associated with a large rise in road traffic injuries. Examples are Cambodia (where 75% of all vehicles are motorized two-wheelers or motorized three-wheelers), The Lao People's Democratic Republic (79%), Malaysia (51%) and Viet Nam (95%). In Vietnam, the number of motorcycles grew by 29% during 2001; at the same time road deaths rose by 37% (WHO, 2003).

2.3.9 Use of protective equipment among road crash victims

Use of seat belts and helmets is usually considered an important factor affecting the severity of motor vehicle traffic crashes (Koushki *et al*., 2003). In a study conducted in Kuwait city, it was found that use of seatbelts reduced both road traffic fatalities and multiple injuries. Non-users of seat belts experienced higher frequencies of head, face, abdominal, and limb injuries while seat-belt users of suffered higher frequencies of neck and chin injuries (Koushki *et al*., 2003). The World Health Organization in the world report on Road traffic injury prevention in 2004 recommended the mandatory use of helmets for motorcycle riders and pillions (including scooters and mopeds) in all countries based on observations from independent studies (Peden et al., 2004).

2.3.10 Alcohol use and road traffic injuries

Alcohol results in impairment of judgment which increases the likelihood of a crash since it produces poor judgment increased reaction time, lower vigilance and decreased visual acuity (Global Road Safety Partnership, 2007). Apart from its direct impact on crash outcomes, alcohol is also believed to affect other aspects of driver safety such as seat-belt wearing, helmet use, and speed choice (Global Road Safety Partnership, 2007). Studies in low- and middle-income countries have shown that between 33% and 69% of fatally injured drivers and between 8% and 29% of non-fatally injured drivers had consumed alcohol before their crash (Peden *et al.*, 2004)

Although it is often difficult to attribute a crash to a particular cause or causes, decisions as to whether or not a crash was alcohol-related are often based on how much, if any, alcohol was present in the bloodstream of the road users involved. Self-reports of alcohol consumption among patients visiting an emergency department (ED) have been used in the investigation of the relationship between drinking and injury.

In a 28-site study (Cherpitel *et al.,* 2007) comparison between positive self-reports of alcohol use and high BAC (Blood Alcohol Concentration) was carried out to assess the validity of self-reports. On average, 88% of individuals with high BAC also reported alcohol consumption before injury. The study also showed that normal BAC was more likely with alcohol consumption admitted than high BAC with alcohol consumption denied. The authors concluded that the evidence supported the validity of self-report measures based on the objective criterion of BAC estimate. Similarly, another study in Switzerland concluded that there were no substantive differences between BAC measures and self-reports with 90% of patients giving consistent self-reports and objective BAC measures (Gerhard *et al.,* 2008).

2.4 Measures of severity of injury

Injury severity generally describes the impact of an injury in terms of the extent of tissue damage (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 types; 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 *et al.,* 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 *et al.*, 1999).

The Glasgow Coma Scale (GCS) was published in 1974 and is widely used for the assessment of a patient's level of consciousness. 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 Score 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. It was originally developed for use by multidisciplinary vehicular crash investigators in the

1970s as a standardized injury severity assessment tool (Sharma, 2005). The AIS 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 (Rosman *et al.*, 1996). 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 *et al.*, 1996).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Study site

The study was carried out at Thika Level 5 Hospital. The hospital is a 265-bed regional referral health facility located in Thika district, 45km north-east of Nairobi (Figure 3.1). The hospital was selected because it is traversed by two busy highways: Nairobi-Nyeri and Nairobi-Garissa. Thika District is one of the districts in Central Province, Kenya and covers an area of 1,960.2 square kilometers. It borders Nairobi City to the south, Kiambu District to the west, Maragua District to the north and Machakos District to the east. (NCAPD, 2005).

3.2 Study design

This was a cross-sectional study to determine the characteristics and factors associated with injury severity among victims of road traffic crashes attending Thika Level 5 hospital.

3.3 Study population

The study population consisted of patients injured in road traffic crashes and presenting at Thika Level 5 hospital.

3.4 Study period

The study was carried out between 10th August 2009 and on 15th November, 2009. An assumption that the number of road crash victims attending Thika Level 5 hospital was uniform throughout the year was made.

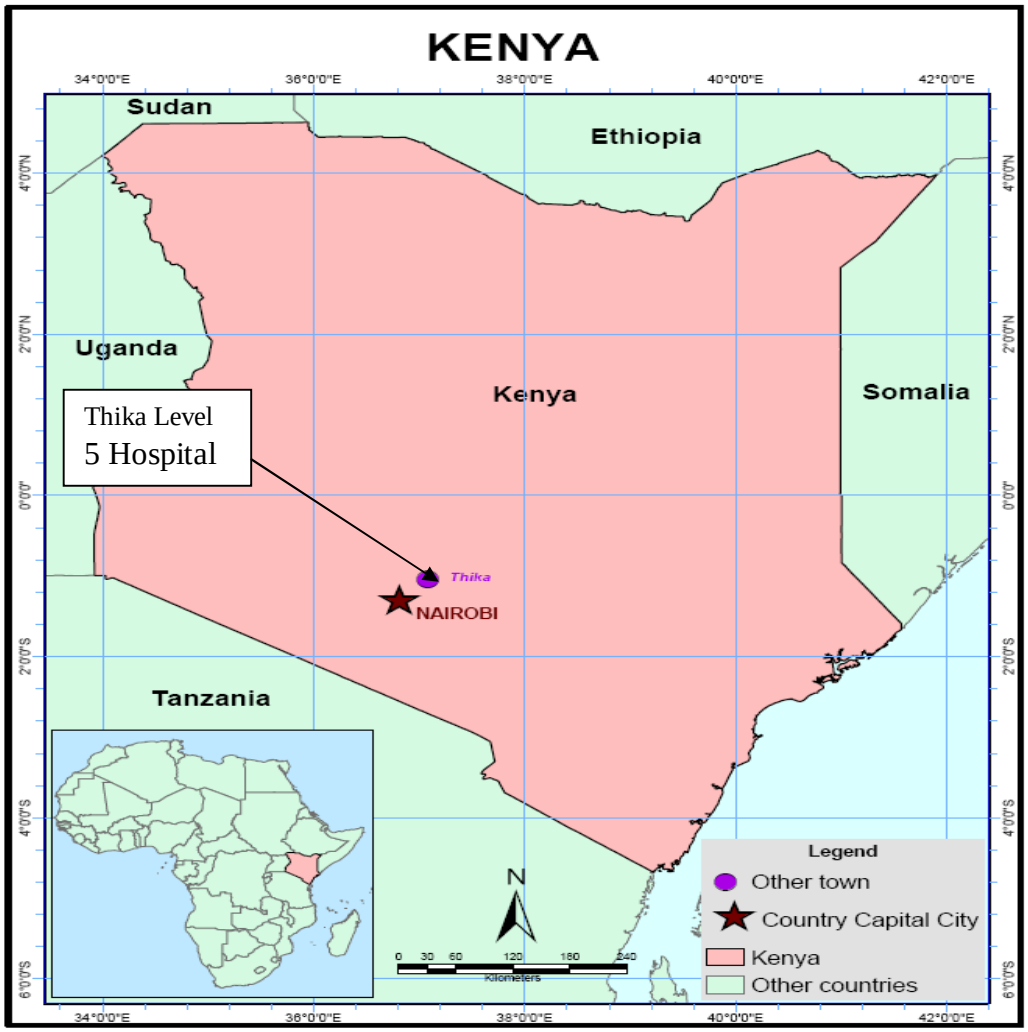


Figure 3.1 Map of Kenya showing location of Thika Level 5 Hospital

3.5 Inclusion and exclusion criteria

3.5.1 Inclusion criteria

This was any person involved in a road traffic crash and who presented for treatment at Thika Level 5 hospital within 24 hours after the road traffic crash and was also able to give informed consent or assent.

3.5.2 Exclusion criteria

This was defined as any person involved in a road traffic crash who presented to Thika Level V Hospital more than 24 hours after the road crash or any person who met the inclusion criteria but refused to give consent or assent.

3.6 Study participants' selection

Patients presenting to the hospital following road traffic crashes during the study period and meeting the inclusion criteria were recruited consecutively.

3.7 Determination of sample size

An estimation of a proportion of a variable based on previous studies was used in calculating the sample size (Bartlett *et al.*, 2001). The proportion of cyclists was used in determining the minimum sample size.

A study at Kenyatta National Hospital reported that cyclists constituted 2.2% of the road users (Akama *et al.*, 2003), 7.6% in a study in a private hospital in Nairobi (Saidi &

Kahoro, 2001) while a medium sized hospital based study in Uganda reported 24.7% (Andrews *et al.*, 1999).

Based on the hospital study in Uganda, an assumption that the proportion of cyclists among road crash victims attending Thika Level 5 Hospital is 25% was made. The sample size for the study was calculated using Cochran's formula (Bartlett *et al.*, 2001) as shown below.

$$\text{Sample size} = \frac{z^2 * p\,(1-p)}{d^2} = \frac{(1.96^2 * 0.25 * 0.75)}{(0.05)^2}$$

$$= 289$$

Where:

p: assumed proportion of cyclists among road crash victims attending Thika Level 5 Hospital (25%)

d: absolute precision (5%)

z: corresponding value at 95% confidence level (1.96)

3.8. Data collection

3.8.1 Semi-structured questionnaire

A semi-structured questionnaire was developed for data collection during the study period (Appendix 1). The questionnaire was interviewer administered and data were

collected on a 24 hour basis. Pre-testing of the questionnaire to remove ambiguity and clarify response categories was carried out two weeks before the study began. Three research assistants were recruited and underwent a two-day training to ensure consistency in data collection. The training covered enrolment procedures for the study, informed consent process, data collection tools and interview techniques.

Data collected included demographic, clinical, road user category, road condition and road crash related circumstances. Clinical data and time of arrival in hospital were recorded from the medical charts. Data on condition of the road, weather conditions and road crash circumstances were obtained from the participant, the police or the people who brought the participant to hospital, if the participant was unable to give the information. Injury severity was coded by the principal investigator.

The study purpose, risks and benefits were explained and informed consent/assent obtained from the participants before enrollment. The data were collected by the interviewers from the injured person, if found conscious and oriented in time, place and person. However, if the patient was brought to the hospital unconscious or disoriented, data were collected from the patient's attendant. For road crash victims brought to the hospital unconscious, informed consent/assent was first obtained from the patient's attendant and then from the patient when the condition allowed. The patients were interviewed after they had received initial medical care.

3.8.2 Measurement of injury severity

Injury severity was measured based on the Injury Severity Score (ISS) which provides 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 and External) (Sharma, 2005). Only the highest AIS score in each body region was used. The three most severely injured body regions had their AIS score 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 was graded as severe, moderate or mild based on the Injury Severity Score (ISS). Severe injury was defined as an ISS >15, moderate injury an ISS from 9-15 and mild injury an ISS $\leq$ 8 (Saidi, 2003).

3.9 Data analysis

Data was validated, cleaned, analyzed using Epi-info statistical software (Epi Info 3.5.1, 2008). Univariate analysis of frequencies 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 road crash victims were divided into two groups for the analysis of factors associated with injury severity. The grouping was based on the Injury Severity Score with the first group comprising those with moderate or severe injury (ISS >8) and second group those with mild injury (ISS of 1to 8).

The odds ratio (OR) was used as a measure of association to compare whether the probability of sustaining moderate/severe injury compared to mild injury was the same for various factors. Crude odds ratio (cOR) was the odds ratio for two groups before controlling for confounders while adjusted odds ratio (aOR) was the odds ratio after controlling for confounders. An OR of more than 1 was taken to be risk while an OR of less than 1 was taken to be protective. An OR of 1 indicated that there was no association between the factor and severe injury. Confidence interval of 95% was used to assess the variability and significance of the OR. A confidence interval of OR which included 1 was interpreted to be not significant.

Multivariate logistic regression was used to identify significant factors associated with injury severity and estimating the magnitude of the adjusted odds ratios (aOR) for each significant factor while controlling for other confounding factors. The aOR of significant factors and the 95% confidence intervals (CIs) were computed by stepwise backward elimination process. A variable with a P-value of <0.05 was taken to be significantly associated with injury severity.

The functional form of the logistic regression model is given below.

$$log\left(\frac{p}{1-p}\right) = b_0 + b_1x_1 + b_2x_2 + \ldots.$$

Where:

log - the natural logarithm (base e)

p = probability of sustaining moderate/severe injury (dependent variable)

b_o, b_1 and b_2 are regression coefficients

x_1 and x_2 represents the independent variables entered into the model

3.10 Ethical Considerations

No personal identifiers were collected during the study. Confidentiality was observed for all information obtained which was then stored in password protected computers. 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 road crash victims who were minors. Informed assent was obtained from participants less than 18 years (Appendix 2). There were no incentives or coercion to participate. The respondent was free to withdraw from the study if they changed their mind during the study. Study approval from the Ministry of Education, Science and Technology was sought and granted (Appendix 3). Ethical approval was sought and granted from Hospital Ethics Committee of Thika Level 5 Hospital (Appendix 4).

CHAPTER FOUR

4.0 RESULTS

4.1 Characteristics of road crash victims

4.1.1 Socio-demographic characteristics of road crash victims

The demographic characteristics of the road crash victims enrolled and interviewed during the study period are presented in Table 4.1. Majority of the road crash victims were male (72.7%). The mean age of the road crash victims was 32.4 years (range 3-75 years), while 75% (225) were aged between 20-49 years. The difference in proportions in occupation between males and females was statistically significant (Chi-square=18.4, df=3, P=0.0004). Approximately half of the participants had at least primary level of education with 49% having secondary level of education and above. A quarter of the female road crash victims had post-secondary education compared to 11% of males. The difference in proportions in level of formal education between males and females was statistically significant (Chi-square=11.2 df=3, P=0.0107).

Table 4.1 Demographic characteristics of road crash victims, Thika Level 5 Hospital, 2009

Characteristic	**Female (n=82)**	**Male (n=218)**	**Total (n=300)**
	No. (%)	**No. (%)**	**No. (%)**
Age range (years)	5-75	3-73	3-75
Age group (years)			
<20	11(13.5)	29(13.3)	40(13.3)
20-29	22(26.8)	71(32.6)	93(31.0)
30-39	23(28.0)	70(32.1)	93(31.0)
40-49	15(18.3)	249(11.0)	39(13.0)
>49	11(13.4)	24(11.0)	35(11.7)
Occupation			
Formal Employment	33(40.2)	85(39.0)	118(39.3)
Informal Employment	28(34.2)	110(50.5)	138(46.0)
Student/child	12(14.6)	17(7.8)	29(9.7)
Unemployed	9(11.0)	6(2.7)	15(5.0)
Education			
None	1(1.2)	5(2.3)	6(2.0)
Primary	39(47.6)	108(49.5)	147(49.0)
Secondary	21(25.6)	81(37.2)	102(34.0)
Post-Secondary	21(25.6)	24(11.0)	45(15.0)

4.1.2 Mode of transport used by road crash victims

The road traffic crashes were analyzed by mode of transport (Figure 4.1). Participants who travelled by matatu or bus were 45.6%, one third were either pedestrians or two wheel vehicle users, 14.7% were using cars while 6.7% travelled in a pickup or lorry

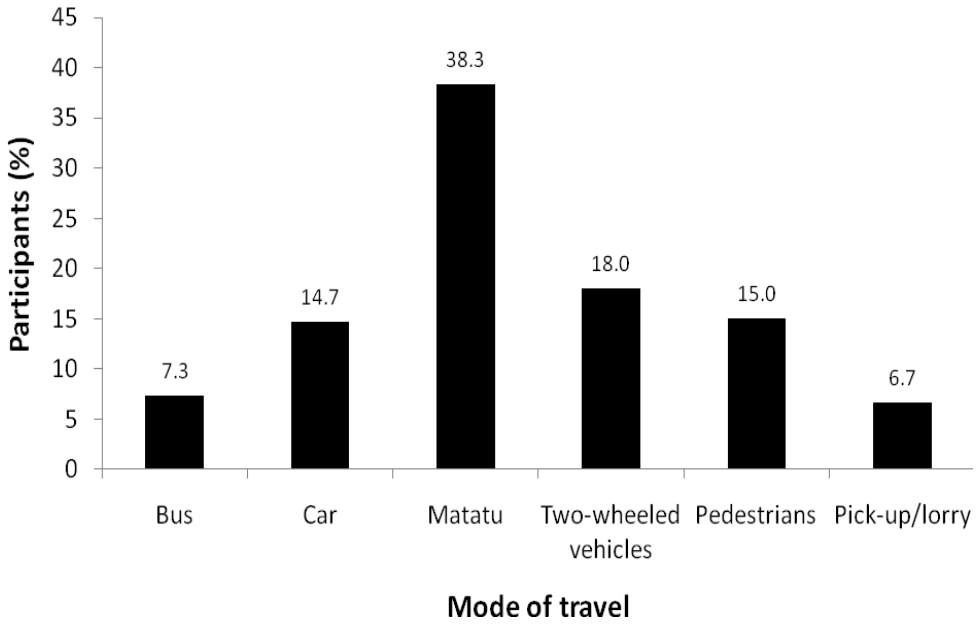


Figure 4.1 Mode of travel used by victims of road crashes, Thika Level 5 Hospital, 2009

4.1.3 Category of road users among road crash victims

Majority (63%) of the participants were travelling as passengers at the time of crash, pedestrians comprised 15% while drivers and riders/cyclists comprised 22% of the participants (Figure 4.2).

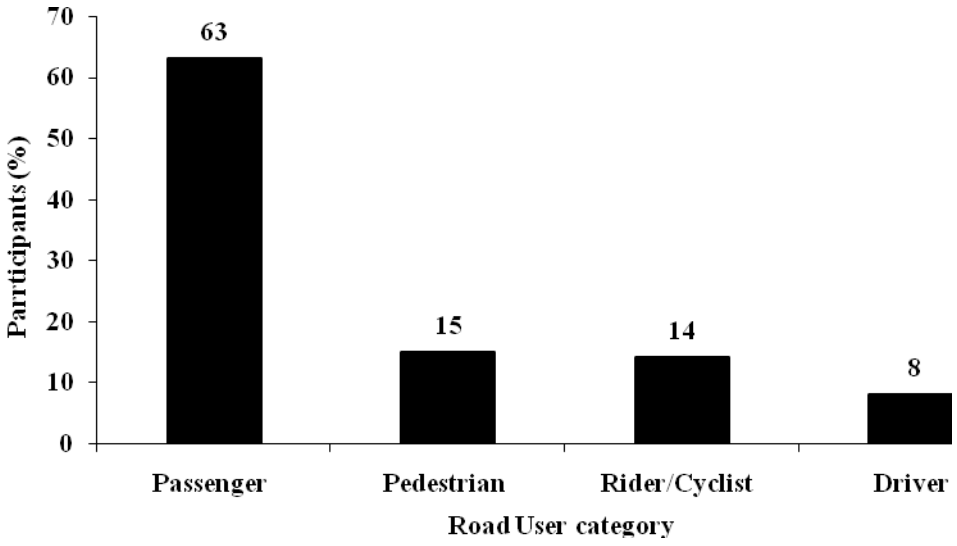


Figure 4.2 Road user category of victims of road crashes, Thika Level 5 Hospital, 2009

Vulnerable road users (pedestrians and two-wheel vehicle users) comprised 33% (99) of all the road crash victims. Vulnerable road users were compared to vehicle occupants on some socio-demographic variables. The differences in proportions of sex, occupation and education between the vulnerable road users and vehicle occupants were significant

(Table 4.2). The mean age of vulnerable road users was lower at 30.6 years compared to the other road users (33.3 years). However, the difference in means of age was not significant (T statistic=1.65, P=0.1001).

4.1.4 Use of protective equipment by road crash victims

Self-reported information on the use of seatbelts or helmets indicated that 47.4% (n=255) of the vehicle occupants and two wheel vehicle users reported use of either of them at the time of the crash. Almost half of vehicle occupants (n=201) and 39.6% (n=54) of the users of two-wheeled vehicles reported seatbelt and helmet use respectively.

4.1.5 Day of week and time of day of road crash

Majority (72.3%) of the road crash victims were involved in a road crash occurring between Friday and Monday, 12% were involved in a crash on Wednesday while 15.7% were involved in a crash either on Tuesday or Thursday (Figure 4.3).

Figure 4.4 shows the time of day when road crash occurred. Majority (68.7%) of the road crash victims were involved in a road crash in the afternoon or evening, 29.3% were involved in the morning while 2% were involved in early morning.

Table 4.2 Socio-demographic characteristics of vulnerable users and vehicle occupants among road crash victims, Thika Level 5 Hospital, 2009

Characteristic	Vulnerable road users (n=99) No. (%)	Vehicle occupants (n=201) No. (%)	P-value
Sex			
Female	12(14.6)	70(83.3)	
Male	87(39.9)	131(60.1)	<0.0001*
Age group			
<20 yrs	14(35.0)	26(65.0)	
20-29 yrs	38(40.9)	55(59.1)	
30-39 yrs	29(31.2)	64(68.8)	
40-49 yrs	9(23.1)	30(76.1)	
>49 yrs	9(25.7)	26(74.3)	0.2500
Occupation			
Formal employment	24(20.3)	94(79.7)	
Informal employment	65(47.1)	73(52.9)	
Student/child	6(20.7)	23(79.3)	
Unemployed	4(26.7)	11(73.3)	<0.0001*
Education			
None	2(33.3)	4(66.7)	
Primary	62(42.2)	85(57.8)	
Secondary	26(25.5)	76(74.5)	
Post-Secondary	9(20.0)	36(80.0)	0.0087*

*Significant P-values

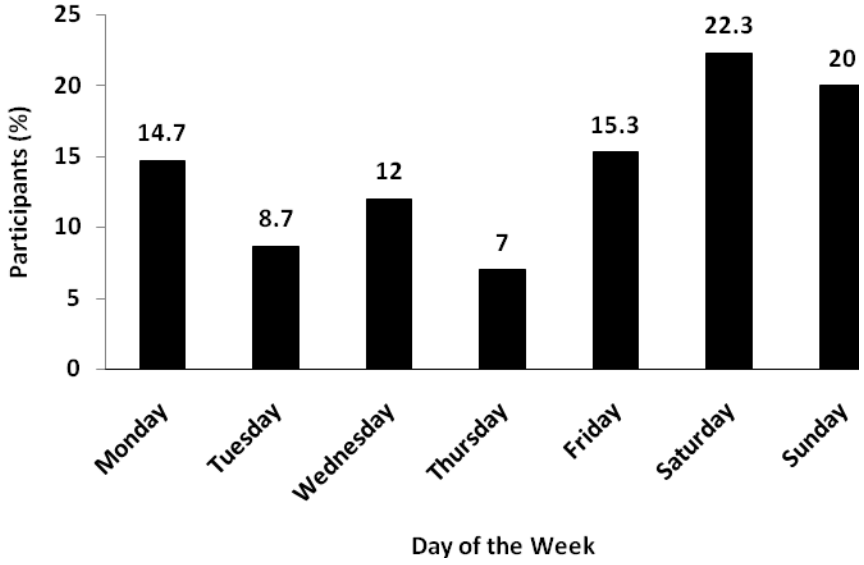


Figure 4.3 Day of the week when patients attending Thika Level 5 Hospital were involved in a road crash, Thika, 2009

4.1.6 Suspected alcohol use among road crash victims

Among the road crash victims who were drivers 25% (n=24) were suspected to have used alcohol based on self reports and breathe odor. Ten percent (n=42) of riders and cyclists were suspected to have used alcohol.

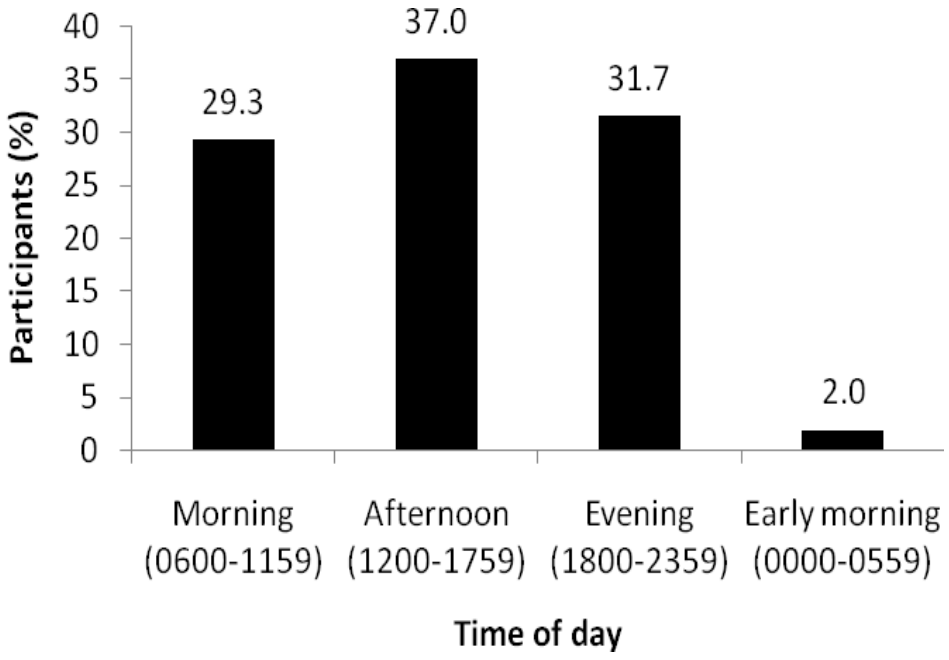


Figure 4.4 Time of day when patients attending Thika Level 5 Hospital were involved in road crash, Thika, 2009

4.1.7 Position of road crash victim in vehicle or on road

Among the road crash victims who were vehicle occupants, 34.8% (n=201) reported that they were occupying the front seat while 35.8% reported occupying the back seat. Occupation of other seats other than the front and back seat at the time of road crash was reported by 20.9% of vehicle occupants. Among the pedestrian road crash victims, 75.6% (n=45) reported that they were involved in a road crash while on the road while 24.4% were on a footpath or verge of the road.

4.1.8 Characteristics of the road crashes

Eighty percent (240) of the road crash victims were involved in road traffic crashes on highways while in 20% (60), the road crash occurred in rural or urban roads. When asked about type of collision at the time of the road crash, majority (60.4%) of the road crash victims reported that they were either angled or head-on collisions.

Approximately two-thirds of the road crash victims were involved in a road crash occurring on a straight and flat stretch of the road, in 28.7% the road crash occurred on a curved section of the road and in 2.7% the road crash occurred at a corner or junction (Figure 4.5). Eight percent (23) of the road crash victims were involved in road crashes occurring in pot-holed sections of the road for 92% the road crash occurred on roads in good condition.

4.1.9 Evacuation and disposition of road crash victims

Evacuation of the injured to hospital was by taxi or other private vehicle (89%), police vehicles (6.3%), ambulance (3%) and self (1.7%). Twenty percent (60) of all road crash victims were admitted following the injuries sustained and 74.7% (224) were treated and discharged. Eight (2.7%) road crash victims died at the casualty department and 2.7% (8) of the road crash victims were referred to other hospitals because of the nature of their injuries or patient preference.

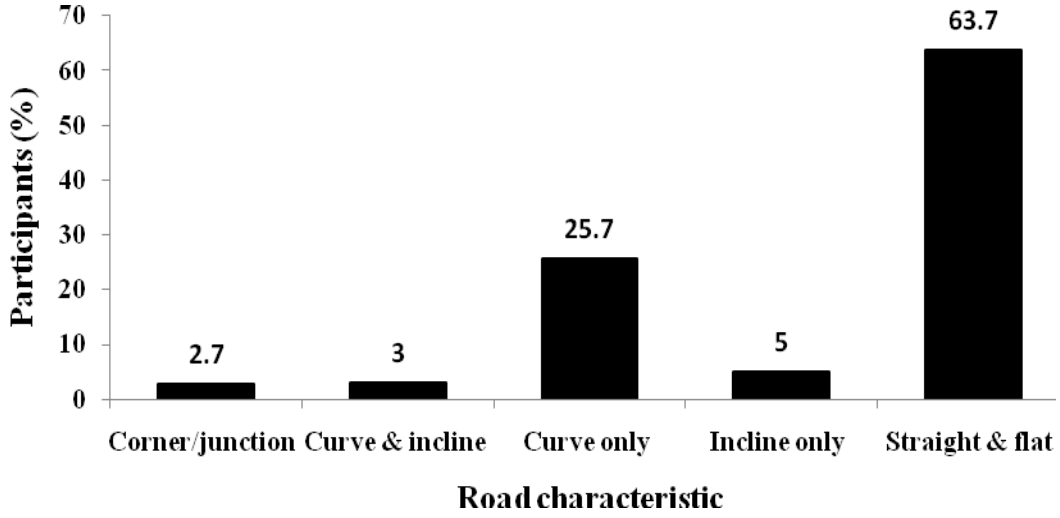


Figure 4.5 Road curvature where road crash occurred as reported by road crash victims attending Thika Level 5 Hospital, Thika, 2009

4.2 Injuries sustained by road crash victims

4.2.1 Pattern of injuries by body region

Table 4.3 summarizes the injuries sustained by the road crash victims to the various body regions. Most of the injuries were to the head and neck region and lower extremities. Among road crash victims who sustained head injury, 73.3% (11) were vulnerable road users while 26.7% (4) were vehicle occupants (Table 4.3). This difference in proportions was significant (Chi-square=8.07, df=1, P=0.004).

4.2.2 Severity of injury

Moderate injury was observed in 12.3 % (37) of the road crash victims while 6.3 % (19) had severe injury (Table 4.4). The proportion of vulnerable road users who had moderate or severe injury (25.3%) was higher than that of vehicle occupants of 15.5% (Table 4.4).

4.3 Factors associated with injury severity

Nineteen percent (56) of the road crash victims sustained moderate or severe injury while 81% (244) of the road crash victims had mild injury. The severity of injury was not significantly associated with the participants' sex, mean age, occupation or education level (Table 4.5).

Factors associated with injury severity were analyzed and results are presented in Table 4.6. Four factors were significant at $\alpha = 0.05$. Road crash victims who were vulnerable road users were more likely to have moderate/severe injury (cOR=1.8 P=0.0304) compared to vehicle occupants.

Table 4.3 Injuries sustained by victims of road crashes, Thika Level 5 Hospital, 2009

Body region injured*	Vulnerable users (n=99) No. (%)	Vehicle occupants (n=201) No. (%)	Total (n=300) No. (%)
Head and neck			
Superficial injury	60(60.6)	130(64.7)	190(63.3)
Laceration	4(4.0)	2(1.0)	6(2.0)
Fracture	5(5.1)	2(1.0)	7(2.3)
Head injury	11(11.1)	4(2)	15(5.0)
Thorax and abdomen			
Superficial injury	7(7.1)	2(1.0)	9(3.0)
Fracture	9(9.1)	8(4.0)	17(5.7)
Upper extremity			
Soft tissue injuries	13(13.1)	32(15.9)	45(15.0)
Fracture	9(9.1)	16(8.0)	25(8.3)
Lower extremity			
Soft tissue injuries	48(48.5)	65(38.3)	113(37.7)
Lacerations	4(4.0)	3(1.5)	7(2.3)
Fracture	32(32.3)	41(20.4)	73(24.3)

*Not mutually exclusive

Table 4.4 Assessment of severity of injury using the ISS among victims of road crashes, Thika Level 5 Hospital, 2009

Injury Severity Score	Vulnerable Users No. (%)	Vehicle Occupants No. (%)	Total No. (%)
1-8	74(74.7)	170(84.6)	244(81.3)
>8-15	17(17.2)	20(10.0)	37(12.3)
>15	8(8.1)	11(5.5)	19(6.3)

Similarly night-time road crashes (cOR=2.4, P= 0.0039) and crashes in rainy weather (cOR=2.9, P=0.008) were more likely to result in moderate/severe injury compared to daytime crashes and crashes in fair weather, respectively. Travelling in a matatu or bus was less likely (cOR=0.5, P=0.0189) to result in moderate/severe injury compared to other road users. Road crashes occurring on a highway were more likely to result in moderate/severe injury compared to crashes on other roads although the association was not significant (cOR=1.7 P=0.1705)

Table 4.5 Comparison of socio-demographic characteristics of victims of road crashes with moderate/severe injury and mild injury, Thika Level 5 Hospital, 2009

Variable	**Moderate/severe injury(n=56) No. (%)**	**Mild injury(n=244) No. (%)**	**P-value**
Sex			
Female	16(28.6)	66(27)	0.4681
Male	40(71.4)	178(73)	
Mean Age (SD)	32.5(12.4)	32.4(13.4)	0.9371
Occupation			
Formal Employment	22(18.7)	96(81.4)	
Informal Employment	25(18.1)	113(81.9)	0.9654
Student/child	6(20.7)	23(79.3)	
Unemployed	3(20)	12(80)	
Education			
None	0(0.0)	6(100.00	
Post-Secondary	31(21.1)	116(78.9)	0.3375
Primary	15(14.7)	87(85.3)	
Secondary	10(22.2)	35(77.8)	

Table 4.6 Bivariate analysis of factors associated with injury severity in victims of road crashes, Thika Level 5 Hospital, 2009

Variable	Moderate/severe injury (n=56) No. (%)	Mild injury (n=244) No. (%)	cOR (95% C.I.)	P-value
Vulnerable road users				
Yes	25(25.3)	74(74.7)	1.8(1.0,3.4)	0.0304*
No	31(15.4)	170(84.6)		
Helmet use				
Yes	4(19.0)	17(81.0)	0.6(0.2,2.3)	0.3397
No	9(28.1)	23(71.9)		
Weekend				
Yes	38(22.0)	135(88.0)	1.7(0.9,3.2)	0.1184
No	18(14.2)	109(85.3)		
Highway				
Yes	49(35.0)	191(65.0)	1.9(0.8,4.5)	0.1705
No	7(11.7)	53(88.3)		
Rainy weather				
Yes	13(36.1)	23(63.9)	2.9(1.4,6.2)	0.008*
No	43(16.3)	221(83.7)		
Night time crash				
Yes	28(28.0)	72(72.0)	2.4(1.3,4.3)	0.0039
No	28(14.0)	172(86.0)		
Use of matatu/bus				
Yes	17(12.5)	119(87.5)	0.5(0.2,0.9)	0.0189*
No	39(23.8)	125(76.2)		
Suspected alcohol use				
Yes	5(22.7)	17(87.3)	0.9 (0.3,2.8)	0.5700
No	20(24.1)	63(75.9)		
Seat belt use				
Yes	14(14.1)	85(85.9)	0.8(0.4,1.8)	0.3710
No	17(16.8)	84(83.2)		

*Significant p values

Multivariate logistic regression was carried out and three factors were statistically significant in the final model. Road crash victims who were vulnerable road users (aOR=2.0, P=0.0446) and those involved in road crashes in rainy weather (aOR=2.9, P=0.0075) or at night (aOR=2.0, P=0.0238) were more likely to sustain moderate/severe injury than mild injury (Table 4.7).

Table 4.7 Final model of logistic regression of factors associated with injury severity among road crash victims, Thika Level 5 Hospital, 2009

Variable	**Adjusted Odds Ratio**	**95% C.I.**	**P-value**
Vulnerable Road Users	2.0087	1.02,3.92	0.0446*
Rainy weather	2.9477	1.33,6.51	0.0075*
Nighttime Road Crash	2.0775	1.10,3.92	0.0238*

*Significant P values

CHAPTER FIVE

5.0 DISCUSSION

Majority of the participants in this study were males with a male: female ratio of 2.7:1. This is consistent with findings from other studies in Kenya (Odero *et al*., 2003) and in other low-income and middle-income countries (Odero *et al.*, 1997). In the study on low and middle income countries (Odero *et al.,* 1997) the higher proportions of males was reported to be probably due to the greater exposure to traffic as drivers or riders and as frequent travelers in motor vehicles for work of the males as compared to females.

In this study, three-quarters of the road crash victims were aged between 20-49 years. Similar age distribution of road crash victims was reported in other studies in Eldoret, Kampala and in a Kenyan country epidemiologic review (Odero & Kibosia, 1995; Andrews *et al.,* 1999; Odero *et al.,* 2003). The involvement of this economically active and productive age group results in a huge economic loss at individual, family and societal levels (Peden *et a., 2004).* The proportion of road crash victims in any form of employment (80%) was higher than that of a similar study in Ghana of 64% (Mock *et al.,* 1999b). While the difference could be due to the use of different criteria for classifying employment status, the finding could be because those who go to work are more exposed to the risk of a road crash.

In this study car occupants comprised the majority of road crash victims (70.7%) consistent with findings of a study in Eldoret (Odero *et al.*, 2003). The proportion of two wheel vehicle users in this study was higher than 5.9% reported in a retrospective hospital based study in Nairobi (Saidi & Kahoro, 2001) and 11.7% in a prospective hospital-based study in Eldoret (Odero *et al.*, 2003). Comparatively, two wheel vehicle crashes accounted for 80% of the road traffic injuries in Thailand and more than 50% of the traffic deaths in Malaysia (Mau-Roung & Kraus, 2009). In these two Asian countries two-wheelers represent more than 50% of all registered vehicles (Mau-Roung & Kraus, 2009) compared to Kenya where motor cycles comprised 7.7% of all licensed vehicles in 2005 based on unpublished data from the government. Studies from Asian countries suggest that as two wheel vehicle use increases their contribution to road crashes and injuries also increases (Peden *et al.*, 2004).

Use of seat belts in closed vehicles and helmets by two wheeled vehicle users is usually considered an important factor affecting the severity of injury during road crashes. Seatbelts help in reducing severity of injury by restraining the seat occupant from the high-speed jarring movement during a crash while helmets protect the head from the heavy impact with the road surface (Hazen *et al.*, 2006). Use of seatbelts in this study was higher than findings (27.4%) of a study at a Nairobi hospital and a study in Qatar which reported seatbelt use of 33% (Saidi, 2003; Munk *et al.*, 2008). Use of helmets by two wheel vehicle users was higher than a study in Nigeria on motor cycle injuries

which reported helmet use of 3.5% (Oluwadiyaa *et al.*, 2009) In this study, the use of seatbelts or helmets was not protective against severe injury compared to mild injury.

An important factor that is associated with road traffic crashes is the day of week (Peden *et al.*, 2004). The results obtained in this study showed that 72.3% of the road traffic injuries occurred between Friday and Monday with a peak on Saturday. This is consistent with findings of a study at Kenyatta National Hospital but whose peak was Friday (Akama *et al.*, 2007) and in Nepal where half of the crashes occurred on Friday and Sunday (Nilambar & Chandra, 2004).

Road users impaired by alcohol have a significantly higher risk of being involved in a crash (Global Road Safety Partnership, 2007). In this study 25% of drivers were suspected to have used alcohol which is lower than 40% among drivers reported in a hospital based survey in Eldoret, Kenya (Odero, 1998). The proportion of riders and cyclists suspected to have used alcohol was lower than 30% reported in a survey among two wheel vehicle users in Ife-Ife, Nigeria (Oginni *et al.*, 2007). These differences could be due to the methods used in assessing alcohol levels. The studies in Eldoret and Nigeria used blood alcohol level measurements to assess the influence of alcohol which could be more objective than the self reporting used in this study.

In this study, three-quarters of the pedestrians involved in a road crash were walking or crossing the road at non-designated areas. This could be due to the lack of separation between motorized and non-motorized traffic in Thika which leads to mixing of slow-moving and fast-moving traffic hence increasing the likelihood of a road crash. Majority of the road crashes in this study occurred on straight and flat sections of the road similar to findings of a study on motorcycles crashes in Nigeria (Oluwadiya *et al.*, 2009).

The prompt and safe evacuation of road 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 a by private vehicle (89%) which is similar to findings elsewhere in Kenya (Hazen *et al.*, 2006) and Uganda (Andrews *et al.*, 1999). A comparative study of mortality among seriously injured patients across a range of countries of different economic levels found that for low and middle income countries, the vast majority of deaths occurred in the pre-hospital phase (81% for Ghana) (Mock *et al.*, 1998). The finding in this study that only 3% of the road crash victims were evacuated by ambulance would be 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 road crash scenes.

The most common part of the body injured was the head and neck followed by the lower extremity. This is consistent with findings in New Delhi where the most common pattern of injury was head (18.9%) followed by fractures of lower limb (17.8%) (Malhotra *et al.*, 2005). Abrasions and lacerations were the commonest types of injuries among the soft tissue injuries noted in this study. On analysis by road user type, vulnerable road users accounted for two-thirds of head injuries which is higher than 55% reported in study at a national referral hospital in Kenya (Akama *et al.*, 2007). Vulnerable road users also accounted for 45% of those with of moderate/severe injury although they constituted 33% of the road crash victims. The higher proportion of head injury and moderate/severe injury among vulnerable road users is expected because in most instances they are knocked down by other vehicles leading to more severe injury and are not as protected as those inside vehicles.

On bivariate analysis, use of matatu or bus was found to be protective against severe injury compared to other modes of transport although the association was not significant on multivariate analysis. This may be explained by the large number of people transported in matatus and buses where most sustained mild injury therefore decreasing the overall proportion of victims sustaining severe injury among matatu and bus users.

Being a vulnerable road user, during rainy weather and night time crashes were significantly associated with injury severity. The findings that vulnerable road users

were more likely to sustain moderate/severe injury compared to vehicle occupants are consistent with other studies in Africa and Asia (Odero *et al.*, 2003; Yang & Kim, 2003). This could be because of free mixing of slow-moving road users with fast-moving vehicles. The absence of adequate separation of pedestrian and cyclist facilities from other motorized traffic probably increases the risk of a road traffic injury for these road users.

Road crashes during rainy weather and at night were independent risk factors for moderate/severe injury compared to crashes in fair weather and daytime crashes respectively. These findings are similar to those reported in case-control studies in Iran (Majdzadeh *et al.*, 2008) and Hong Kong (Yau & Kelvin, 2004). This could be due to slippery roads during rainy weather and decreased visibility at night or in rainy weather which increases the likelihood of a high impact road crash.

5.1 Study limitations

5.1.1 Information bias

Information on the nature and circumstances of the road traffic crash was based on the road crash victims' perception and recall. This could affect the validity of the information obtained. This bias was minimized by corroborating the patient's account with that of other patients involved in the same road crash and attending the hospital or the police. Recall bias was minimized by conducting the interview as soon as was

feasible after admission and limiting the participants to those who were involved in road crashes within 24 hours before admission.

5.1.2 Selection bias

The use of a cross-sectional study was limiting in assessing the factors associated with road crashes because the comparison groups were selected after recruitment of participants. This bias was probably minimal because there were no significant differences in the proportions of some socio-demographic variables between the comparison groups. The findings may not be representative of the catchment population of the hospital because some patients with minor injuries may not have come to the hospital, pre-hospital fatal cases were not brought to the hospital and some patients were treated in other facilities.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

A hospital based cross-sectional study was conducted to determine the characteristics and factors associated with road traffic injuries in patients attending Thika Level 5 hospital.

The majority of the road crash victims were in the economically active and productive age group of 20-49 years with males forming the majority. The proportion of road crash victims who were travelling in two-wheeled vehicles was higher than reported in previous studies.

Evacuation of victims from road crash sites was mostly by private vehicles and most of the injuries were to the head and neck region. Independent risk factors for moderate/severe injury were vulnerable road users, road crash in rainy weather and night time crashes. Based on the study findings the null hypothesis was rejected and the alternate hypothesis adopted.

6.2 Recommendations

There is need to;

- Encourage and enforce use of protective equipment like helmets among two wheel users
- Have policies and efforts to enhance visibility at night and in rainy weather

- Strengthen pre-hospital care by identifying and training first responders

Areas for further research:

- Observational studies on helmet and seat belt use
- Cross sectional studies including private facilities' and mortuaries' data
- Studies using objective alcohol level measures to identify contribution of alcohol to road crashes

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APPENDICES

Appendix 1: Questionnaire

Characteristics and Factors Associated with Road Traffic Injuries in Patients Attending Thika Level 5 Hospital

1.Questionnaire Number _____	2. IP/OP Number_____
3. Date of interview (dd/mm/yy _____/_____/_____	4. Interviewer initials _____

Demographic data

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

7. Age of patient _____ Residence_____

8. Occupation of patient

☐ Farmer ☐ Casual labourer ☐ Businessman

☐ Salaried employment_____ ☐ Child

☐ Informal employment _____ ☐ Student

☐ Other (specify) _____ ☐ Unemployed

9. Highest level of formal education attained

☐ None ☐ Primary ☐ Secondary

☐ Post-secondary ☐ Other (specify) _____

Injury Related Factors

10. Vehicle involved. What was the mode of transport/vehicle used by injured person?

☐ Pedestrian ☐ Motor bike ☐ Bicycle ☐ Three- wheeled vehicle

☐ Car ☐ Matatu ☐ Mini-bus/Bus ☐ Handcart

☐ Pick-up ☐ Truck/lorry

Other(specify)_____

11. Type of Road User

☐ Pedestrian ☐ Driver ☐ Rider/Cyclist
☐ Passenger ☐ Unkown
☐ Other(specify)_____-

12. Were you wearing a helmet at the time of accident? **(for motorcycle and bicycle users)**

☐ Yes ☐ No ☐ Not established

13. Did you have a seatbelt on at the time of the accident?**(for vehicle passengers/driver)**

☐Yes ☐No ☐ Not established

14. What was the position of the passenger (from vehicle or cycle) at the time of accident? **(for passengers)**

☐Front seat ☐ Rear seat ☐ M/cycle passenger
☐ Other Bus/matatu seat ☐ Back of truck or pickup ☐ Not Applicable
☐Other(specify)_____

15. Where was the pedestrian at the time of the accident? **(Pedestrians only)**

☐On pedestrian Crossing ☐ Near Pedestrian crossing(within 50 metres)
☐ On the road ☐ On Footpath/Verge
☐ Not Applicable ☐ Other(specify)_____

16. How was the patient transported to hospital?

☐ Ambulance ☐ Police vehicle ☐ Taxi/Other vehicle Self ☐ ☐ Not Established
☐ Other(Specify)_____

17. What was the duration between the time of accident and arrival at casualty? _____Hrs

Road Crash Related Factors

18. Date when accident occurred ----------

19. On which day of the week did the accident occur?

☐ Sun ☐ Mon ☐ Tues ☐ Wed

☐ Thurs ☐ Fri ☐ Sat ☐ Not Established

20. At what time did the accident occur? _____

21. On which road did the accident occur?

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

☐ Not Established ☐ Other(specify)_____

Place where accident occurred_____

22. 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)_____

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

☐ Fair ☐ Rain ☐ Foggy

☐ Smoke/ Dust ☐ Not Established

☐ Other(specify)_____

24. 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)_____

25. How was the road condition?

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

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

☐ Yes ☐ No ☐ Not established

27. What was the surface type of the road?

☐ Tarmac ☐ Gravel ☐ Earth/Murram ☐ Not established

28. How were the surface conditions of the road?

☐ Dry ☐ Wet ☐ Muddy ☐ Flooded

☐ Not established ☐ Other(specify)_____

29. Had you taken/used alcohol in the last 6 hours before the accident?
(Drivers/Riders/Cyclists/Pedestrians)

☐ Yes ☐ No ☐ Not established

30. Was alcohol use suspected **(smell of breath for drivers/riders/cyclists/pedestrians)**

☐ Suspected ☐ Not suspected

☐ Not Established

31. What time did you start driving today before the accident happened?**(for drivers/ riders/cyclists)**

_____

Period of time driving/riding before accident _____Hrs

32. What time do you (driver/rider) normally work?**(for drivers/cyclists/riders)**

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

☐ Not established ☐ Not applicable

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

Specific Injuries

Vital Signs BP_____ HR_____ RR _____Temp**.** _____

G.C.S_____

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

Was the patient taken/planned for theatre?

☐ Yes ☐ No ☐ Not Established

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		
I.S.S		

Appendix 2: Consent Forms

Consent Form A: Informed Consent Form for Patients Aged 18 years and above

My name is _____a researcher/assistant in a study on road traffic injuries reported in this hospital.

I am going to give you information and then invite you to participate in this study. Your decision to participate in this study is entirely voluntary. If you choose not to consent, all the services you receive at this hospital will continue and nothing will change.

We are studying all people who come to this hospital after involvement in a road traffic crash. Road traffic crashes have become common in this country resulting in injuries which can be long term, monetary losses in damages and even death. The purpose of this study is to record the road traffic injuries reported in this hospital and write a report which may help understand more about road traffic injuries. We are therefore inviting you to participate because you were involved in a road traffic crash.

We are going to ask you some questions about yourself and the accident which will take about 20 minutes. We will also get more information about your injuries from the medical notes. The information that we collect from this research will be kept confidential. Information about you that will be collected from the research will be put away and no-one but the researcher will be able to see it. Any information on you will have a number on it instead of your name. Only the researcher will know what the number is and we will lock up that information.

If you have any questions or clarifications about the research feel free to contact the following.

Eric Osoro P.O Box 14380 20100 Nakuru

Declaration

Have you understood the information given above?

[ ] Yes [ ] No

Do you give consent to participate in the study?

[ ] Yes [ ] No

Interviewer signature _____

Consent Form B; Informed Assent Form for Patients under 18 years of age

My name is _____and my job is to research on road traffic injuries reported in this hospital.

I am going to give you information and invite you to be part of the research study. You can choose whether or not you want to participate. 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. Even if you choose not to consent, the treatment you are receiving in this hospital will continue normally.

We are studying all people come to this hospital after involvement in a road traffic crash. Road traffic crashes have become common in this country resulting in injuries which can be long term, money lost in damages and even death. The purpose of this study is therefore to record all the road traffic injuries reported in this hospital and write a report which may help understand more about road traffic injuries. We are therefore inviting you to participate because you were involved in a road traffic crash.

We are going to ask you a few questions about yourself and the accident which will take about 20 minutes. We will also get more information about your injuries from the

medical notes. We will not tell other people that you are in this research and we won't share information about you to anyone who does not work in the research study.

If you have any questions or clarifications about the research feel free to contact the following.

Eric Osoro P.O Box 14380 20100 Nakuru

Declaration

Have you understood the information given above?

[ ] Yes [ ] No

Do you assent to participate in the study?

[ ] Yes [ ] No

Interviewer signature _____

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

My name is _____a researcher/assistant in a study on road traffic injuries reported in this hospital.

I am going to give you information and invite you to have your child participate in this study. Your decision to have your child participate in this study is entirely voluntary. If

you choose not to consent, all the services you and your child receive at this hospital will continue and nothing will change.

We are studying all people who come to this hospital after involvement in a road traffic crash. Road traffic accidents have become common in this country resulting in injuries which can be long term, money lost in damages and even death. The purpose of this study is therefore to record all the road traffic injuries reported in this hospital and write a report which may help understand more about road traffic injuries. We are therefore inviting your child to participate because he/she was involved in a road traffic crash.

We are going to ask the child some questions about the accident which will take about 20 minutes. I will also get more information about the child's injuries from the medical notes

The information that we collect from this research will be kept confidential. Information about your child that will be collected from the research will be put away and no-one but the researchers will be able to see it.

If you have any questions or clarifications about the research feel free to contact the following.

Eric Osoro P.O Box 14380 20100 Nakuru

Declaration

Have you understood the information given above?

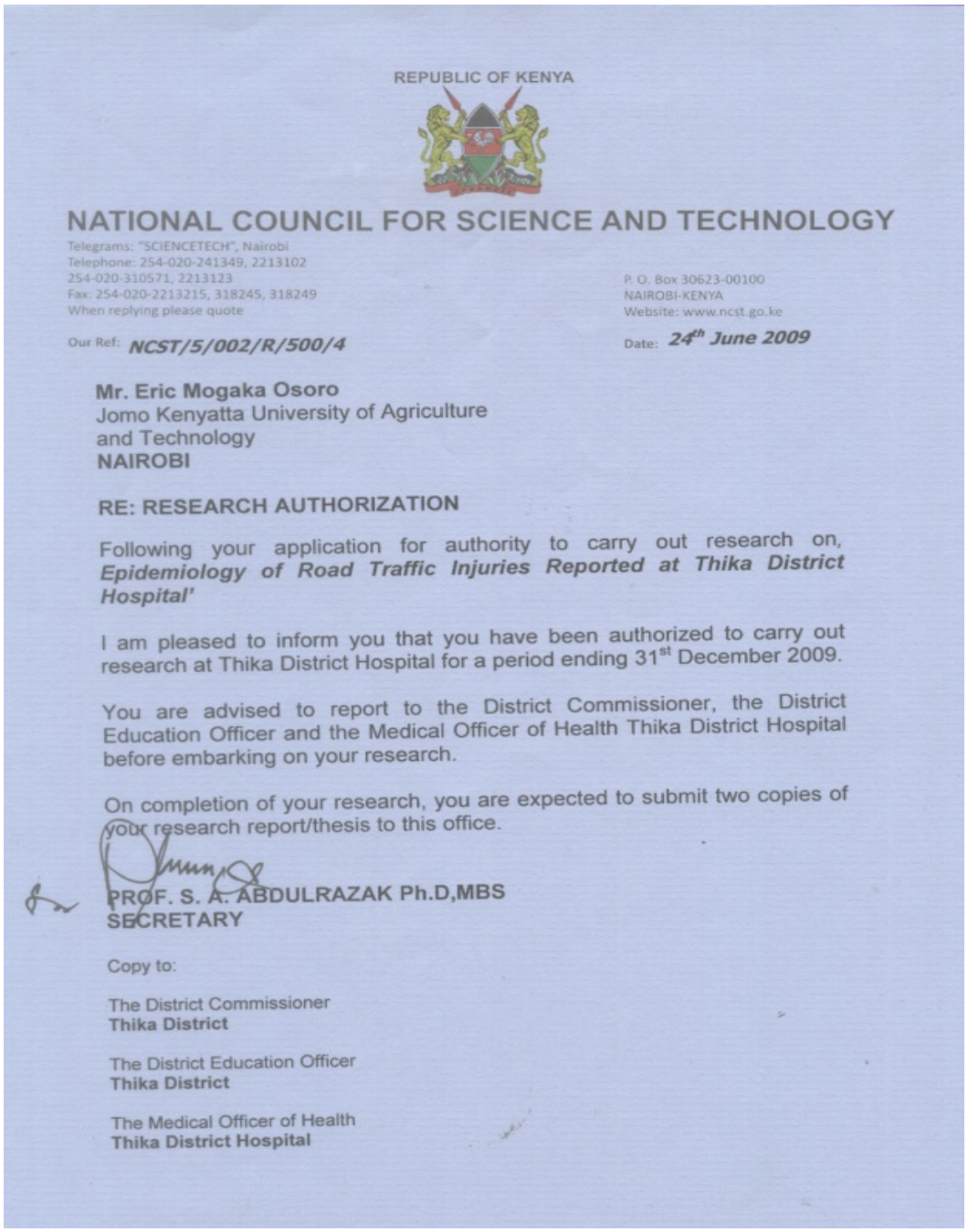
[ ] Yes [ ] No

Do you give consent to have your child participate in the study?

[ ] Yes [ ] No

Interviewer signature _____

Appendix 3: Research Authorization Letter



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Fax: 254-020-2213215, 318245, 318249
When replying please quote

P. O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: *NCST/5/002/R/500/4*

Date: *24th June 2009*

Mr. Eric Mogaka Osoro
Jomo Kenyatta University of Agriculture
and Technology
NAIROBI

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on, ***Epidemiology of Road Traffic Injuries Reported at Thika District Hospital'***

I am pleased to inform you that you have been authorized to carry out research at Thika District Hospital for a period ending 31st December 2009.

You are advised to report to the District Commissioner, the District Education Officer and the Medical Officer of Health Thika District Hospital before embarking on your research.

On completion of your research, you are expected to submit two copies of your research report/thesis to this office.

PROF. S. A. ABDULRAZAK Ph.D,MBS
SECRETARY

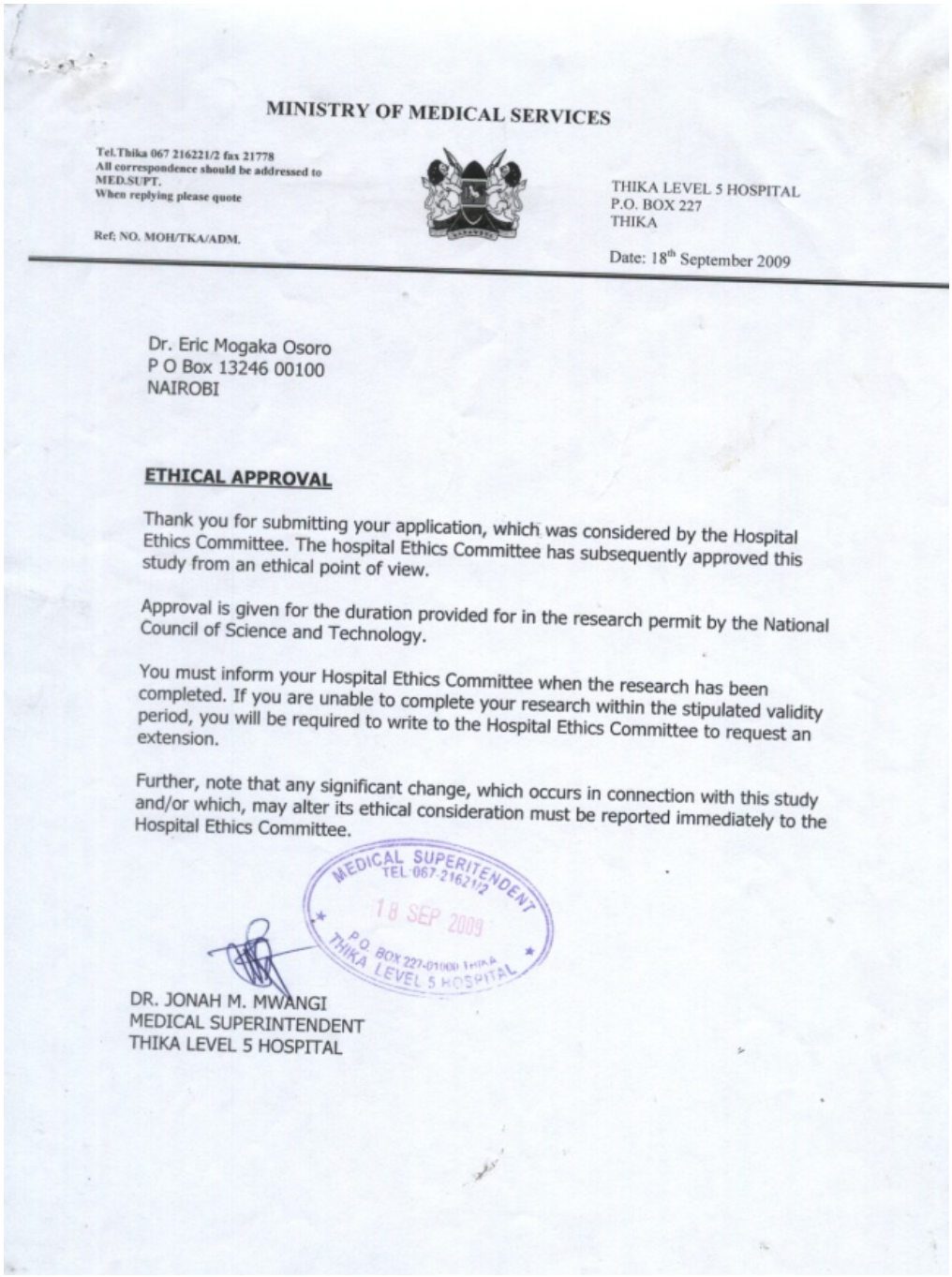
Copy to:

The District Commissioner
Thika District

The District Education Officer
Thika District

The Medical Officer of Health
Thika District Hospital

Appendix 4: Ethical Approval Letter



MINISTRY OF MEDICAL SERVICES

Tel.Thika 067 216221/2 fax 21778
All correspondence should be addressed to MED.SUPT.
When replying please quote

Ref; NO. MOH/TKA/ADM.

THIKA LEVEL 5 HOSPITAL
P.O. BOX 227
THIKA

Date: 18th September 2009

Dr. Eric Mogaka Osoro
P O Box 13246 00100
NAIROBI

ETHICAL APPROVAL

Thank you for submitting your application, which was considered by the Hospital Ethics Committee. The hospital Ethics Committee has subsequently approved this study from an ethical point of view.

Approval is given for the duration provided for in the research permit by the National Council of Science and Technology.

You must inform your Hospital Ethics Committee when the research has been completed. If you are unable to complete your research within the stipulated validity period, you will be required to write to the Hospital Ethics Committee to request an extension.

Further, note that any significant change, which occurs in connection with this study and/or which, may alter its ethical consideration must be reported immediately to the Hospital Ethics Committee.

MEDICAL SUPERITENDENT TEL: 067-21621/2 18 SEP 2009 P.O. BOX 227-01000 THIKA THIKA LEVEL 5 HOSPITAL

DR. JONAH M. MWANGI
MEDICAL SUPERINTENDENT
THIKA LEVEL 5 HOSPITAL