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UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

FACULTY OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

RESEARCH REPORT

RISK FACTORS AND TRENDS IN INJURY MORTALITY IN RUFIJI DEMOGRAPHIC SURVEILLANCE SYSTEM, RURAL TANZANIA FROM 2002 TO 2007

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A research report submitted to the School of Public Health, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Medicine in the field of Population Based Field Epidemiology

Johannesburg, South Africa 2009

DECLARATION

I, Kenneth Ae-Ngibise Ayuurebobi declare that this research report is my own work. Secondary ideas are duly recognized and referenced appropriately. This work is being submitted for the degree of Master of Science in Medicine in the field of Population Based Field Epidemiology in the University of the Witwatersrand, Johannesburg. This is the first time this work is being submitted for this degree or examination, and to the best of my knowledge, this work has never been submitted to any other University for the same or similar degree.

Signature: 

Full Name: Kenneth Ae-Ngibise Ayuurebobi

This……8th…… day of …December….. 2009

DEDICATION

The work is dedicated to the Omnipresent and Omnipotent God for his guidance, and for granting me knowledge and good health to complete this report. This piece is also dedicated with love to my parents Mr and Mrs Ae-Ngibise, my best friend Juliet Jabulo as well as all my friends for their nurturing and continual support throughout the period of my training.

ABSTRACT

Background

Worldwide, injuries are ranked among the leading causes of death and disability, killing over 5 million people and injuring over 50 million others globally. Approximately 90% of these deaths occur in developing countries. The burden and pattern of injuries in low-income countries are poorly known and not well studied. Few studies have been conducted on injury mortality and therefore this study can add to the scientific literature. Analyzing injury mortality in rural Tanzania can assist African countries to develop intervention programmes and policy reform to reduce the burden caused by injuries.

Objectives

The objective of this study was to identify the risk factors and trend in injury mortality in the Rufiji Demographic Surveillance Area in rural Tanzania from 2002-2007. Specifically, the study would identify and describe the types and trends in injury mortality, calculate the crude death rates of injury mortality by gender, SES and age groups, describe the risks factors associated with injury mortality, and measure association between the risk factors and injury mortality.

Methods

Rufiji HDSS data used included people aged 1 year and older from 2002-2007. Verbal Autopsy data was used to determine the causes of death which was based on the tenth revision of the International Classification of Diseases (ICD 10) recommended by WHO. Injury Crude death rates (ICDR) were calculated by dividing number of deaths in each year by person years observed and multiplying by 100,000. Principal Component Analysis (PCA) was used to construct household wealth index using household characteristics and assets ownership. Also trend test analysis was done to assess a linear relationship in the injury mortality rates across the six year period. Poisson regression was used to investigate

association between risk factors and injury mortality and all tests for significant associations were based on p-values at 5% significance level and a 95% confidence interval.

Results

The overall injury crude mortality rate was 33.4 per 100,000 PYO. Injuries contributed 4% of total mortality burden with statistical significant association between gender, age and occupation. Mortality rate was higher for males [Adjusted IRR=3.04, P=0.001, 95% CI (2.22 - 4.17)]. The elderly (65^{+}) were 2.8 times more likely to die from injuries compared to children [Adjusted IRR=2.83, P=0.048, 95% CI (1.01 - 7.93)]. The unemployed, casual workers, the retired, and farmers all had an increased risk of dying from injuries compared to students (P<0.005). Most injury deaths were due to road traffic accidents (28%), unspecified external injuries (20%), drowning (16%), burns (9%), accidental poisoning (8%), homicidal (8%) and animal attack (5%).

Conclusion

The contribution of injury to mortality burden in the Rufiji Demographic Surveillance Area was relatively low. However, there is the need to institute measures that would help prevent injuries. Life saving interventions such as road safety education, regular road maintenance, rapid response to accidents, use of life jackets for fishermen and recreational swimmers are very necessary in preventing injuries. Also, proper fishing practices should be imparted to the populace as precautionary measures to reduce the burden of injury mortality.

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DEFINITION OF TERMS

Age-Dependency Ratio: The ratio of persons in the ages defined as dependent (under 15 years and over 64 years) to persons in the ages defined as economically productive (15-64 years) in a population (The Population Handbook)

Animal bites: Deaths resulting from being bitten by wild and dangerous animals like snakes, dogs, bees, cuts and others.

Crude Death Rate (CDR): Total number of deaths occurring in a population divided by the total population at midpoint.

Demographic Surveillance System: This is a set of field and computing operations to handle the longitudinal follow-up of well-defined entities or primary subjects (individuals, households, and residential units) and all related demographic and health outcomes within a clearly circumscribed geographic area (INDEPTH Network).

Drowning: Is death from suffocation (asphyxia) caused by a liquid entering the lungs and preventing the absorption of oxygen leading to cerebral hypoxia and cardiac arrest (**Wikipedia**)

Falls: Refers to trip, slip, stumble or fall on a level plane, from one level to another, or into a hole or other opening in a surface whether being unintentional or due to assault and self-directed violence.

B**urns:** Deaths resulting from sustaining fire flames or other liquid substance.

Homicide: Killing of a human being by another person through the use of physical means.

Household: This is a social group of one or more individual members who are normally but not always related.

Injury: Physical damage that results when a human body is suddenly or briefly subjected to intolerable levels of energy.

Intentional Injury: Injuries that are purposefully inflicted by the victim (s) themselves.

Injury mortality: Death as a result of an injury event.

Poison: A substance that causes injury, illness, or death, by biochemical means on the body's physiology.

Road Traffic Accident: An event occurring on a street, road or highway, in which at least one vehicle in motion is involved, by collision, crashing or losing control, and which causes injury or death to either occupants in the vehicle or pedestrians.

Suicide: Human act of taking one's own life intentionally or a death arising from an act inflicted upon oneself with the intent to kill oneself.

Undetermined injury mortality: Injury category used to describe those injury mortalities where it is difficult to judge whether an injury was inflicted intentionally or unintentionally.

Unintentional injury mortality: Death resulting from injuries that are not intentionally inflicted.

Wealth Index: Proxy measure of the wealth of households which is based on household characteristics, ownership of assets (house ownership, animal ownership, electricity etc)

LIST OF ACRONYMS AND ABBREVIATIONS

AIDS: Acquired Immunodeficiency Syndrome

BAC: Blood Alcohol Concentration

CI: Confidence Interval

DALYs: Disability Adjusted Life years

DHS: Demographic and Health Survey

DSA: Demographic Surveillance Area

ICD: International Classification of Diseases

ICDR: Injury Crude Death Rate

HR: Hazard Ratio

HRS: Household Registration System

IHI: Ifakara Health Institute

INDEPTH: International Network for Continuous Demographic Evaluation of Populations and Their impact on Health in Developing Countries

IRR: Incidence Rate Ratio

MDG: Millennium Development Goals

MR: Mortality Rate

PCA: Principal Component Analysis

PYO: Person Year of Observation

RHDSS: Rufiji Health and Demographic Surveillance System

RTA: Road Traffic Accidents

SES: Socio-Economic Status

VA: Verbal Autopsy

WHO: World Health Organization

YLL: Years of Life Lost

CHAPTER ONE

INTRODUCTION AND LITERATURE REVIEW

1.0 Introduction

This chapter summarises the published literature on injury mortality worldwide, regionally and in Tanzania where the study was conducted. The literature is focused on the burden and causes of injury mortality and the risk factors, especially on the relationships between gender, education, occupation, marital status, household socio-economic status, age groups and injury mortality. The chapter concludes by outlining the aims and objectives of this study as well as the need to carry out this analysis.

1.1 Background information

Injuries have traditionally been regarded as 'unavoidable' accidents. In recent decades however, there is a shift in perspective and injuries are being recognized as preventable events (1). Globally, injuries and violence are ranked among the leading causes of death and disability. In low and middle-income countries, injuries are growing in significance because of the epidemiologic, demographic and socioeconomic transitions that have characterized the development of these countries in recent decades (2). Mortality due to injury is a major global public health problem. Studies have shown that injuries accounts for 9% of mortality worldwide and 16% of all disabiltiies annually (3). Although non-communicable diseases were responsible for nearly 60% of deaths globally in 2001compared to 9% due to injury mortality, the Years of Life Lost (YLL) proportional to injuries is much higher at 12% compared to 40% for chronic diseases (4). According to the Global Burden of Disease 2000 data, over 5 million people (83.7 per 100,000 population) died worldwide from injuries in 2000 (5). Eight of the 15 leading causes of death for people aged 15 to 29 years were injury-

related including both intentional and unintentional (6;7). In many developing countries injuries have a greater impact on the health of populations than have generally been recognised and are rapidly becoming a major cause of death and disability. Modernisation was also reported to associate with injury mortality. A study in Tanzania reported that as populations grow more mobile, a large proportion of adults is at higher risk for injuries than in the past (8). The aim of this research therefore is to investigate the burden and determine gender and age specific trends as well as risk factors associated with injury mortality from 2002 to 2007 in rural Tanzania. The study was conducted in Rufiji Health and Demographic Surveillance System (RHDSS), one of the Demographic Surveillance Sites in Tanzania.

1.2 Literature review

1.2.1 Classification of injury mortality

Injuries are broadly classified into two main types: intentional and unintentional. The first type refers to self-inflicted (suicide) and interpersonal (homicide) as well as war-related injuries. Unintentional injuries refers to the external causes including road traffic accidents, drowning, accidental poisoning, falls, burns, animal attacks (1).

Road traffic accidents (RTA) are a leading cause of death, killing nearly 1.2 million people annually, injuring 50 million and costing the global community about US$ 518 billion (6;7). Approximately 90% of these deaths occurring in low and middle-income countries (3).

1.2.2 Global ranking and projection of Injury mortality and DALYs

In 2002, road-tracfic injuries was ranked the 11^{th} leading cause of death and the 8^{th} leading cause of disability-adjusted life years (DALYs) in the world (7). If current trends continue, road traffic and intentional injuries will rank among the 15 leading causes of death and disease burden in the world. The ranking is by leading cause of death.

	Ranking of Deaths		Ranking of DALYs Lost	
	1990	2020	1990	2020
Road traffic accidents	9	⟹ 6	9	⟹ 3
Self-inflicted	12	⟹ 10	17	⟹ 14
Interpersonal	16	⟹ 14	19	⟹ 12
War	20	⟹ 15	16	⟹ 8

Adapted from Peden et. al, The Injury chart Book: WHO, 2002

Road traffic accident is the major contributory factor to injury mortality; the aggregate rates of road-trafic fatalities per 100 000 population were lowest in the highest income countries in the European region (11.0), whereas the highest rates were reported in the low-income and middle-income countries in eastern Mediterranean (26.4) and Africa regions (28.3) (7;9). It has been projected that by 2030, road traffic injuries will rank as high as third among causes of disability-adjusted life years lost (10;11).

Literature review published in 1997 showed that pedestrians accounted for between 41% and 75% of all road traffic deaths in developing countries; pedestrians and passengers of public transportation in Africa are the most affected (12). A study in Kenya found that over three thousand people are killed annually on Kenyan roads and more than 75% of these road traffic casualties are economically productive young adults; four-fold increase in road fatalities has been experienced over the last 30 years (13). In Kenya pedestrians represented 80% of road traffic causalities in 1990 (13), 55% in Mozambique in the 1993–2000 period (14) and 46% in Ghana between 1994 and 1998 (15). These large proportions of vulnerable road users maybe explained by traffic mix of different users (pedestrians, cyclists, motorbikes, cars, and trucks), with most of the roads lacking pavement along large urban streets. The problem also arises because of the poor transport conditions such as lack of seat belts and overcrowding in the vehicles (16).

Extensive analysis of RTAs have been done in South Africa because of the high mortality rates due to them. RTAs mortality rates in South Africa were about double the global rate in both sexes, peaking at 2.5 times the global rate in adult women aged 30–44 and the age-standardized road traffic injury mortality rate was estimated at 39.7 per 100 000 (59.4 for males; 22.6 for females) (17). Another study analysing pedestrians fatalities from 2001 to 2004 and making use of data from the National Injury Mortality Surveillance System (NIMSS) in four South African cities found that pedestrians make up the largest group of road traffic injuries casualties. The results indicated that there were a total of 7433 pedestrian deaths for the four cities and the majority and most (56.7%) were between ages 20 and 44 years. This is the productive working age group and thus has greater implication for socioeconomic development of every nation. Overall, there were 3.3 male pedestrian deaths for every female pedestrian death (18). In low and middle income countries, pedestrians represent a sub-population with a low unemployment status, socioeconomic status and high incidence of substance abuse (19). In Tanzania, injury is a major public health concern as many lives are lost yearly and many others are permanently disabled as a result of intentional and unintentional injuries. According to police records released by the Ministry of Works, "traffic-related injuries alone amounted to about 16000 injured persons and 2250 fatalities in Tanzania mainland in 2003 corresponding to a crude mortality rate of 6.7 per 100 000 population" (20). A community-based study in Tanzania reported that 'During a 6 year period… Among all ages, deaths due to injuries accounted for 5% of all deaths in Dar es Salaam, 8% in Hai and 5% in Morogoro… Transport accidents were the most common cause of mortality in all injury-related deaths in the three project areas'(8).

Poisoning as a type of injury is reported to be high in developing countries compared to the developed ones. The World Health Organisation report in 2002 indicates that more than 94%

of fatal poisonings occurred in low- and middle-income countries and the majority of the number of DALYs lost to poisoning globally are among young children and young adults (21). Injuries and poisoning were ranked first as causes of adolescent mortality in Mexico (rate= 13.35/100,000) between 1979 and 1997 (22).

Another type of injury mortality which is also reported as an important cause of death is falls. A systematic review on unintentional childhood injuries in developing countries reported that "over 140 000 injuries to children under 19 years were reported in 56 studies (21 from Asia, 20 from Africa and 15 from South America); on an average 36% of injuries (52 575) were due to falls (23). The median incidence was estimated at 137.5 fall injuries per 100 000 children. The incidence of falls specific to the under-five age group was reported in 16 studies with a median incidence of 40.6 falls per 100 000. The overall average incidence rate for childhood falls was highest in South America at 1315 followed by Asia at 1036 and Africa at 786 per 100 000, respectively. Average mortality rates were highest for Asia at 27 followed by Africa at 13.2 per 100 000, respectively (23).

Intentional injuries (homicidal/suicidal/interpersonal) are another cause of injury mortality. According to the World Health Organization report in 2002, over half a million (520,000) people died as a direct result of homicide at a rate of 8.8 per 100,000 in the year 2000 (21). In 2000 also, an estimated 815 000 people worldwide committed suicide and over 85% occurred in low and middle-income countries (1). In 2002, over 40% of the total number of DALYs lost globally to suicidal behaviour occurs in young adults aged between 15–29 years (1). Over 60% of the global mortality due to interpersonal violence occurs among young persons aged between 15–44 years and America has the highest interpersonal violence mortality rates worldwide among males aged 15-29 (1). An increasing trend of homicides and suicides was observed in Mexico between 1979 and 1997 (22). A study in South Africa found that

interpersonal violence dominated the South African injury profile with age-standardized mortality rates at seven times the global rate. In that study injuries were the second-leading cause of loss of healthy life, accounting for 14.3% of all DALYs in South Africa in 2000 (17). Intentional injury was the leading cause of injury mortality for females in Hai district in Tanzania in 2001 (8).

Assessment of burns as a cause specific injury mortality reveals that globally, fire-related burns were responsible for 238 000 deaths in 2000 and more than 95% of fatal fire-related burns occurred in low and middle-income countries (1). Studies in Tanzania and South Africa reported that infants has the highest mortality rates and most burns injuries among this group occurred accidentally (97.5%), although some (2.5%) were intentional (24;25).

1.2.3 Gender and injury mortality

There are gender differentials in the injury mortality rates. A multi-national study compiled for 57 countries from the World Health Statistics, investigating the differences in cause-specific patterns of unintentional injury mortality found that drowning for males and burns for females in the low and middle-income countries were significantly higher than in high-income countries (26). This might be as a result of the gender specific roles orchestrated in many developing countries. The variation in the pattern of injury by road user and sex has significant implication for prevention measures. Whereas the highest interpersonal violence mortality rates worldwide occurred among males aged 15-29 in America, females in Africa have the highest interpersonal violence mortality rates (1). A study in Tehran evaluating sex and age distribution of traffic accident victims, found that forty-five percent of the injuries were related to RTAs and men/women ratio in these patients was 4.2/1. The crude mortality rate in men was nearly two times that of women (6.2% versus 3.8%) (27) . In rural Tanzania, a study investigating the effect of recall on estimation of non-fatal injury rates reported that

out of 516 individuals who had injuries during the preceding year, 313 (61.5%) were males and 196 (38.5%) were females (28).

1.2.4 Age, education and injury mortality

More than 98% of child deaths occurred in low and middle-income countries and the leading causes of death at age 5–14 years included infectious diseases, unintentional injuries and cancers. Injuries were responsible for 17% of the disease burden in adults aged 15–59 years in 2001 and were an important cause of death in this age group, accounting for one-quarter of deaths, one-third in Europe and Central Asia (4). Violence and war accounted for a disproportionate share of injury deaths in this age group in Sub-Saharan Africa (47%) and Latin America and the Caribbean (45%) (4). Age specific mortality varies considerably by setting and external cause.

Educational status has also been found to correlate with injury mortality in other parts of the world. A study investigating the educational level inequalities and transportation injury mortality in the middle aged and elderly in European settings found that; "among men, those of low educational level had higher death rates in all settings, a pattern that was maintained in the different settings; no inequalities were found among women. However, among men, in all the settings, the relative risk (RR) was higher in the 30-49 age group (RR 1.46, 95% CI 1.32 to 1.61) than in the age groups 50-69 and >= 70 years, a pattern that was maintained in the different settings. For women for all the settings together, no differences were found among educational levels in the three age groups" (29). A study in the United Kingdom reported that there were inverse linear associations between childhood intelligence assessed at the ages of 7, 9, and 11 years and having had a hospital admission due to an unintentional injury. The study concluded that this association between childhood intelligence and injury may contribute to the association between childhood intelligence and premature mortality

demonstrated in several studies (30). A report from preliminary results from the National Institute of Public Health, Denmark indicates the risk of poisoning was twice higher for children living in households where the mother has a low school education, whereas the risk of burns was twice as high for children living with lone fathers/mothers (31). A study investigating the causes, magnitude and management of burns in children under five years of age in Dar es Salaam, Tanzania reported that forty nine percent were males while approximately fifty one percent were females. Most of the children (54.9%) were aged between 1-2 years. Seventy eight percent had scalds while approximately twenty two percent had flame burns. Most of the burns (97.5%) occurred accidentally, although some (2.5%) were intentional (24). A related study in Western Cape, South Africa found that burn injury incidence is particularly high for toddlers, infants, boys, and for African children. The same study reported that most of the burn injuries were flame-related (25).

1.2.5 Socioeconomic status and injury mortality

Socioeconomic status is also reported to associate with injury mortality. In 2000, an estimated 815 000 people worldwide committed suicide and 86% of all suicides occurred in the low- and middle income countries (1). A study in the United States investigating the relationship between childhood SES and adult cause specific mortality reported that males from manual compared with nonmanual social classes were more likely to die from unintentional injury, homicide, and alcoholic cirrhosis (32). Another study in the United States of America has shown that there was approximately twofold increased risk of homicide associated with living in a neighbourhood characterised by low socioeconomic status, after adjusting for individual demographic and socioeconomic characteristics. The study concluded that social inequalities in injury mortality exist for both persons and places (33). In the United States also, a study assessing the relationship between SES inequalities

and injury, found that increasing SES has a strong inverse association with the risk of both homicide and fatal unintentional injuries, although the results for suicide were mixed (34).

Social and demographic characteristics of pedestrians involving in accidental injuries are a major predictor of injury cases. Pedestrians were compared with unintentional trauma patients with regard to demographics, socioeconomics, possession of a driver's license and other injury prone risk behaviours. Pedestrians were significantly more likely to be black, not married, unemployed, binge drinkers, alcohol dependent, drug dependent, BAC+, to have a low income, low educational achievement, younger age, and to not have a driver license (19).

A study in Tanzania on childhood burns report that about 82.9% of burns occurred in low socio-economic groups, 94.4% occurred at homes and scalding from hot liquids accounted for 75.8% of the burns, followed by open flame burns which accounted for 16.2% (35).

1.2.6 Occupation and injury mortality

Worldwide, hazardous conditions in the workplace were responsible for a minimum of 312,000 fatal unintentional occupational injuries. It is estimated that about 2 million work-related deaths take place annually. Men suffer two thirds of those deaths (36). Together, fatal and non-fatal occupational injuries resulted in about 10.5 million DALYs; that is, about 3.5 years of healthy life lost per 1,000 workers every year globally. Occupational risk factors are responsible for 8.8% of the global burden of mortality due to unintentional injuries and 8.1 % of DALYs (37). Approximately 100 unintentional injury deaths occur annually to children and adolescents on US farms, and an additional 22 000 injuries to children younger than 20 years occur on farms (38). A study in Turkey reported that of all the deaths due to occupational injuries, 121 (31.3%) were caused by traffic injuries, 93 (24.1%) by falling from high places, and 43 (11.1%) by electrocution; 89% occurred at workplaces. Sectors with the highest rates of fatal occupational injuries were construction (30.2%), transportation (13.2%),

basic metal industry (9.0%), manufacturing of metal products (5.9%), and heating with electricity, gas, and steam (5.9%) (39). A related study in the same country reported that the construction sector is responsible for the largest number of work-related fatalities among all industries. The incidence of occupational injuries was found overall to be 4.5% in Kocaeli, while the annual mortality rate was 60.4 in Kocaeli and 79.0 per 100,000 workers over the entire time period (40).

1.2.7 Marital status and injury mortality

A study investigating the relationship between motor vehicle driver injury and marital status reported that never married participants had twice the risk of driver injury [HR=2.06, 95% Cl (1.35-3.16)] as married participants (HR 1.00). The relative risk for never married participants was slightly higher (HR=2.29), though less precise (95% Cl, 1.39-3.76), after further adjustment for alcohol intake, driving exposure, area of residence, body mass index, and occupational status (41).

1.2.8 Alcohol, smoking and injuries

Alcohol plays a significant role in motor vehicle collisions and in pedestrian injuries. Data from 2000 showed that approximately 20% of all fatal pedestrians younger than 20 years had a blood alcohol concentration greater than or equal to 0.08 globally. Of those drivers fatally injuring a pedestrian, 14% had a blood alcohol concentration greater than or equal to 0.08 (42). In 2005, the total number of pedestrians killed in alcohol-related crashes was 2180, accounting for approximately 45% of all pedestrian fatalities in the United States (43). Another study in the United States on alcohol-drinking history and fatal injury in older adults revealed that the relative odds for drinkers versus non drinkers for falls, motor vehicle crashes, and suicides were 1.7, 1.7, and 1.6, respectively, adjusted for age, gender, marital status, education, and working in the last year. Drinking increased the risk of suicide more for

women than for men. Drinking history in older adults is associated equally with an increased risk of fatal injury from falls, motor vehicle crashes, and suicides (44). In South Africa, over half (58%) of 4004 pedestrians casualties tested were positive for alcohol (18).

A study conducted in Taiwan on excess injury mortality among smokers found that in 2001, over one fifth (23%) of all male injury deaths was associated with smoking with the heaviest smokers having the highest risk, the lightest smokers the lowest risk, and ex-smokers, no increase (45).

From the studies reviewed so far, injuries pose a great threat to human existence and survival. There is the need for greater attention and commitment from all stakeholders to help curb this menace.

1.3 The Demographic Surveillance System

The INDEPTH Network's monograph on mortality defines a demographic surveillance system (DSS) as a set of field and computing operations to handle the longitudinal follow-up of well-defined entities or primary subjects (individuals, households, and residential units) and all related demographic and health outcomes within a clearly circumscribed geographic area. Unlike a cohort study, a DSS follows up the entire population of such a geographic area (46). There is always an initial census that enumerates and registers the whole population of a well-defined geographic area, the demographic surveillance area (DSA). After enumeration, regular visits are made to each registered location within the DSA in order to record demographic and health-related events that have taken place since the previous visit and to update the status of all entities registered at the location (47). Most of the DSS are members of the INDEPTH Network (An **In**ternational **N**etwork of Field Sites with Continuous **De**mographic Evaluation of **P**opulations and **Th**eir Health in Developing Countries) (48). Many DSSs implement a death-tracking system that is able to capture deaths in a timely

fashion and administer a "verbal autopsy" (VA) interview with the primary caregivers of the deceased persons. Although VAs are not able to attribute cause of death as accurately as standard autopsies, they are reasonably accurate for most causes of death and usually provide reasonable cause of death distributions at the community level (49-53) Again, the VA diagnosis was validated against medical records in Tanzania and found to reliably estimated cause specific mortality fractions for diseases of public health importance in all age groups (54).The DSS is very advantageous over other data collection systems because it usually describes populations that are not described by other data, it is individual-based, prospectively collected, fully linked data describing whole populations at different levels and it is longitudinal and often describes the long term history of the population under study. The major setback of the DSS is that of representativeness (often covers small populations), high cost of running them and the accessibility of the data that they normally generate (47).

1.4 Statement of the problem

Intentional and unintentional injuries are the cause of death and disability for millions of people in low and middle income countries every year (3). Despite the fact that injury is being recognised as a growing public health problem in developing countries, research into the burden and risk factors, especially important cause specific injuries like RTAs which is a major contributing factor is scarce in Africa (16). This is inconsistent with the magnitude and dimension of the problem because little is known about the extent of the problem. It is also due to lack of proper records on injury mortality because inadequate attention is focused on the issue by public health professionals. However, most of the mortalities from injury can be avoided through preventive and intervention measures.

1.5 Justification for the study

The burden and pattern of injuries in Africa and other low-income countries are poorly known and not well studied. As a result, accurate data on the vital statistics about injury mortality is not well documented (55).The incidence of injury mortality is on the increase, partly due to rapid growth of motorised transport and expansion of industrial production without adequate safety precautions (56). Although few studies have been conducted on injury mortality, they are mostly based on hospital records, few population-based and mainly focussed on unintentional injuries. It is therefore very important to make available information on the burden of injury mortality from a rural perspective using population-based data. This study also aims to capture information on the possible risk factors for injury mortality. The study is important because the acheivemnt of the MDG goal I (eradication of extreme poverty and hunger) and goal 2 (reduction of child mortality) could not be met in developing countries and Tanzania especially if proper information on injury mortality were not available for strategic policy planning and implementation.This will inform policy makers to develop comprehensive preventable measures towards the reduction of mortality resulting from injuries.

1.6 Study objectives

1.6.1 Research question

Evidence-based research in the developing world is generally lacking on the association between risk factors and injury mortality. There is therefore the need to assess the enormity and the burden of injury mortality as well as the pattern and trends of this public health canker in the Rufiji HDSS, rural Tanzania from 2002-2007.

1.6.2 General objective

The main aim of this study was to describe the pattern, trends by age group, SES and gender differentials associated with injury mortality in Rufiji HDSS in rural Tanzania from 2002-2007.

1.6.3 Specific objectives

1) To identify and describe the types and trends of injury mortality in RHDSS from 2002-2007
2) To calculate the crude death rates of injury mortality by gender, SES and age groups in RHDSS from 2002-2007
3) To describe the risks factors associated with injury mortality in RHDSS from 2002-2007
4) To measure association between the risk factors (gender, age, household SES, education, occupation, marital status) and injury mortality in RHDSS from 2002-2007

CHAPTER TWO

METHODOLOGY

2.0 Introduction

This chapter presents the materials and methods used to carry out the study which includes description of the study area, the study design, study population, inclusion and exclusion criteria, and sampling strategy used as well as the data extraction and management.

2.1 Demographic and Socio-economic description of the study area

The study was conducted in the Rufiji District of Tanzania. According to The United Republic of Tanzania 2002 Population and Housing Census General Report, the population of Rufiji district was approximately 203,102 (98,398 males and 104,704 females) with an annual growth rate of 2.3% (57). The population densities for the District and surveillance area are 12.5 and 64 per square kilometer respectively. The mean household size for the whole district is about 5 persons (57). The district is largely rural though the population is clustered around Utete (District headquarters), Ikwiriri, Kibiti and Bungu townships. All of the last three centres are within the DSS area. Islam is the dominant religion, followed by Christianity and then African traditional believers. Kiswahili is the main language spoken by the inhabitants.

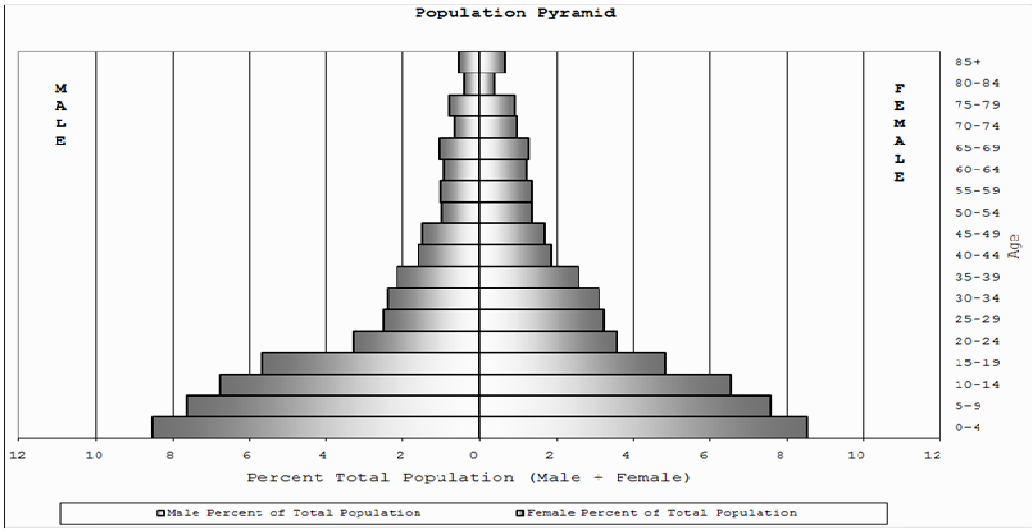
The majority of the people in Rufiji district are subsistence farmers. Farming areas are often located some distance from the family home and make use of periodically flooded alluvial soils. Major crops grown include cassava, maize, rice, millet, sesame, coconut and cashew nuts. Fruits such as mangoes, oranges, pineapples, papaya and jackfruit are also grown. Some

residents are involved in fishing while others in small scale commercial activities such as selling wood products.

2.2 Rufiji Health and Demographic Surveillance System

The RHDSS area extends from 7.470 to 8.030 south latitude and 38.620 to 39.170 east longitude. The area is located in Rufiji district, about 178 kilometres south of Dar es Salaam. The RHDSS operates in 6 contiguous wards and 31 villages (about 60 km long × 30 km wide) and covers an area of 1813 km**.** The total population under surveillance is about 85,000. Females (52%) outnumber males (48%) in the Rufiji DSA. Averagely, a household has about 4-8 persons. The dependency ratio in 1999 was 110 (meaning that for every 100 workers there are 110 people not of working age) and the total fertility rate in 1999 was 6.2 per woman in the reproductive age. Currently, the dependency ratio is 114 and the total fertility rate is 5. Neonatal and under five mortality rates for 2007 are given as 39.5 and 15.2 per 1000 population respectively. There are 56 health facilities comprising 48 government dispensaries, 5 government health centres and 2 hospitals (one public and the other, a mission) (58).

2.2.1 Population Pyramid of the Rufiji HDSS, 2007



Adapted from Mrema S et. al "Fertility Levels, Trends and Differentials at Rufiji HDSS, Tanzania"

The pyramid reveals that the DSS population is relatively young because the 15-64 age group constitutes about 46 percent and the male–female ratio is 92.7: 100

2.2.2 Primary Data Source

The Rufiji Health and Demographic Surveillance System's cause specific mortality data was used as our primary data source for this study. Injury mortality data from 2002 to 2007 was extracted from the database for the analysis. The RHDSS collects longitudinal data prospectively on household demographics and is updated every four months. Household socio-economic and environmental data is collected once a year. The RHDSS is a member of the INDEPTH-Network (www.indepth-network.org), a network of sites in Africa, Asia and Latin America. The DSS was set up purposely to provide sentinel data through a continuous surveillance of households and members within households in cycles with the aim of gathering information on health and demographic data to inform health policy and planning and to evaluate or monitor the impact of health reforms.

2.2.3 The Study design

The study used both descriptive and analytic cross-sectional study methods of secondary data analysis of injury mortality in RHDSS, rural Tanzania from 2002-2007. The descriptive aspect illustrated the trends and patterns in injury mortality by age, gender, SES, and the identification of risk factors associated with injury mortality. The analytic component involved the determination of the association between age, gender, SES, education, occupation, marital status and injury mortality. The study used secondary data for the analysis.

2.2.4 The Study population

This includes all people resident within the Demographic Surveillance Area of the RHDSS from 2002-2007.

2.2.5 Study sampling

Non-randomised purposive sampling technique was used to select all deaths due to injury from 2002-2007 among resident members of the demographic surveillance area. The study recruited 119,271 people contributing a total of 592,324.03 PYO of which 198 injury deaths were recorded over the six year period. The DSS is a sample already and there was no need for sample size calculation. Therefore, all the injury deaths were included for this analysis.

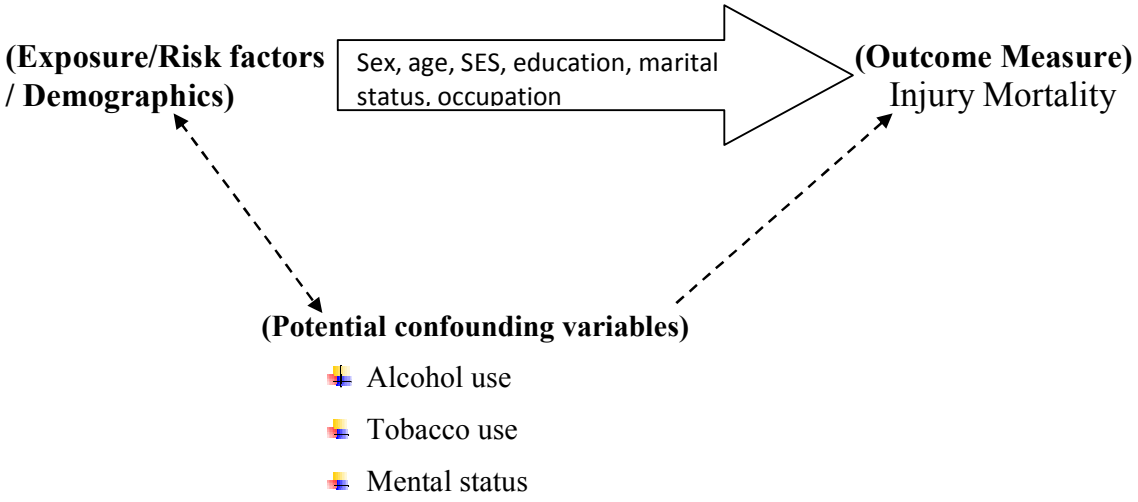
2.2.6 Inclusion and Exclusion criteria

All the injury mortality in RHDSS from 2002-2007 as identified by verbal autopsy were included. Study participants must also have been registered members of the RHDSS during the same period.

All neonatal deaths as well as non-registered members of the RHDSS were excluded from this study. The exclusion of neonates and non-registered members of the DSS was to make sure neonatal deaths were not misclassified as injury deaths and that there was proper measurement of person years contributed in the study area respectively.

2.3 Variables of the study

A diagrammatical presentation of the variables of this study is shown below



The above variables were selected for this study based on published literature showing the relationship between injuries and the demographic and risk factors. Again, it was also based on the variables available in the Rufiji Health and Demographic Surveillance System data, which was used for the analysis.

2.3.1 Outcome Variable

Injury mortality: This was our outcome variable of interest. It included all deaths due to injuries, whether accidental or intentional from 2002-2007. The causes of death were already determined by the physicians using the verbal autopsy data. The diagnoses are usually based on both remote and immediate factors leading to death. Outcome is the result which arises as a result of being previously exposed to a particular condition. A death outcome was classified

as injury death when it occurred due to any one or combination of the following; fire burns, falls, animal bites, road traffic, stab, homicide, drowning, suicide (poison, hanging) and firearm. For analysis purposes we coded our outcome variable as positive for all injury mortality and negative for individual alive in a particular year. In this study, not every participant was observed for the same length of time. Poisson regression was ideal for this measurement because it takes into account each participant contribution of time throughout the entire study duration.

2.3.2 Verbal autopsy

Verbal Autopsy (VA) interviews are performed on all deaths occurring in the study site using a standardised questionnaire to determine probable cause of death. This is a questionnaire that collects information from the deceased closer relatives about the symptoms and signs experienced by the deceased prior to death from which a diagnosis of the probable cause of death is made. Sensitivity and specificity of the VA in accurately picking up cause-specific diagnosis is a source of concern. However, this may not apply to injury deaths since these are dramatic and obvious. There are normally two specially trained physicians who review the VA questionnaire independently using mortality tabulation list and come up with a probable cause of death. In case of disagreement between the first two, a third physician is asked to independently code the cause of death in the case of discordant results. Where there are three discordant codes, the cause is registered as "unknown" or "undetermined." The causes of death are based on the 10^{th} revision of the International Classification of Diseases (ICD 10).

2.3.3 Demographic and Explanatory variables

Exposure or risk factor is the variable that is suspected to be associated with the outcome of interest. These may include demographic characteristics or external harmful substance. The

socio demographic and confounding variables included in the analyses were coded as follows:

1) Gender: male or female
2) Age group: children (1-14), young adults (15-34), middle adults (35-64),the elderly (65^{+})
3) Education: non-formal, primary, secondary, and tertiary
4) Occupation: unemployed, student, retired, casual (those who engage in non-permanent and menial jobs), farming, other (specify). There were very few participants who had salary jobs and were classified into other (specify).
5) Marital status: single (>15 years), ever married (>15 years), children (<15 years). There were fewer numbers in the categories divorced, widowed, separated and were therefore collapsed into the ever married group.
6) Household SES: high, medium and low, based on the PCA approach.

2.3.4 The Principal Component Analysis

The Principal component Analysis (PCA) is a statistical method use to construct a socio-economic index for each household. Principal components as a statistical method involves extracting from a large number of variables those few orthogonal linear combinations of the variables that best capture the common information (59). The technique reduces the number of variables in a data set into a smaller number of dimensions and assigns a weighted value to each variable base on the commonality of the particular variable among the studied population (60). The categorizations of the households into high, medium and low socio-economic status were based on the average number of household assets owned by the study participants as well as the environmental and household characteristics using the Principal Component Analysis technique. Some of the assets included for the construction of the PCA were ownership of goats, cattle, sheep, houses, chicken, cars, chicken, televisions, etc.

2.3.5 Potential confounding variables

Confounding is the condition where an apparent relationship between the exposure factor (gender, age, SES, education, marital status, occupation) and the outcome variable (Injury death) is completely or partially due to another exposure.

Alcohol abuse, psychiatric history or mental status, smoking and substance abuse were envisaged as possible confounding variables. Alcohol abuse was explained by never drank, ever drunk and unknown. Smoking history was measured by whether the deceased ever smoked or never smoked. Psychiatric history was explained by whether or not the deceased ever experienced mental confusion, fits, and other mental disorders. These were not very strong confounders in this rural setting and were collapsed into these binary outcomes because of fewer numbers. Specifically, there were not enough information on fits and mental disorders and were subsequently combined as one entity. The study made use of all the available information on the confounding variables. Information available on these possible confounders (alcohol use, mental status and smoking) was incomplete for this analysis. There were different confounders for different groups. For instance alcohol abuse, smoking, psychiatric disorders were possible confounders for adults but not for children. Childhood injuries might have been confounded by their mother's level of education, whether they were staying with biological parents or guardians among others. Some of these confounding variables were not available for this analysis and are stated in the study limitation.

2.4 Data Processing and Management

2.4.1 Extraction of the variables

The RHDSS datasets are stored in FoxPro database software. Required tables were extracted and exported into STATA version 10 using Stat Transfer software. The data tables included the individual information or member table, marital status table, verbal autopsy, mortality,

migration and SES. We created an analysis file with necessary variables by linking the above tables using personal identifiers. STATA software was used in linking the datasets and resolving the queries. Data cleaning was done by examining the dataset for missing values, duplicates, inconsistencies and incomplete information before proceeding to perform the analysis.

2.4.2 Person Years of Observation

The person years of observation (PYO) was computed for all the study participants from the individual member information table, the migration table which takes into consideration the movements of participants, the event file which records all the event history that have happened to individual members, and the interval file which basically is the start and end date of the study from which the person time of contribution is generated.

2.4.3 Data Analysis Plan

The study employed both descriptive and inferential statistical analysis. Bivariate and Multivariate Poisson regression analysis was performed using STATA 10 (statistical software package for data analysis) to assess association between the dependent variable (injury mortality) and the independent variables (gender, age, education, occupation, marital status, and household SES). We examined the trend and pattern in injury mortality by using a Chi squared test for trend. All tests for significant associations were based on p-values at 5% significance level and a 95% confidence interval (See Table 3.3). Specifically, the following statistics were performed:

1) Calculated the annual crude injury mortality rate per thousand person years with a 95% confidence interval

2) Calculated crude cause specific annual injury mortality rates in RHDSS, with corresponding 95% confidence intervals (Appendix 5)
3) Calculated gender differentials in injury mortality rates in RHDSS from 2002-2007.
4) Analyzed age specific injury mortality rates in RHDSS from 2002-2007
5) Analyzed trends and patterns of injury mortality by gender, age groups and SES, using Chi squared test for linear relationship in the injury mortality rates.
6) Determined the annual injury mortality rates from 2002 to 2007.
7) Conducted a bivariate and multivariate regression controlling for potential confounders to determine the association of the risk factors and injury mortality.

2.5 Ethical considerations

This study was based on secondary data analysis. Anonymity and confidentiality was properly taken care of, as any potential personal identification of the study participants were replaced by unique reference codes. Ethics approval was obtained from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand. The Protocol Number is M080970 (Appendix 2)

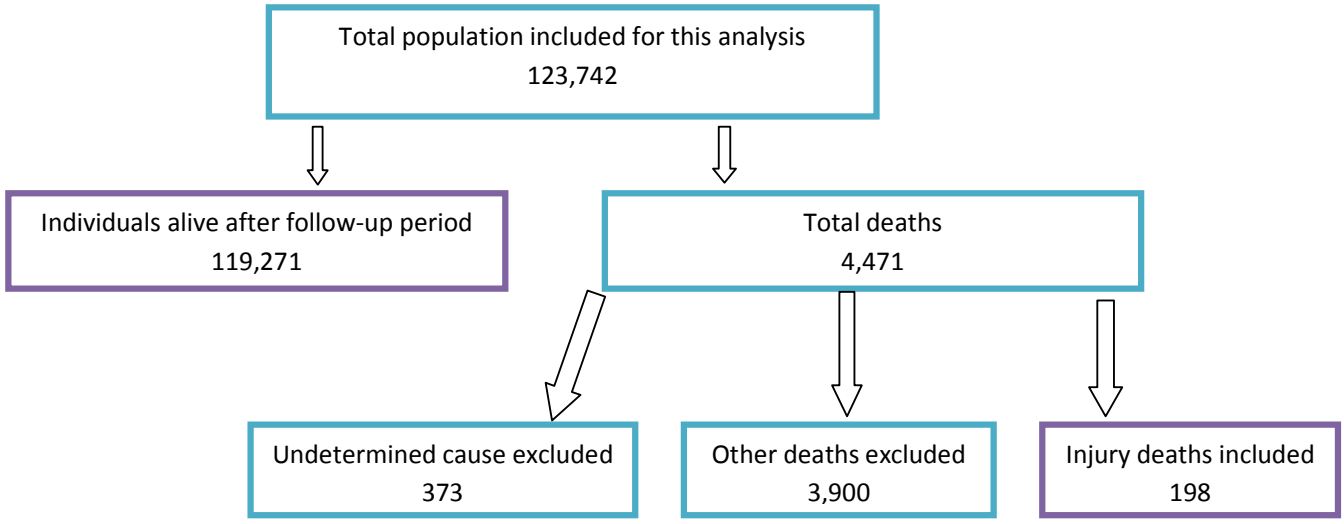
Ethics clearance was also obtained from the Ifakara Health Institute Institutional Review Board for the primary study as well as this secondary analysis (Appendix 3).

CHAPTER THREE

RESULTS

3.0 Introduction

This chapter presents the results of the analysis for the study. It is sub-divided into four sections according to the study objectives. The first section involves the identification of the types of injury mortality and the measurement of the trend from 2002 to 2007. The second section estimates the yearly crude death rates of injury from 2002-2007. Chi-Square trend test was used to determine the significance of mortality rates across the six year period. The third part assessed the risk factors for injury mortality and the last part measured the strength of the association between the risk factors and injury mortality. Bivariate and multivariate Poisson regression analysis was done to measure these associations. The undetermined causes of death includes those that the physicians did not agree on the definite cause of death as well as those deaths yet to be assigned a cause. A flow diagram on the selection of the study population is presented below.



Graph 1: Flow diagram of the study population included for this analysis

3.1 Descriptive Analysis

3.1.1 Missing Data

Table I presents the missing data of the study population. Data was collected through the DSS survey and Verbal Autopsy was used to determine the causes of death. Incompleteness of information for all individual in the DSA sometimes arises because of the internal and external migration, such that the people under surveillance are not always available to provide specific information to the DSS field workers.

Table I: Missing information on demographic characteristics of study population

Exposure factor	Frequency (No)	Percent (%)	Total
Education			
Missing	24	0.02	24
Occupation			
children	24,195	20.3	24,195
Household SES			
Missing	65,893	55.2	65,893
Marital status			
Missing	8,092	11.7	8,092

Alcohol use, smoking and mental status (mental confusion, fits and loss consciousness) of participants were envisaged as potential confounders or risk factors for injuries as supported by literature. However, less than 15% of the death had information available for analysis. These variables were therefore excluded from this analysis.

3.1.2 General description of the study population

Table II presents the socio-demographic characteristics of the study population. There were 119,271 participants contributing a total of 592,324.03 PYO over the six year period. The total person years observed was the summation of all the individual time at risk of injury mortality from 2002 to 2007. The study participants were aged 1 year and above. There were slightly more females (52.9%) verses males (47.1%). Children younger than 15 years were

the largest group 50,515 (42.4%); followed by young adults aged 15-34, 41,195 (34.5%), middle-aged adults 35-64 constituting 19,480 (16.3%) and the elderly 65^{+} who were 8,081(6.8%). About half of the study population had no formal education 60,588 (50.8%) compared to primary 53,024 (44.5%), secondary 4,878 (4.1%) and tertiary 757 (0.6%). Most of the study participants were farmers 35,505 (37.3%), 17,377 (18.3%) were casual workers (those who engage in non-permanent and menial jobs), students were 27,435 (28.9) and 4,026 (4.2%) were unemployed or were currently looking for jobs. The retired persons were 4,399 (4.6%). Household wealth profile constructed for each household through the principal component analysis (refer to page 21) method revealed that 18,971 (35.5%) participants belong to the low socio-economic status class, 18,418 (34.5%) were classified into the middle socio-economic status group, and 15,989 (30%) were in the group of high socioeconomic status. In terms of conjugal or marital status, 20,675 (18.6%) participants were not married while 40,554 (36.5%) of the total study population ever married. Children under 15 years of age constituted 49,950 (44.9%) of the total sample in this group.

A total of 4,471 deaths were recorded over the six year period. Examining injury mortality group specifically reveals that there were 198 injury recorded deaths during the study period of which 140 (70.7%) were males and 58 (29.3%) were females. Most of the injury deaths were unintentional (90%) compared to intentional (10%).

Table II: Descriptive statistics of study population by study variables

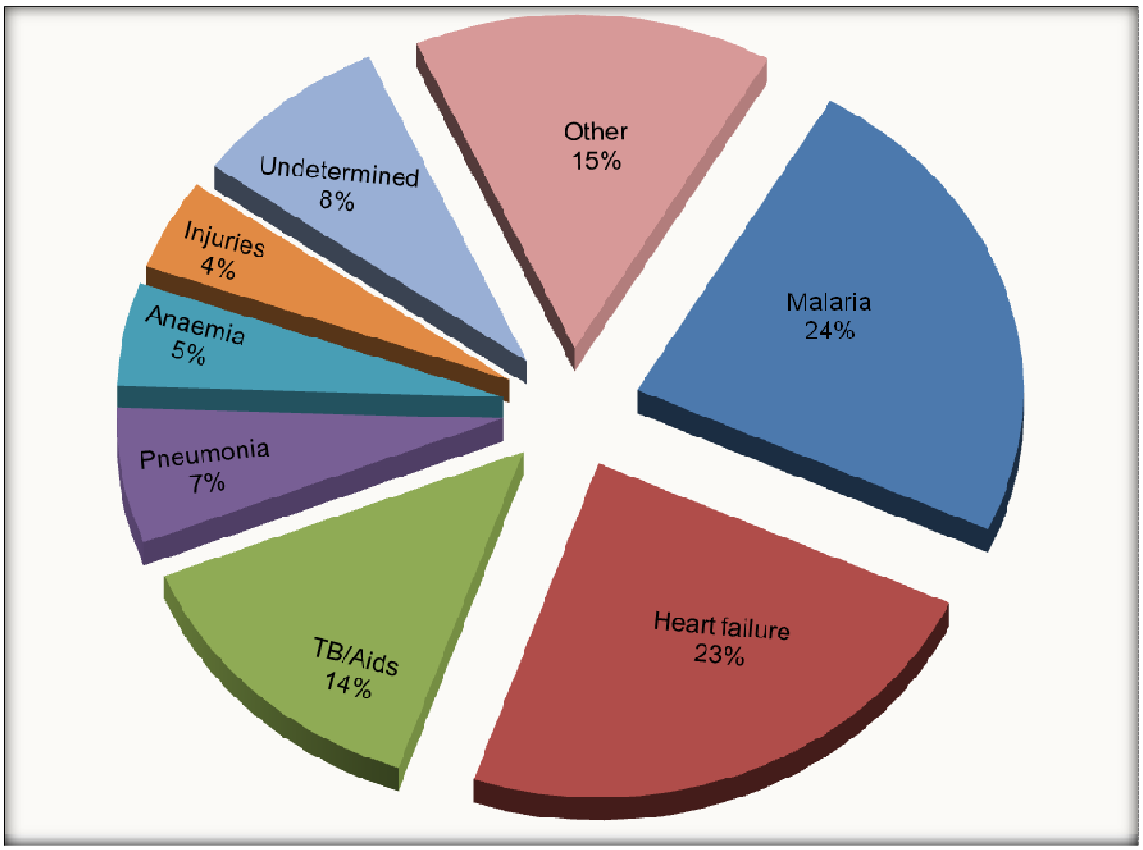
Exposure factor	Frequency (No)	Percent (%)	Total	P-Value
Gender				
Female	63,042	52.9	119,271	**0.000**
Male	56,229	47.1		
Age Groups				
1-14	50,515	42.4		
15-34	41,195	34.5	119,271	**0.000**
35-64	19,480	16.3		
65^{+}	8,081	6.8		
Education				
Primary	53,024	44.5		
No-formal	60,588	50.8	119,247	**0.018**
Secondary	4,878	4.1		
Tertiary	757	0.6		
Occupation				
Unemployed	4,026	4.2		
Student	27,435	28.9		
Retired	4,399	4.6	95,076	**0.000**
Casual	17,377	18.3		
Farming	35,505	37.3		
Other	6,333	6.7		
Household SES				
High	15,989	30.0		
Medium	18,418	34.5	53,378	0.197
Low	18,971	35.5		
Marital status				
Single (>15 years)	20,675	18.6		
Ever Married	40,554	36.5	111,179	**0.000**
Children (<15 years)	49,950	44.9		

Socio-demographic characteristics of the study participants

3.1.3 An overview of mortality burden in Rufiji DSA from 2002-2007

Injuries (intentional and unintentional) contributed 4% to mortality burden during the period of this analysis and the overall mortality burden was 754.8 per 100,000 PYO. As shown in graph 3.2, the main cause of mortality in Rufiji DSA was attributed to malaria (24%) during the six year period of this analysis. Cardiovascular and heart failures (23%) was the second leading cause of mortality burden. Acquired Immune Deficiency Syndrome and Pulmonary Tuberculosis (14%) was third, Anaemia (5%), and Injuries (4%). The other category (15%) as a cause of mortality includes maternal deaths, specified and unspecified communicable disease, specified and unspecified acute febrile illness, diarrhoeal diseases, meningitis, hepatitis, specified and unspecified acute respiratory infections, tetanus and measles.

Undetermined causes (8%) included deaths without an assigned cause as well as those yet to be coded for the year 2007. Graph 2 shows the major causes of mortality burden in the study area between 2002 and 2007.



Graph 2: Mortality Causes of Mortality in RHDSS from 2002-2007

3.1.4 The burden of injury mortality in the Rufiji DSA

Table III shows the injury mortality distribution by covariates from 2002 to 2007. The overall injury mortality rate was 33.4 per 100,000 PYO. The number of male injury deaths was 140, representing a mortality rate of approximately 50 per 100,000 PYO. The proportion of female injury mortality rate was approximately 19 per 100,000 PYO. The elderly (65^{+}) was the age category that mostly experienced injury mortality. The proportion of deaths from this group was approximately 129 per 100,000 PYO, followed by the middle-aged adults (35-64) with

the mortality rate of 47 per 100,000 PYO. Young adults (15-34) had a mortality rate of 29 per 100,000 PYO and then children (1-14) had 16 per 100,000 PYO. Injury deaths in the tertiary education level participants were proportionally higher (85 per 100,000 PYO) compared to those who had secondary (16 per 100,000 PYO), primary (27 per 100,000 PYO) or no formal (40 per 100,000 PYO) education. It must be noted that tertiary education level participants had a small sample population (n=757, number of deaths=3) compared to the other education categories. There were also proportionally higher injury deaths for retired workers (273 per 100,000 PYO), casual workers (62 per 100,000 PYO), unemployed (56 per 100,000 person years), and farmers (41 per 100,000 PYO). Participants of low socio-economic status had the highest mortality rate (46 per 100,000 PYO) compared to those of medium socio-economic status (42 per 100,000 PYO) and high socio-economic group (29 per 100,000 person years). Those who ever married had mortality rate of 57 per 100,000 PYO, compared with 29 per 100,000 PYO for those who never married.

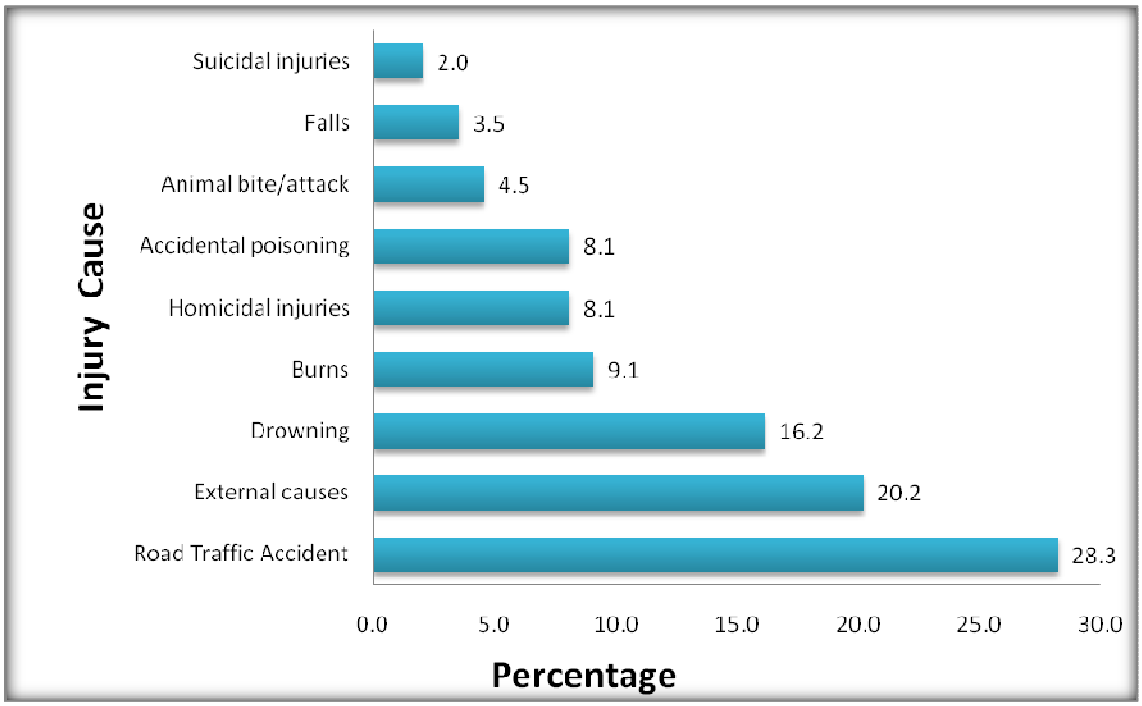
Table III: Distribution of injury deaths by different characteristics

Exposure factor	Person Time	Dead	Rate	95% Confidence Interval
Gender				
Female	310,556.33	58	18.7	14.4 - 24.2
Male	281,767.7	140	49.7	42.1 - 58.6
Total	**592,324.03**	**198**	**33.4**	**29.1 - 38.4**
Age Group				
1-14	254,938.5	40	15.7	11.5 - 21.4
15-34	192,014.21	55	28.6	22.0 - 37.3
35-64	102,645.01	48	46.8	35.2 - 62.1
65^{+}	42,726.31	55	128.7	98.8 - 167.7
Total	**592,324.03**	**198**	**33.4**	**29.1 - 38.4**
Education				
Primary	270,807.1	73	27.0	21.4 - 33.9
No-formal	293,677.2	118	40.2	33.6 - 48.1
Secondary	24,250.0	4	16.5	6.2 - 44.0
Tertiary	3,516.5	3	85.3	27.5 - 264.5
Total	**592250.83**	**198**	**33.4**	**29.08 - 38.4**
Occupation				
Student	151,544.4	12	8.0	4.5 - 13.9
Unemployed	17,878.2	10	55.9	30.1 - 104.0
Retired	12098.2	33	272.8	193.9 - 383.7
Casual	74459.5	46	61.8	46.3 - 82.5
Farming	181796.8	74	40.7	32.4 - 51.1
other	128472.2	23	17.9	11.9 – 26.9
Total	**566249.2**	**198**	**35.0**	**30.4 - 40.2**
Household SES				
High	78,611.6	23	29.3	19.4 - 44.0
Medium	91,127.64	38	41.7	30.3 - 57.3
Low	93,664.9	43	45.9	34.1 - 61.9
Total	**263,404.14**	**104**	**39.5**	**32.58 - 47.9**
Marital status				
Single (>15 years)	102,676.6	30	29.2	20.43 - 41.8
Ever Married	218,805.1	125	57.1	47.9 - 68.1
Single (<15 years)	261,6721.0	43	16.4	12.2 - 22.2
Total	**583,153.6**	**198**	**33.4**	**29.1 - 38.4**

3.1.5 The distribution of cause-specific injury mortality in the Rufiji DSA

Injury contributed a relatively low (4%) proportion to the overall mortality burden in the Rufiji DSA as seen in graph 2. The types of injury mortality recorded in the study area during the period included road traffic accident, drowning, burns, homicidal injuries, accidental poisoning, animal bite/attack, falls, suicidal injuries and unspecified external injuries (deaths due to surgical operations or being hit by an external materials like trees and heavy loads).

Most of the injury deaths were due to road traffic accidents 56 (28%), unspecified external injuries 40 (20%), drowning 32 (16%) and burns 18 (9%). The lowest injury deaths were attributed to suicide 4 (2%) or broadly referred here as intentional injuries. The distribution of injury deaths across the broad categories are shown in graph 3.



Graph 3: Distribution of Injury Cause-Specific Mortality in RHDSS

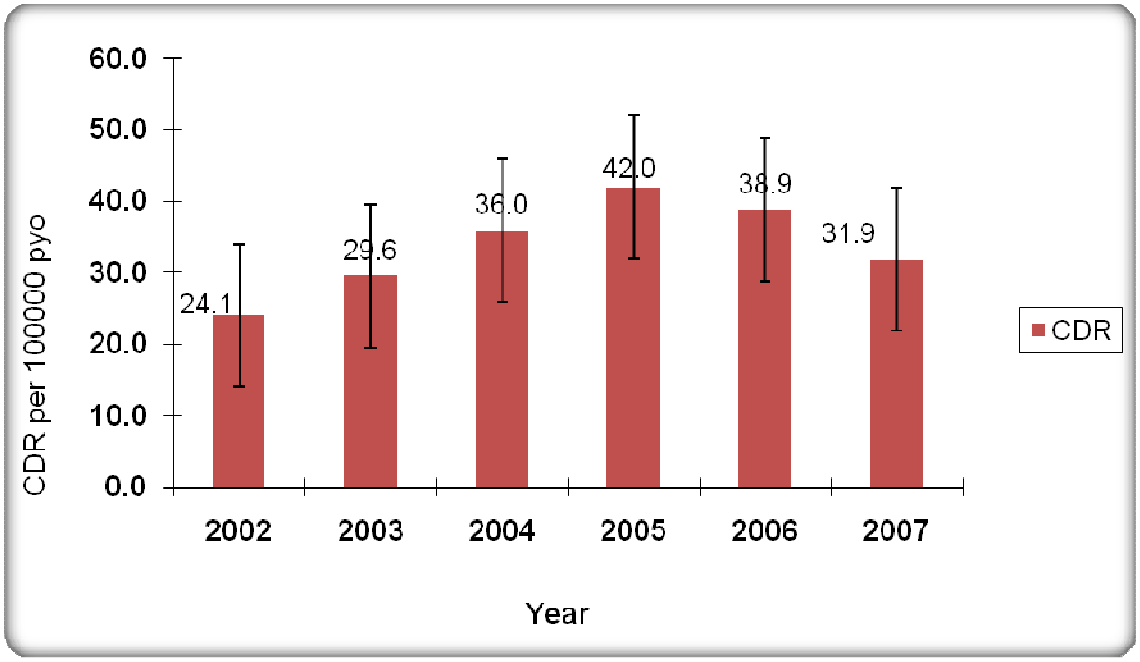
3.1.6 Estimating the yearly crude death rates of injury from 2002-2007

There was a consistent yearly increase in injury CDR from 2002 to 2005. However, a slight decline in the injury CDR between 2005 and 2007 was observed. Total PYO for each year was generated by summing the total time at risk per each individual in that particular year. This is depicted in table IV and graph 4.

Table IV: Annual crude death rates of injury mortality from 2002-2007

Year	Person-time	Mortality			Death rate per 100,000 PYO	95% CI
		Intentional	Unintentional	Total		
2002	116,121.6	4	24	28	24.1	(16.6 - 34.9)
2003	108,084.2	1	31	32	29.6	(20.9 - 41.9)
2004	102,891.2	5	32	37	36.0	(26.1 - 49.6)
2005	100,032.3	7	35	42	42.0	(31.0 - 56.8)
2006	90,047.2	2	33	35	38.9	(27.9 - 54.1)
2007	75,147.5	1	23	24	31.9	(17.4 - 38.7)
Overall	**592,324**			**198**	**33.4**	**(29.1 - 38.4)**
	Chi-Square test = 6.18				**P = 0.288**	
	Chi-Square of Linearity test = 6.14				**P= 0.188**	

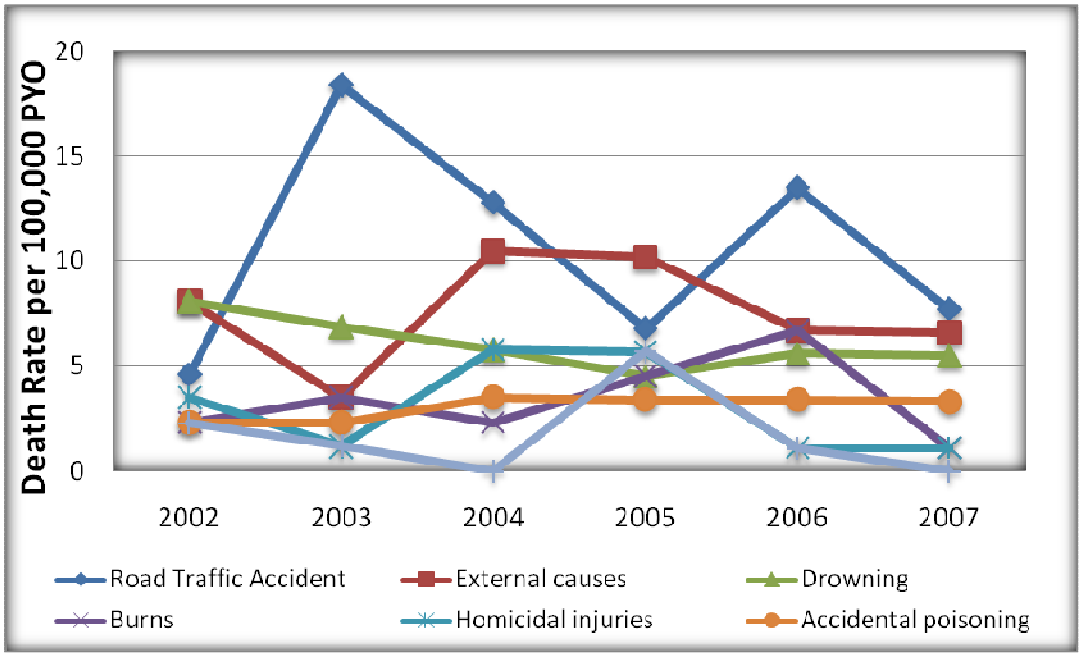
The Chi-Square test shows that there were no significant difference in proportions of injury deaths among the different years (P=0.288). The confidence bands were overlapping indicating that the injury mortality rates were not significantly different in the different years. The trend showing the annual crude injury mortality rates per hundred thousand person years with 95% confidence bands is presented in graph 4.



Graph 4: Trend of Injury Mortality from 2002-2007

3.1.7 Trend of Injury Mortality by type from 2002-2007

Road traffic accidents (RTAs) were the leading cause of death (peaking at death rate of 18.2 per 100,000 PYO) through out the study period with the exception in 2005 where external injuries led. There was no definite trend among all the cause specific injuries except accidental poisoning which was relatively constant over the entire period. These trends are shown in graph 5.

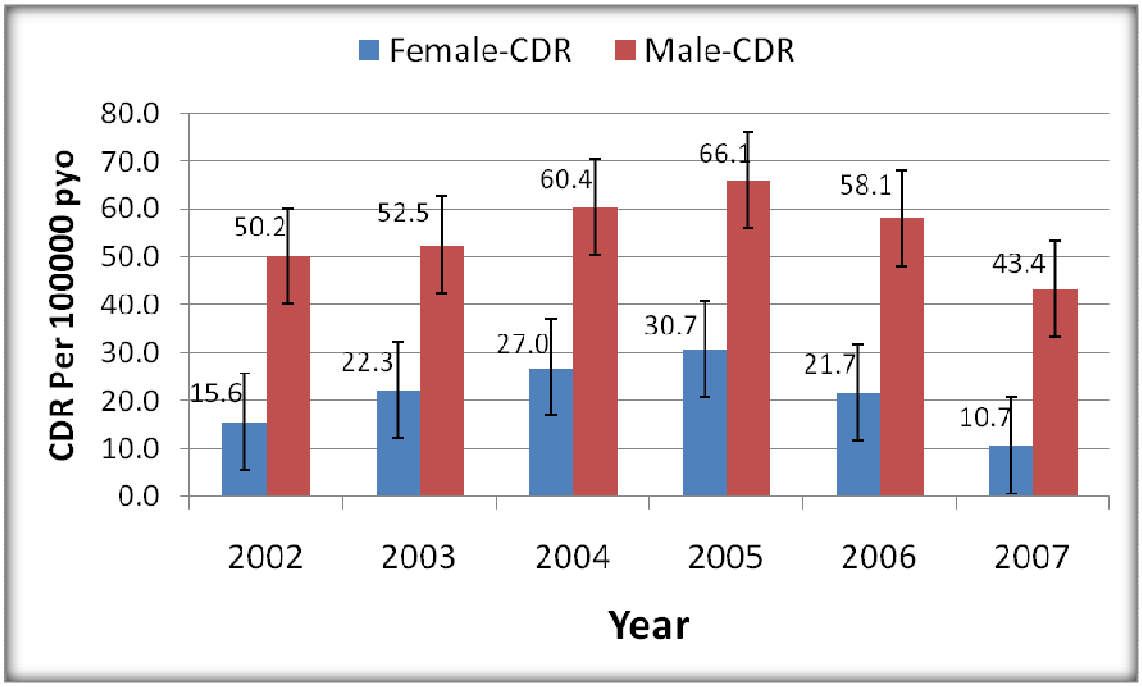


Graph 5: Trend of Injury Mortality by type from 2002-2007

3.1.8 The role of gender in Injury Mortality from 2002-2007

Gender was a significant factor in terms of injury mortality in the Rufiji DSA during the period of this analysis. Males were the most affected group throughout the six year period (n=140, 71%). From 2002, injury deaths started increasing for both sexes and reached a peak in 2005 (ICDR=30.7 and 66.1) per 100,000 PYO for females and males respectively. The ICDR started to decline after the year 2005 with the decline shaper for females compared to

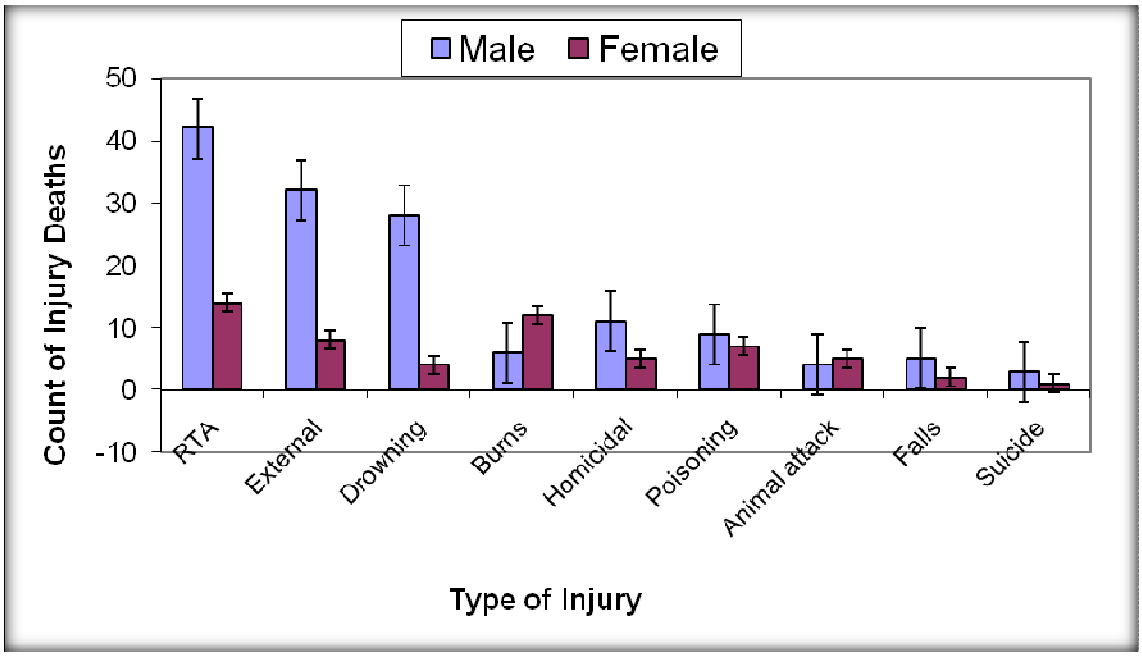
males. There was a significant difference in the death rates between females and males as shown by the non-overlapping confidence bands throughout the study period. These trends with corresponding 95% confidence bands are shown in graph 6.



Graph 6: Trend of Injury Mortality by Gender from 2002-2207

3.1.9 Cause-Specific Injury Mortality by gender

Graph 7 shows the cause-specific injury mortality by gender. The diagram indicates that in all the causes of death attributed to injuries, males were significantly dying more than females with a ratio of 2.4: 1. This pattern was observed for road traffic accidents (RTA), external injuries and drowning (all showing a non-overlapping confidence bands). The other cause specific injury mortality (homicidal injuries, accidental poisoning, falls and suicide burns and animals attack) also showed variation in death rate between gender but were not statically significant because of the over-lapping confidence bands.

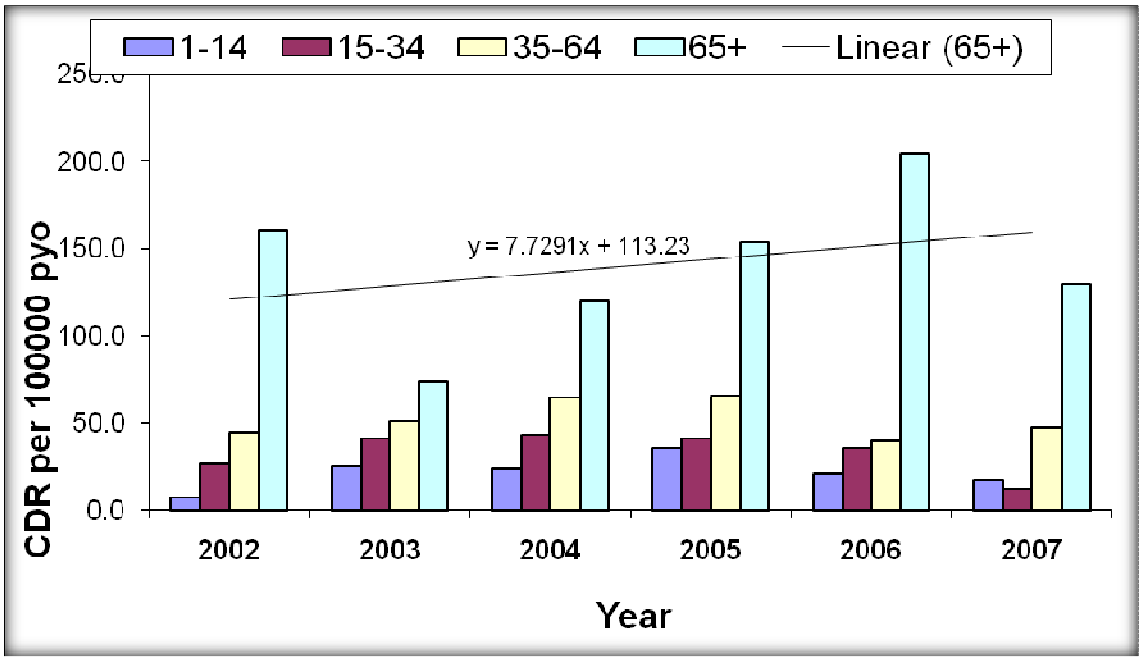


Graph 7: Cause-Specific Injury by Gender

3.2.0 Distribution of Injury Mortality by Age group from 2002-2007

The elderly and the middle-aged adults were the most affected age groups in terms of injury mortality during the period under study. There were more injury deaths among the elderly aged over 64 years (n=55, Mortality Rate = 128.7 per 100,00 PYO) compared to the other age groups. There was approximately 8% increase in injury mortality as shown by the equation

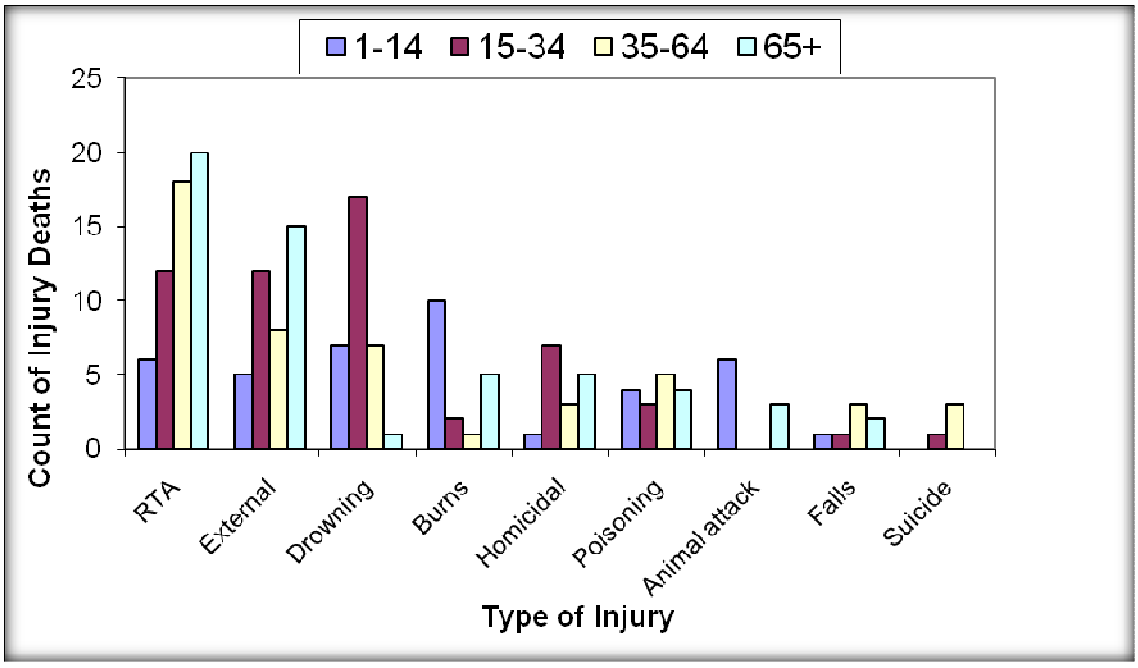
line (R-squared=7.7) over the entire six year period in adults aged over 64 years and 5% in middle adults aged 35-64. Children were the group that experienced least deaths due to injuries during the period. The distribution of injury deaths among the different age groups are shown in graph 8.



Graph 8: Distribution of Injury Mortality by Age group from 2002-2007

3.2.1 Cause-Specific Injury Mortality by age group

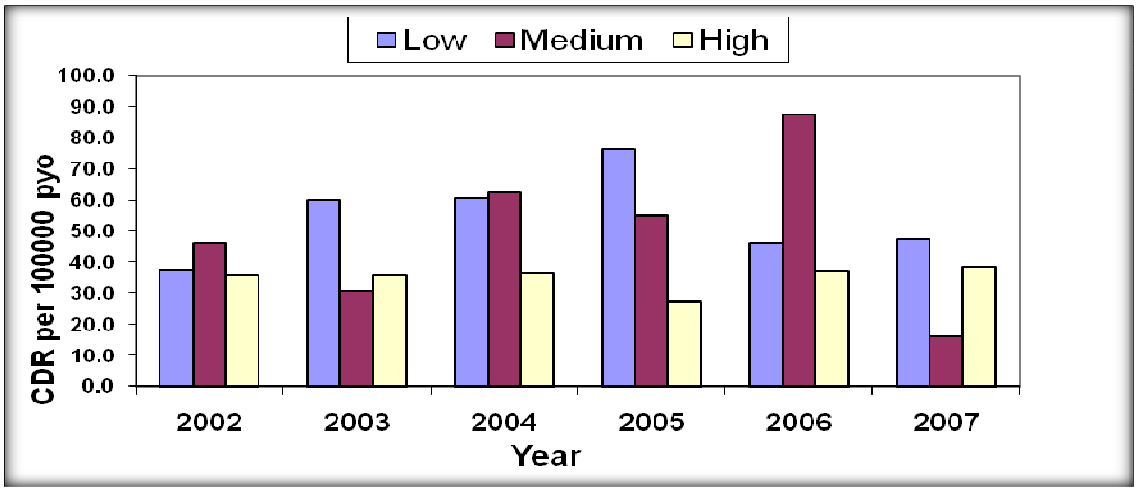
Road traffic accidents, external causes, drowning and burns were the leading cause of injury fatalities in all the age groups. In terms of road traffic accidents, most casualties were from the elderly age group, followed by the middle-aged adults, young adults and then children. Road traffic accidents increased with increasing age. A reverse trend was observed for burns as a cause of injury mortality. Children were dying more, followed by the elderly, young adults and then middle-aged adults. Most of the drowning as well as homicidal injuries occurred among young adults aged 15-34 compared to the other age groups. The elderly was the group that experienced the least deaths as a result of drowning. About the same rate of death was observed for all the different age groups as a result of accidental poisoning. Children were the most vulnerable to animal bite or attack and followed by the elderly. This distribution of age specific injury mortality is shown in graph 9.



Graph 9: Cause-Specific Injury by Age group

3.2.2 Distribution of Injury Mortality by Socio-economic status

Socio-economic status (SES) was another factor that showed association with injury mortality even though a large sample of participants (55%) had missing data. SES data is collected every other year in the DSA. Study participants of low and medium SES were the groups mainly affected in most of the years. Comparatively the least injury deaths occurred in the high SES class. This observation was consistent during the six year period of this analysis. An exception was however observed in 2003 and 2007 where most injury deaths occurred in low SES group, followed by high SES status class and then the medium socio-economic class. Graph 10 shows injury mortality rate per 100,000 PYO by SES.

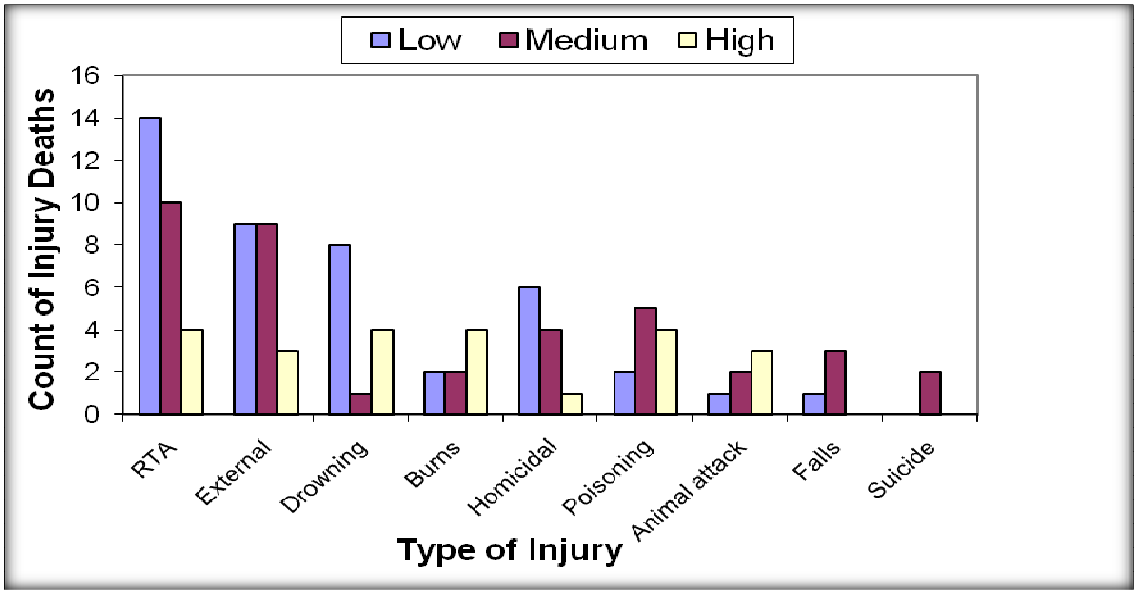


Graph 10: Distribution of Injury Mortality by Socio-economic Status

3.2.3 Cause-Specific Injury Mortality by Socio-economic status

Graph 11 shows the cause-specific injury mortality by SES class. Injury deaths due to burns were double in the high SES group compared to the other SES groups. Furthermore, deaths due to animal attacks were also high in the same group compared to the low and middle SES groups. On the other hand, road traffic accidents were more than three times higher in the low

SES group compared to the other groups. Drowning and homicidal injuries were also highest in the low SES class compared to the other groups.



Graph 11: Cause-Specific Injury by Socio-economic Status

3.3 Inferential Analysis

3.3.1 Bivariate Poisson regression analysis of risk factors for injury mortality

Bivariate and Multivariate Poisson regression analysis was carried out to investigate the association between risks factors (gender, age, occupation, education, marital status, socio-economic status) and injury mortality. This was carried out for all the study participants aged 1 year and above and resided in the Rufiji DSA between 1st January, 2002 and 31st December, 2007. Incidence Risk Ratios (IRR) were used to measure the strength of the relationships and interpreted as Relative Risk. The results are presented in Table V.

Table V: Bivariate and Multivariate Poisson regression analysis of injury mortality

Factors	Bivariate Model (95% CI)			Multivariate Model (95% CI)		
	IRR	CI	P-Value	IRR	CI	P-Value
Gender						
Female	**1***			**1***		
Male	2.66	1.96 - 3.61	**0.000**	3.04	2.22 - 4.17	**0.000**
Age Groups						
1-14	**1***			**1***		
15-34	1.83	1.22 - 2.74	**0.004**	0.98	0.38 - 2.52	0.972
35-64	2.98	1.96 - 4.53	**0.000**	1.34	0.48 - 3.75	0.582
65^{+}	8.20	5.46 - 12.33	**0.000**	2.83	1.01 - 7.93	**0.048**
Occupation						
Student	**1***					
Farming	5.14	3.05 - 16.35	**0.000**	4.13	1.81 - 9.42	**0.001**
Casual	7.80	4.13 - 14.73	**0.000**	7.36	3.25 - 16.66	**0.000**
Unemployed	7.06	2.79 - 9.46	**0.000**	8.57	3.26 - 22.48	**0.000**
Retired	34.45	17.79 - 66.70	**0.000**	28.26	12.53 - 63.71	**0.000**
Marital status						
Single (>15 years)	**1***			**1***		
Ever Married	1.96	1.31 - 2.91	**0.001**	1.08	0.64 - 1.83	0.776
Children (<15 years)	0.56	0.35 - 0.90	**0.016**	1.45	0.59 - 3.57	0.423
Education						
Primary	**1***			**1***		
No-formal	1.49	1.11 - 2.00	**0.007**	1.25	0.87 - 1.79	0.230
Secondary	0.61	0.22 - 1.67	0.339	0.59	0.21 - 1.62	0.306
Tertiary	3.16	1.00 - 10.04	**0.050**	1.19	0.37 - 3.86	0.769
Household SES						
High	**1***					
Medium	1.43	0.85 - 2.39	0.180			
Low	1.58	0.95 - 2.60	0.081			

1*=*Reference group*

There were five factors that were associated with injury mortality in the bivariate model (gender, age occupation, education and marital status). There was a strong evidence of an association between injury mortality and gender. Men were about 2.7 times more likely to die of injuries compared to females. [IRR=2.66, P=0.001, 95% CI (1.96 - 3.61)].

Age was also associated with injury mortality. The relative risk of young adults (15-34) death from injuries was 1.8 times higher compared to children (1-14) [IRR=1.83, P=0.004, 95% CI (1.22 - 2.74)]. Middle-aged adults (35-64) had an increased risk of about three times of dying

from injuries compared to children [Unadjusted IRR=2.98, P=0.000, 95% CI (1.96 - 4.53)]. The relative risk of death from injuries was highest among the elderly (65^{+}). They were 8.2 times more likely to die from injuries compared to children [IRR=8.20, P=0.001, CI (5.46 - 12.33)].

There was also evidence of an association between occupation and injury mortality. The unemployed were seven times more likely to die of an injury event compared to students, [IRR=7.06, P= 0.001, 95% CI (3.05 - 16.35)]. Those who were on retirement were 34.5 times more likely to die of an injury compared to students. [IRR=34.45, P=0.001, 95% CI (17.79 - 66.70)]. The relative risk of death from injuries for casual workers was 7.8 times higher compared to students, [IRR=7.80, P=0.000, 95% CI (4.13 - 14.73)]. Farmers had a five times higher risk of injury mortality compared to students, [IRR=5.14, P=0.001, 95% CI (2.80 - 9.46)].

Marital status was associated with injury mortality. The risk of injury death for those who were currently or ever married was almost two times higher compared to those who were not married but over age 15 [IRR=1.96, P=0.001, 95% CI (1.31 - 2.91)]. Risk of injury mortality was however protective for singles under 15 years of age [IRR=0.56, p=0.016, 95% CI (0.35 - 0.90)] compared to singles aged over 15.

We also observed an association in the bivariate model in terms of educational attainment of the study participants. The risk of injury death was 1.5 times higher for those study participants who never had any formal education compared to those who acquired primary education, [IRR=1.49, P=0.007, 95% CI (1.11 - 2.00)].

We did not find any evidence of an association between SES and injury mortality [IRR=1.58, P=0.081, CI (0.95 - 2.60)].

In the multivariate Poisson regression model, variables that were significant in the bivariate model were included for analysis to control for confounding effect. It must be noted however

that data on all the suspected confounders mentioned in section 2.3 were not available for this analysis. In this model, factors that remained significant and are thus associated with injury mortality were gender, age and occupation. Education and marital status of study participants were no longer significant in the final multivariate model.

There was a strong evidence of an association between gender and injury mortality. Adjusted for age, occupation, education and marital status, males were three times more likely to die from injuries compared to females, [Adjusted IRR=3.04, P=0.001, 95% CI (2.22 - 4.17)]

The elderly were 2.8 times at risk of dying from injuries compared to children less than fifteen years of age, controlled for the effect of gender, occupation, marital status and education [Adjusted IRR=2.83, P=0.048, 95% CI (1.01 - 9.93)].

There was an observed strong relationship between occupation and injury mortality after adjusting for age, gender, education and marital status. Compared with students, the unemployed had an increased risk of 8.6 times more likely to have experienced injury mortality, [Adjusted IRR=8.57, P=0.001, 95% CI (3.26 - 22.48)]. Study participants who were retired were 28.3 times more likely to die of injuries compared to students, [Adjusted IRR=28.26, P=0.005, 95% CI (12.53 - 63.71)]. The risk of injury death was 7.4 times higher for casual workers compared to students, [Adjusted IRR=7.36, P=0.001, 95% CI (3.25 - 16.66)] after adjusted for age, gender, education and marital status. The relative risk of injury mortality for farmers was four times higher compared to students, [Adjusted IRR=4.13, P=0.001, 95% CI (1.81 - 9.42)] after controlling for age, gender, education and marital status.

3.4 Assessing confounding Effect

Education level of participants and marital status became insignificant after adjusting for gender, age and occupation in the multivariate model. This shows that age, gender and

occupation were suspected confounders as the real effect of education and marital status in the multivariate model became insignificant.

CHAPTER FOUR

DISCUSSION

The chapter discusses the results of the study. It makes an attempt to compare the main findings of this study which is assessing risk factors and trends of injury mortality in the Rufiji Demographic Surveillance Area between 2002 and 2007, with the literature and try to draw conclusions on similarities and differences. The limitations and strengths of the study will be discussed.

4.1 Main findings of the study

The overall crude mortality rate was 754.8 per 100,000 PYO and that for injury specific crude mortality was 33.4 per 100,000 PYO (4% of total deaths). Road traffic accidents were the leading cause of injury mortality (28%). The annual injury crude death rate increased over the study period except between 2005 and 2007 where there was a slight decreased in the injury death rates although not significant (P=0.188). Age, gender and occupation all showed a significant association with injury mortality.

4.1.1 Risk factors

There was strong evidence that gender was significantly associated with injury mortality in Rufiji Demographic Surveillance Area. Males were three times more likely to die of injuries compared to females (P=0.001).

Age was also a risk factor for injury mortality. The probability of dying from injuries was higher for the elderly and the middle-age adults compared to the youth as well as the children less than 15 years of age (P=0.048).

Type of work was also significantly associated with injury mortality. Compared with students, the unemployed, the retired, casual workers and farmers all had an increased risk of injury mortality (P<0.001).

There was no proof of an association between socio-economic status and risk of injury mortality in this analysis.

4.1.2 Cause-specific injury mortality

Injury contributed 4% to overall mortality burden in the Rufiji DSA during the period of this analysis. Road traffic accidents were the leading cause of death (28%), followed by unspecified external injuries (20%), drowning (16%), burns (9%), homicidal injuries (8%), accidental poisoning (8%), animal bites or attack (5%), falls (4%) and suicidal injuries (2%).

4.1.3 Comparing the findings with previous studies

4.1.3.1 Comparing the risk factors for injury mortality to other studies

The finding of this study is consistent with other studies that males were more likely to experience injury mortality than females. In this study, males were three times more likely to die of an injury compared to females (P=0.001). Globally, injury mortality among males is twice of that among females and males in Africa and Europe have the highest injury-related mortality rates (1). In South Africa, the male-female injury mortality ratio in 2008 was 3.3:1 (18). This study demonstrated that road traffic related injuries was the main cause of injury deaths and males were more at risk of dying compared to females (ratio 3:1). This is consistent with the WHO findings in 2002 that put the male-female road traffic related ratio at 3:1 (1). The high male injury fatality rate in this rural setting might be explained by the gender specific roles where men are more likely to perform the risky jobs like fishing and farming.

Studies conducted in Tanzania and Tehran also found that 61.5% of injured patients were males and the crude mortality rate for men was nearly twice that of women respectively (27;28). This study is reflective of the study conducted by Moshiro et al.(2001) in Tanzania specifically in Dar es Salaam, Hai, and Morogoro districts investigating the importance of injury as a cause of death which showed that injury mortality rates among men were approximately three times higher than among women in all study areas (8).

Age was also associated with injury mortality. The elderly were consistently associated with higher injury mortality rates compared to the younger age groups. In particular, the study revealed that those aged 65 and above had an increased risk of 2.8 times compared to children under 15 years (P=0.048). This finding is similar to the study conducted by Lopez et al. (2006) assessing the global burden of disease and risk factors which indicated that injuries was responsible for one-quarter of deaths in the age group 15–59 in 2001 (4) .The rest of the injuries deaths occurred in the age groups less than 15 years and above 60 years. The assertion that injury mortality rates increased with age is similar to the findings of Moniruzzaman et al. (2008) which reported that in low and middle income countries, unintentional injury mortality rates increased with age between 5-64 years (61). The study indicated that there is a direct relationship between age and injury mortality such that as age increases, the risk for injury mortality increases also. This finding is supported by a study in Tanzania (2001) investigating the importance of injury as a cause of death which found that injury death rates were highest among those aged 60 years and above (8).

A couple of studies have shown that increasing SES has a strong inverse association with the risk of fatal injuries and more than 80% of childhood burns occurred in low socio-economic groups (32-35). This study did not find sufficient evidence to suggest that household wealth was a risk factor for injury mortality. It must be noted here however that we did not have

socio-economic status information for all the households who were included in this analysis (55%). This inadequate information could have influenced these findings. Furthermore, Rufiji is a rural area and almost homogeneous in terms of wealth index, there is no much variation in items they possess hence, no significant difference in SES between the high and low groups.

4.1.3.2 Comparing cause-specific injury mortality to other studies

Among the two broad types of injuries, 90% were unintentional compared to intentional (10%). This high unintentional injury deaths was also reported in others studies in Tanzania where 74% were unintentional (8). Road traffic accident was the leading cause of injury mortality (28%) in this study. A study in some parts of Tanzania (Dar es Salaam, Hai and Morogoro districts) also confirmed that road traffic accidents was the leading cause of injury mortality as did studies in Kenya and Ghana (8;13;62).

The data analysis showed an increasing trend in injury mortality from 2002 to 2005. It also showed a decreasing trend from 2005 to 2007. The Chi squared trend test showed that the trend was statistically insignificant (P=0.288). The initial increased in injury crude death rates between 2002 and 2005 might be due to the bad road network during that period as road traffic accidents were the leading cause of injury mortality throughout the period. Conversely, there was a general decreased in the number of injury fatalities between 2005 and 2007 in this study. This reversal trend might also be explained partially by the reconstruction of the Dar es Salaam Rufiji road which was completed in 2005. This is because most of the injury mortalities were caused by road traffic accidents. The highest number of all injury-related deaths occurred in 2005. This was an election year and there was an increased in motorised activity in the Rufiji district and the whole country at large, coupled with some of the social behaviours characterised by the electioneering campaigns.

Injuries related to burns showed that females were more likely to die compared to males (ratio 2:1). Other studies in Africa reported that males were more likely to die of burn fatalities and that young children and the elderly are the most vulnerable (1;35;63;64). One possible reason for the differences in findings has to do with the settings. Whereas those studies were conducted in urban settlements, this study was conducted in the rural area where feminine is associated with the role of cooking.

Drowning was one of the leading causes of injury mortality in this study. Studies have shown that Africa had the highest drowning mortality rate (13.1 per 100,000 populations) and males had higher drowning mortality rates than females for all ages and in all regions and was more pronounced in children up to fourteen years (5). In this study however, most of the drowning fatalities occurred in young (15-34) and middle-aged (35-54) adults compared to children and the elderly. This might be due to setting differences. In the Rufiji Demographic Surveillance Area, most of the people are engaged in subsistence farming and fishing activities with the proximity of the Rufiji River as a possible influencing factor. For children less than 15 years of age, burns were the leading cause of injury death, followed closely by drowning and animal attacks among both sexes. Most of the burn injury occurred in the high socio-economic group. This might be due to the type of stove this group of people uses for cooking as their social status is high and they were more likely to owe gas and electric cookers.

There were more male deaths from accidental poisoning compared to females. Our result is also reflected in other studies which indicate that the highest poisoning mortality rates were found in the male populations of the low and middle-income countries and over 60% of the global mortality due to poisoning occurs among adolescents and adults aged between 15–59 years (21).

The result also showed that males of middle-age were dying more of homicidal injuries than females (ratio 2:1). This is consistent with global report that more than three-quarters (77 percent) of homicide deaths in 2000 were males and the highest levels of homicide occurred among males 15 to 29 years old, closely followed by those 30 to 44 years old (21). Results from the South African National Injury Mortality Surveillance System (NIMSS) in 2000 also indicate that homicidal injuries contributed 36 percent to all injury deaths (65) and that homicide continues to be the leading cause of premature death among South African males (66).

4.2 Limitations of the study

Generalization of the results is limited to residents of the Rufiji Demographic Surveillance Area and similar rural settings. This is because the area is a rural settlement. The population is dynamic with difference life styles. Also, the DSA is a sample cohort which is not large enough for generalization purposes.

Also, the analysis was restricted to variables available in the dataset hence analysing other relevant variables that could have prejudiced these findings were left out e.g. the nature of the road network, religious denomination, driver over-speeding etc.

Again, the information collected on some of the variables was inconclusive for the purpose of this analysis e.g. missing information on alcohol use, tobacco use and mental status of studied participants. The study did adjust for the potential effect of these variables on injury mortality but the information used for this analysis was not conclusive enough to impact significantly on the findings.

Further, this report was based on secondary data analysis which was not collected purposely for this study. Information therefore was not collected on all the variables that would have

been an important component of this analysis as the questionnaire was not designed specifically to illicit information from the respondents to answer these study objectives.

Although some studies have reported that using the verbal autopsy to evaluate the cause of deaths have been reliable and accurate (49;53;54;67), this study can not rule out the probability of injury deaths being misclassified due to recall bias. This is because there were some of the deaths that were labelled 'undetermined cause' and it was possible for some of the injury related deaths to be classified into that group.

Despite these shortcomings, however, this data provides sufficient epidemiological information to inform preventive action.

4.3 Strengths of the study

The sample size was a true representation of the study area and was large enough to give the study a statistical power.

We used PYO method which is a more accurate measure of time -to-event compared to mid-year population estimates.

The study used longitudinal data collected and updated periodically and thus able to monitor demographic change.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSION

In Rufiji Demographic Surveillance Area, injuries remain an important cause of death but the extent of variation by age-group in the overall level of risk as well as risk from individual causes suggest that interventions tailored more to age-group and gender-specific would maximize prevention efforts.

In particular, the threats from road traffic accidents in the middle-aged adults and the elderly, drowning in young adults and children, burns as well as animal attack in children, homicide in young adults, suicide in middle adults, and accidental poisoning in all age groups need urgent attention and consideration. Also, burns as well as animal attack in females, and road traffic injuries, drowning, falls, homicidal or assault, accidental poisoning in males needs specific interventions.

In summary, this study has revealed that there are significant disparities in injury mortality rates by gender, age-group and occupation in the Rufiji Demographic Surveillance Area. It highlighted gender as well as the age-groups at most risk of injury mortality. Also the leading cause of injury mortality was RTAs. Males had consistently higher injury mortality rates than females across all age groups and for all the major types of injuries in the Rufiji Demographic Surveillance Area. Whereas intentional or suicidal deaths were less common among this population, death rates due to road traffic accidents, accidental drowning and homicidal injuries were highest among the low socio-economic status participants.

The causes of injury death that did not show evidence of age variation were accidental poisoning and falls. Homicidal injuries did not also exhibit significant gender variation. In spite of the downward trend in injury mortality rates between 2006 and 2007 in Rufiji Demographic Surveillance Area, these results suggest that injuries remain a great threat to human survival and there is still a great potential for improvement.

5.2 RECOMMENDATIONS

The recommendations are three fold based on the findings of this study and also evidence from WHO report on violence and road traffic accidents; prevention and management, educational campaigns and continual research.

5.2.1 Prevention and management

As the most common cause of injury mortality, control measures for Road Traffic Accidents could focus on encouraging pedestrians to walk facing traffic, enacting speed limits, persuading drivers to use headlights during the daytime, driving within approved speed limits, heavy fines and punishment for traffic offenders, and the provision of adequate sidewalks for pedestrians who are among the most vulnerable road users. There should be legislation and law enforcement to instil discipline on the roads.

Other measures for the reduction of severity of RTAs may include the use of protective clothing and helmets for cyclists, and the use of seatbelts for passengers.

For management of RTAs, measures should include rapid responses to crashes in the form of first aid for the victims, clearance of accident scenes, and accessibility of health facilities and rehabilitation centres for accident victims. This requires a strong political will as recommended by the World Health Organisation.

As drowning was the third most common cause of injury mortality in adult men due to fishing, prevention strategies should focus on the establishment of strategies to ensure safety water transport and commutation. The use of life jackets and other flotation devices for water users, adult supervision for recreational swimmers especially for children is very important.

5.5.2 Educational campaigns

Injuries are threats to the health of human existence globally, especially in developing countries. As a result, the educational sector could include injury prevention curricula across the various levels of education for awareness creation. The Health Sector can include road safety in their health promotion and disease prevention activities.

Road safety education is one of the key to the successful reduction of fatalities on the roads. There is the need for educational campaigns at various levels to create public awareness of the need for safety and precautionary measures to minimize or prevent injuries. Dissemination of information about injuries should target the general public.

5.2.3 Continual Research

There is the need for intensification of national efforts to lower the burden of death and disability from injury through improved application of scientifically-based evidence on injury control. This has economic implication as injuries consume massive financial and human resources of most developing countries. Ongoing monitoring and evaluation is also necessary for assessing the effectiveness as well as progress of programmes.

National programmes may focus on strengthening capacities of research institutions for data collection and prevention methods, encouraging research on the determinants and costs of injuries and their prevention, encouraging intersectoral and cross-disciplinary collaboration.

More importantly intervention research is encouraged for early interventions and also to provide assistance for vulnerable groups.

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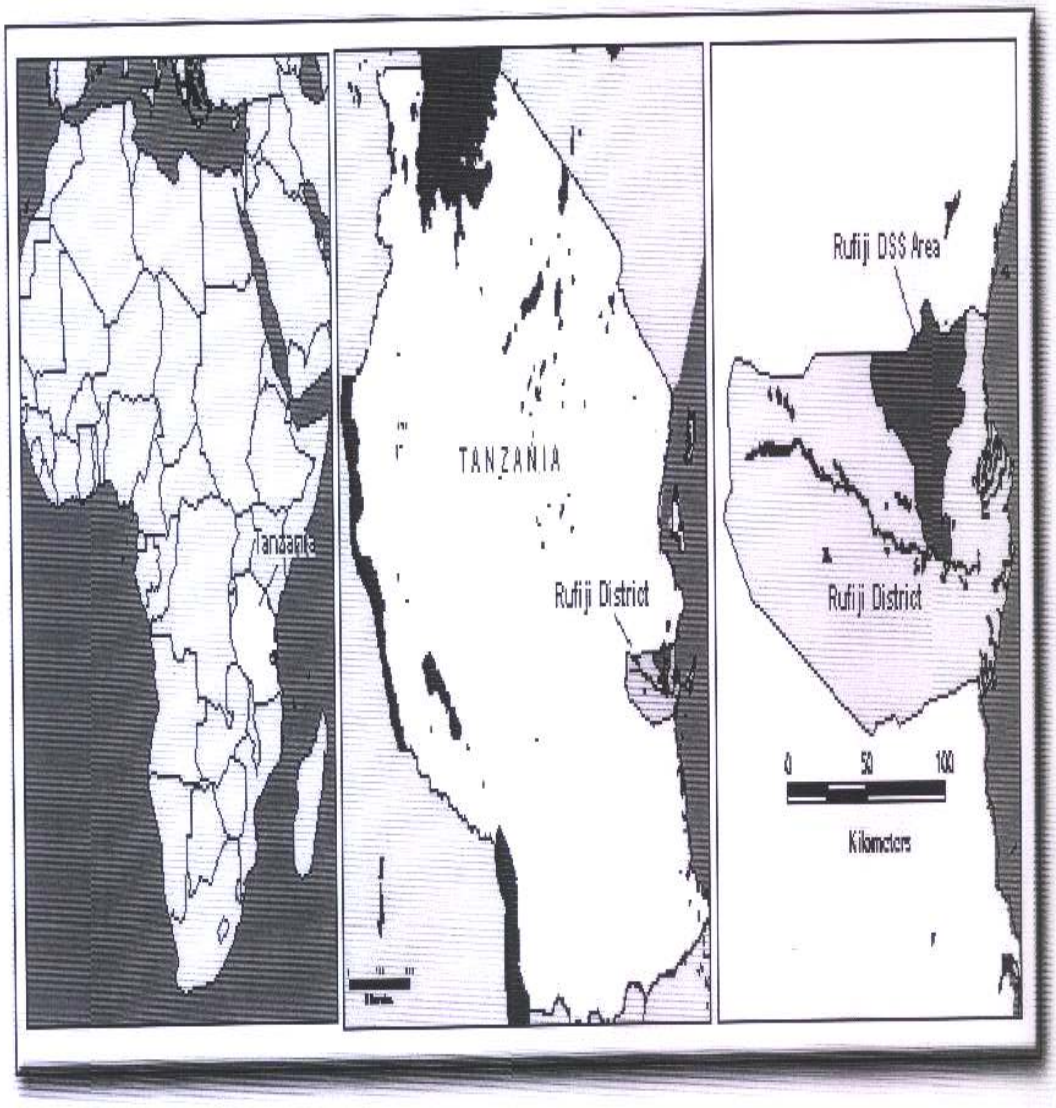
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Appendices

Appendix I: Map of Tanzania showing the Rufiji Demographic Surveillance Area



Appendix II: Human Research Ethics Clearance Certificate by Wits University

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Ae-Ngibise

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M080970**
PROJECT	Risk Factors and Trends in Injury Mortality in Rufiji Demographic Surveillance System, Rural Tanzania from 2002 to 2007
INVESTIGATORS	Mr K Ae-Ngibise
DEPARTMENT	School of Public Health
DATE CONSIDERED	08.09.26
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 08.09.29 **CHAIRPERSON** .....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor · Dr R Kellerman

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix III: Use of Rufiji HDSS data permission letter

IFAKARA HEALTH INSTITUTE
research | training | services

Please reply to:
IHI, Rufiji HDSS

The Chairperson,

Ethics Committee,
University of Witwatersrand,
South Africa

Date: September 8, 2008

Dear Sir/Madam

RE: USE OF RUFIJI HDSS DATA

I would to bring to your attention that Mr Ae-Nginise A Kenneth who is a Masters students at the University of Witwatersrand in South, has been granted permission to use data from Rufiji Health and Demographic Surveillance System (RHDSS) for his dissertation titled "RISKS FACTORS AND TRENDS IN INJURY MORTALITY IN RUFIJI DEMOGRAPHIC SURVEILLANCE SYSTEM, RURAL TANZANIA FROM 2002 TO 2007". Permission has been given for data collected between 2002 and 2007.

Please do not hesitate to contact me in case you have any queries regarding this matter.

IFAKARA HEALTH INSTITUTE P.O BOX 78373 DAR ES SALAAM TANZANIA

Sincerely
Masanja. H, PhD
Rufiji HDSS Site Coordinator

Dar es Salaam PO Box 78373 Tel: 0 222 771 714 Fax: 0 222 771 714
Ifakara PO Box 53 Tel: 0 232 625 164 Fax: 0 232 625 312
Bagamoyo PO Box 74 Tel: 0 232 440 065 Fax: 0 232 440 064
Rufiji PO Box 40 Ikwiriri Tel: 0 232 010 007 Fax: 0 232 010 742
Mtwara PO Box 1048 Tel: 0 232 333 487 Fax: 0 232 333 487
Kigoma PO Box 1077 Tel: 0 282 803 655
www.ihi.or.tz

Appendix IV: Verbal Autopsy Questionnaire

NSS VA Form VA2002-3

VERBAL DIAGNOSIS FORM: 5 YEARS AND ABOVE (ADULT DEATHS)

Area	**Number**		
Date of interview			
Interviewer			
Village/Branch			
Name of ten cell leader			
Name of head of household			
Relation of the respondent to the deceased (circle):	1-Father 2-Mother 3-Wife/Husb 4-Bro/Sister 5-Child 6-Other relative 7-No relation		
Did you live with the deceased during his/her illness before death?	1-Yes 2-No		
Name of deceased			
Sex 1-Male 2-Female	**Year of birth** (write year of birth here)		
Marital Status 1-never married 2-One wife/husband	3 > 1husband/wife 4-separated	5-divorced 6-widow/er	
Occupation			
Place of death (circle)	N-Home H-Hospital O-Other place		
Date of death	Day	Month	Year

What do you think was the cause of death?
(Write exactly as the respondent tells you)

Previously diagnosed medical conditions:

	Months		Months
Hypertension		Diabetes	
Heart disease		TB	
Other chronic illness		Asthma	
Cancer of		Leprosy	

History of events leading to death

" Excuse me, I will ask you some questions concerning symptoms that the deceased had/showed when s/he was ill. Some of these questions may not appear to be directly related to his/her death. Please bear with me and answer all the questions. They will help us to get clear picture of all possible symptoms that the deceased had."

SYMPTOMS		
1 Did s/he had fever?	months	days
2-F Was the fever....	1-continuos 2-on and off	9-Don't know
3 Was s/he breathless on light work?	months	days
4 Was s/he breathless on lying flat?	months	days
5 Did S/he have palpitations?	months	days
6 Did S/he have wheezing?	months	days
7 Did S/he have a cough?	months	days
8-F If yes, was the cough....	1-dry 2-productive 3-with blood	9-Don't know
9 Did S/he have chest pain?	months	days
10-F If yes, was the pain localised near the sternum?	1-Yes 2-No	9-Don't know
11-F Did the pain start....	1-suddenly 2-gradually	9-Don't know
12 Did S/he have diarrhoea?	months	days
13-F If yes, how many times a day?	Number of times	
14-F Did s/he have bloody diarrhoea?	1-Yes 2-No	9-Don't know
15 Did S/he have poor appetite?	months	days
16 Did S/he complain pain on swallowing?	months	days
17 Did S/he have difficulty in swallowing?	months	days
18 Did S/he have headache?	months	days
19 Did S/he pass blood in urine?	months	days
20 Did S/he have pain during passing urine?	months	days
21 Was S/he unable to pass urine?	months	days
22 Did S/he pass urine too many times a day?	months	days
23 Did S/he have a sensation of pins and needles in the feet?	months	days
24 Did S/he have abdominal pain?	months	days
25-F If yes, was the pain....	1-upper 2-lower 3-all over the abdomen	9-Don't know

SYMPTOMS(contd...)		
26 Did S/he have abdominal distension?	months	days
27-F If yes, did the distension start...	1-suddenly within few days 2-gradually over the weeks 9-Don't know	
28 Did S/he vomit?	months	days
29 Did S/he vomit blood?	months	days
30 Did S/he have a mass in the abdomen?	months	days
31 Did S/he become mentally confused?	months	days
32 Did S/he have loss of consciousness?	months	days
33-F If yes, did s/he become unconscious....	1-suddenly 9-Don't know 2-gradually as days went by...	
34 Was s/he paralysed on one side of the body?	months	days
35 Did S/he have paralysis of both legs?	months	days
36 Did S/he develop stiffness of the whole body?	months	days
37 Did S/he have neck pain?	months	days
38 Did S/he have fits?	months	days
39-F If yes, when it was severe, how many times did s/he have fits in a day?		no. of times
— ASK FOR ALL WOMEN (AGED 13 YEARS AND ABOVE) —		
40 Did she have an ulcer or swelling in breast?	months	days
41 Did she have excessive vaginal bleeding during her menstrual period?	months	days
42 Did she have vaginal bleeding on other days apart from her menstrual period?	months	days
43-F If yes, did she have too much vaginal bleeding?	months	days
44 Did she have abnormal vaginal discharge?	months	days
— ALL WOMEN (AGED 13 TO 49 YEARS OF AGE) —		
45 Was she pregnant?	1-Yes 2-No	9-Don't know
46-F If yes, how many months?	Months:	
47 Je alijifungua hivi karibuni?	1-Yes 2-No	9-Don't know
48-F If yes, how many days before death?	Days:	

49-F Did she have excessive bleeding in the beginning of labour pains?	1-Yes 2-No	9-Don't know
50-F Did she have excessive bleeding during labour (before delivering the baby)?	1-Yes 2-No	9-Don't know
51-F Did she have difficulty in delivering the baby?	1-Yes 2-No	9-Don't know
52-F Did she have difficulty in delivering placenta?	1-Yes 2-No	9-Don't know
53-F Did she have a prolonged labour?	1-Yes 2-No	9-Don't know
54-F Did she have a cesarean operation for delivery?	1-Yes 2-No	9-Don't know
55-F Did she have a forceps or vacuum delivery?	1-Yes 2-No	9-Don't know
56-F Did she have too much bleeding after delivering the baby?	1-Yes 2-No	9-Don't know
57-F How is the baby?	1-Alive 2-Born dead 3-died within 7 days of birth 4-died after 7 days after birth 5-twin birth, one died	
58 Did she have an abortion recently?	1-Yes 2-No	9-Don't know
59-F If yes, how many days before death?		Days
--- OTHER SIGNS (ALL ADULTS) ---		
60 Did S/he have ankle swelling?	months	days
61 Did S/he have swelling of joints?	months	days
62 Did S/he have Weight loss?	months	days
63 Did S/he have mouth sores?	months	days
64 Did S/he look pale?	months	days
65 Did S/he have any skin disease?	months	days
66 Did S/he have puffiness of face?	months	days
67 Did the eye colour change to yellow (jaundice)?	months	days
68 Was S/he injured in a road accident?	months	days
69 Did S/he suffer any other accidental injuries recently before death?	months	days
70 Was S/he injured intentionally by someone?	months	days
71 Did a dog bite him/her?	months	days

2

OTHER SYMPTOMS(contd....)		
72 Did any other animal or insect bite him/her? (how long before his/her death?)	months	days
73-F If yes, what type of animal or insect (Mention the name)		
74 Did S/he encounter any accidental poisoning (including alcohol)?	months	days
75 Did S/he commit suicide?	1-Yes 2-No	9-Don't know

-- TOBACCO USAGE --	
Was the deceased smoking?	0-never smoked
	77-pipe or tobacco
	88-number unknown
(write the number of sticks above)	99-don't know

-- ALCOHOL USAGE --	
Was the deceased taking alcohol? If yes, how much did s/he consume on average?	1-never drank
	2-low
	3-moderate
	4-high
	99-unknown

Health services used by the deceased during his/her illness in the period leading to death	Je, alipata dawa hapa?	
Was given traditional medicine ____ order	1-Yes 2-No	9-Don't know
Mother gave modern medicines ____ order	1-Yes 2-No	9-Don't know
Medicine from family ____ order	1-Yes 2-No	9-Don't know
Went to traditional healer ____ order	1-Yes 2-No	9-Don't know
Village health worker ____ order	1-Yes 2-No	9-Don't know
Government dispensary ____ order	1-Yes 2-No	9-Don't know
Government Health Centre ____ order	1-Yes 2-No	9-Don't know
Government Hospital ____ order	1-Yes 2-No	9-Don't know
Medicine from any Govt Health facility ____ order	1-Yes 2-No	9-Don't know
Private dispensary ____ order	1-Yes 2-No	9-Don't know
Private Health Centre ____ order	1-Yes 2-No	9-Don't know
Private Hospital ____ order	1-Yes 2-No	9-Don't know
Private pharmacy ____ order	1-Yes 2-No	9-Don't know
Didn't get any service	1-No service 2-Had serv.	9-Don't know

IF ANSWER IS "YES" ASK ALL QUESTIONS IN THE VAV FORM

Evidence and Summary of details	
Death certificate	
Cause of death	
Burial permit	
Cause of death	
Post-mortem results	
Cause of death	
MCH/ANC card	
Hospital prescription forms	
Treatment cards	
Hospital discharge forms	
Diagnosis	
Other hospital documents	
Laboratory/cytology results	
None	

Did a health worker tell you the cause of death?	1-Yes 2-No	9-Don't know
If yes, what did s/he say?		

EDUCATION		
Primary education (std/class)	1	5
	2	6
	3	7
	4	8
Secondary education (form)	9-form I	12-form IV
	10-form II	13-form V
	11-form III	14-form VI
University	15	
College after Primary education	16	
College after secondary education	17	
Adult education	18	
No education	19	

The deceased was....		
Resident in the DSS area	R	
Dead body brought home for burial	M	
Home-coming sick	O	

Cause of death according to interviewer
Code:

Appendix V: Cause-specific annual Injury deaths per 100000 Person Years

Cause-Specific	2002	2003	2004	2005	2006	2007	Total	CI
RTA	4.6	18.4	12.8	6.8	13.5	7.7	9.5	7.2 - 12.2
External	8.1	3.5	10.5	10.2	6.7	6.6	6.8	4.9 - 9.1
Drowning	8.1	6.9	5.8	4.5	5.6	5.5	5.4	3.8 - 7.5
Burns	2.3	3.5	2.3	4.5	6.7	1.1	3.0	1.9 - 4.7
Homicidal	3.5	1.2	5.8	5.7	1.1	1.1	2.7	1.6 - 4.3
Poisoning	2.3	2.3	3.5	3.4	3.4	3.3	2.7	1.6 - 4.3
Animal attack	2.3	1.2	_	5.7	1.1	_	1.5	0.7 - 2.8
Falls	_	_	2.3	4.5	_	1.1	1.2	0.5 - 2.3
Suicide	1.2	_	_	2.3	1.1	_	0.7	0.2 - 1.6
Total	32.3	36.8	43.1	47.8	39.3	26.5	33.4	29.0 - 38.3