SPATIAL PATTERNS AND TRENDS OF MATERNAL MORTALITY OVER A FIVE YEAR PERIOD AND THEIR ASSOCIATED RISK FACTORS IN IFAKARA HEALTH AND DEMOGRAPHIC SURVEILLANCE SITE (IHDSS)

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DECLARATION

I, Alfred Kwesi Manyeh, declare that this is my own work. It is being submitted for the degree of Master of Science in Epidemiology in the field of Population Based Field Epidemiology in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Signature: 

Date: **1st day of November, 2012**

DEDICATION

I humbly dedicate this degree to the Lord almighty who has made it possible for me to come this far in education. I also dedicate this work to my precious wife, Rosemond Akpene Manyeh; my son, Carl Darwin Dela Manyeh; my lovely niece, Rebecca Manyeh; my dad, Abraham A K Manyeh; my mom, Victoria Asumah; and my siblings. They, through thick and thin, provided all the support to make this level of my education come to pass.

ABSTRACT

Introduction

Worldwide, 99% of deaths of women in their reproductive ages are due to childbirth and pregnancy complications. Maternal mortality is the subject of the fifth United Nations' millennium development goal: the aim is to reduce the maternal mortality ratio by three quarters from 1990 to 2015. Although much research has been conducted in recent years, knowing the spatial pattern of maternal mortality in developing countries will help target scarce resources and intervention programs to high risk areas for the greatest impact, since nationwide interventions are costly.

Objective

This study assessed the spatial patterns and trends of, and causes and risk factors associated with, maternal mortality in the Ifakara Health and Demographic Surveillance Site (IHDSS) in Tanzania, from 2006 to 2010, with a view to providing information that may help reduce maternal mortality in this country.

Method

A secondary data analysis of a longitudinal study using data from the IHDSS was conducted. Inverse distance weighted (IDW) method of interpolation in ArcGIS was used to assess spatial patterns. Cox proportional hazards regression was used to identify and quantify risk factors associated with maternal mortality.

Results

A total of 36 792 women aged 15 to 49 were included in the study of which 77 died due to childbirth or pregnancy related complications. The overall maternal mortality rate for the five years was 0.79 per 1000 person years. The trend declined from 90.42 per 1000 person years

in 2006 to 57.42 per person years in 2010. There were marked geographical differences in maternal mortality patterns with high levels of mortality occurring in areas with close proximity to health facilities in some instances. The main causes of maternal death were eclampsia (23%), haemorrhage (22%) and abortion-related complications (10%). Maternal age, marital status and socioeconomic status were found to be risk factors. There was a reduced risk of 82% (HR: 0.18, 95% CI: 0.05-0.74) and 78% (HR: 0.22, 95% CI: 0.05 – 0.92) for women aged 20-29 and 30-39 years, respectively, compared with those younger than 20 years. While being married had a protective effect of 94% (HR: 0.06, 95% CI: 0.01 - 0.51) compared to being single, women who were widowed had an increased risk of 813% (HR: 9.13, 95% CI: (1.017 – 81.942). Higher socioeconomic status had a protective effect on maternal mortality: women who were in the poorer and least poor socioeconomic groups were 70% (HR: 0.30, 95% CI: 0.11 – 0.81) and 75% (HR: 0.25, 95% CI: 0.06 - 1.09) less likely to die from maternal causes, respectively, compared to those in the poorest category.

Conclusion

There has been a decline in maternal mortality in rural southern Tanzania, with geographical differences in patterns of death. Eclampsia, haemorrhage and abortion-related complication are the three leading causes of maternal death in rural southern Tanzania, with risk factors being maternal age less than 20 years, marital status (single, widowed), and lower socioeconomic status.

Keywords: maternal mortality, risk factors, spatial pattern, maternal mortality rate, verbal autopsy

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GLOSSARY

Cohort: A group of people sharing a common temporal demographic experience who are observed through time.

Health and Demographic Surveillance System (HDSS): 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.

Demographic Surveillance Area (DSA): The catchment area of a Health and Demographic Surveillance System.

Direct obstetric deaths: Deaths resulting from obstetric complications of the pregnant state (pregnancy, labour, and the puerperium), from interventions, omissions, or incorrect treatment, or from a chain of events resulting from any of the above.

Household: A social group of one or more individual members eating from the same pot. They are usually but not always related biologically or by blood.

Indirect obstetric deaths: Deaths resulting from existing disease or disease that developed during pregnancy and that was not due to direct obstetric causes but was aggravated by the physiological effects of pregnancy.

Maternal death: Death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to, or aggravated by, the pregnancy or its management, but not from accidental or external causes.

Maternal mortality ratio: Number of maternal deaths during a given time period per 100

000 live births during the same time period. It is calculated by dividing the number of maternal deaths in a population during some time interval by the number of live births occurring in the same period.

Maternal mortality rate: Number of maternal deaths in a given period per 1 000 women of reproductive age during the same time-period. It is found by dividing the number of maternal deaths in a population by the number of person years observed of women of reproductive age (15 to 49 years). Thus, the maternal mortality rate reflects not only the risk of maternal death per pregnancy or per birth, but also the level of fertility in a population.

Principal Component Analysis (PCA): A multivariate statistical technique used in creating uncorrelated indices, where each index created is a linear weighted combination of the initial variables. This was used to generate SES in this study.

Risk factor: An aspect of personal behavior or lifestyle, environmental exposure, or inborn or inherited characteristic which, on the basis of epidemiologic evidence, is known to be associated with a health-related condition considered important to prevent (WHO definition). In this study, the risk factors considered are the socio-economic and demographic characteristics of women.

Socioeconomic status (SES): A classification of the social group of an individual based on his/her assets, type of residence and utilities.

Verbal Autopsy: A systematic process of soliciting information from a close relative, friend or caretaker who was present either during the illness that led to death or the circumstances that led to the death of the person to be able to assign cause of death where medical certification of cause of death is not available

LIST OF ABREVIATIONS AND ACRONYMS

AIDS Acquired Immune Deficiency Syndrome

DHS Demographic and Health Survey

DSA Demographic Surveillance Area

DSS Demographic Surveillance System

HDSS Health and Demographic Surveillance System

HIV Human Immunodeficiency Virus

HR Hazard Ratio

ICD-10 International Statistical Classification of Diseases and Related Health Problems (10^{th} Revision)

IHDSS Ifakara Health and Demographic Surveillance System

IHI Ifakara Health Institute

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

MDG Millennium Development Goal

MM Maternal Mortality

MMR Maternal Mortality Ratio

MMRate Maternal Mortality Rate

PCA Principal Component Analysis

PYO Person Year Observed

SES Socioeconomic Status

UNFPA United Nations Population Fund

UNICEF United Nations Children's Fund

UNPD United Nations Population Division

VA Verbal Autopsy

WHO World Health Organization

CHAPTER ONE: INTRODUCTION

1.1 Background

Improving maternal health is one of the eight Millennium Development Goals adopted by the international community at the United Nations Millennium Summit in 2000[1]. For Millennium Development Goal 5 (MDG5), countries made a commitment to reduce the maternal mortality ratio (MMR) by three quarters from 1990 to 2015[2]. However, between 1990 and 2008, the global MMR declined by only 2.3%, indicating that achieving MDG5 requires accelerating progress[1]. Due to the unavailability of reliable data, evaluating the progress made towards achieving this target has been a challenge to many developing countries where maternal mortality is still high.

Reflecting on the poor achievement in improving maternal health, the UN Secretary-General; Ban Ki-moon said "…today, maternal mortality is the slowest moving target of all the Millennium Development Goals – and that is an outrage. Together, let us make maternal health the priority it must be. In the 21st century, no woman should have to give her life to give life"[3].

Estimates developed by the WHO in 2007 show that, every day, 1 500 women die from pregnancy or childbirth-related complications[4]. In 2005, there were an estimated 536 000 maternal deaths worldwide, most of which occurred in developing countries and most of which were avoidable. A total of 99% of all maternal deaths occur in developing countries, where 85% of the population lives; more than half of these occur in sub-Saharan Africa and one third in South Asia. The MMR in developing countries is 450 per 100 000 live births versus 9 per 100 000 live births in developed countries[4].

Over the years, studies have shown that there are differences in maternal mortality between countries, large disparities within countries, between people with high and low incomes, and between rural and urban populations[5]. Women die from a wide range of complications in pregnancy, childbirth or the postpartum period. Globally, four major causes of maternal mortality have been identified: severe bleeding (mostly postpartum), infections (also mostly soon after delivery), hypertensive disorders in pregnancy (eclampsia), and obstructed labour[5].

Gil-Gonzalez et al. (2006), in their review of scientific studies, revealed the under-reporting of obstructed labour, unsafe abortion and haemorrhage in the world[6]. Most of these studies were cross-sectional and were carried out in developed countries, without the participation of scientists or researchers in the developing countries where most maternal deaths occur.

The traditional African saying 'a pregnant woman has one foot in the grave' seems still to be true in the 21st century, especially in Africa. In 2006, Khan et al. showed that the obstetric risk of maternal deaths is highest, by far, in sub-Saharan Africa. In 2006, the MMR for sub-Saharan Africa was estimated to be nearly 1 000 per 100 000 live births: almost twice that in South Asia, four times as high as in Latin America and the Caribbean, and nearly 50 times higher than in industrialised countries[7]. In 1987, East Africa had a MMR of 660 per 100 000 live births;[8] in 1996 it was estimated by the WHO and UNICEF to be increasing[9].

Maternal mortality is devastating worldwide[10] and it is associated with a number of risk factors, including age, parity, education of mothers, obstetric factors, unavailability of health facilities and trained health personnel, socio-economic factors, and ethnic and religious affiliations[11-18].

Being a rare event, maternal mortality is difficult to measure since large sample sizes are needed; there is thus a paucity of epidemiological information. There is limited information on levels of maternal mortality and causes of maternal deaths in most developing countries

due to the lack of adequate vital registration systems and poor certification of causes of deaths; most deaths occur at home, making it difficult to obtain satisfactory information[19]. While some hospital studies on medical causes of deaths are available, they provide biased information, due to selective admissions[19]. Therefore, hospital-based maternal mortality data may not adequately define the magnitude of the maternal mortality problem or contribute adequately to information on the distribution of clinical causes and risk factors.

The existence of Health and Demographic Surveillance Systems (HDSSs) in African countries, like Tanzania, have provided a unique opportunity to calculate rates and trends, and to identify risk factors associated with maternal mortality, as demonstrated in studies already conducted in South Africa, Senegal and Ethiopia[16, 17, 20, 21]. In the absence of vital events registration, the HDSS comprise a set of field and computing operations to handle longitudinal follow up of well-defined entities of primary subjects (individuals, households, residential units, etc.) and all related demographic and health outcomes within a clearly circumscribed geographical area.

Verbal autopsies (VAs) are used to collect information on cause of death. As demonstrated by other studies in Tanzania[22] and elsewhere[19, 20], the VA method of identifying probable cause of death is well recognized and tools have been validated in various settings. The use of VA by HDSS sites is the only means by which developing countries are able to observe cause-specific mortality on a longitudinal basis. It is an important method for evaluating trends of disease and mortality as shown in a number of previous studies[20, 23, 24]. The VA used in the HDSS sites has also provided reliable results pertaining to levels and causes of maternal mortality[25, 26]. In Matlab, Bangladesh, the HDSS identified 67.2% of all deaths occurring during pregnancy or within 42 days postpartum, while other special studies reported lower proportions[25]. In Ghana, the health system reported a maternal mortality rate

of 141 maternal deaths per 100 000 live births, while the Navrongo HDSS reported a rate nearly three times higher (373 maternal deaths per 100 000 live births)[27].

VA has been used for more than 20 years. It is a systematic process of soliciting information from a close relative, friend or caretaker who was present either during the illness that led to death or the circumstances that led to the death of the person[28]. It is very useful in ascertaining the cause of death in areas where vital registration systems are not available. Its interpretation relies on either expert independent physicians' assessment or the application of predetermined algorithms. The VA can produce useful data that can effectively guide priority health interventions in rural areas where routine information systems are either very weak or not available. The VA technique is a good surveillance tool for ascertaining the cause of death in a population[29] but is more accurate and effective when at least two independent physicians ascertain the cause of a particular death.

The HDSS sites are also able to provide Geographical Information System (GIS) data (every household is geo-located) in addition to information on potential risk factors which are important in targeting interventions. Longitudinal data on population dynamics, health and social changes which are vital for informing policy and practice, are also collected by the HDSS sites[30].

Studies on spatial analysis and mapping of diseases are becoming increasingly important in public health awareness about disease burdens and risks to the general population. Thus, establishing spatial patterns of maternal mortality and associated risk factors within a specified period of time, either prospectively or retrospectively, is very important[20, 31]. In 2010, Sartorius et al.[20] showed that inequalities in health outcomes or access to health services and benefits can occur across space and time which may reflect compositional effects with variations merely reflecting different groups staying in different locations.

However, maternal health outcome differences may be due to inequalities in allocation of resources and distribution of wealth and socioeconomic privilege in society, rather than a person's choice or behavior, and may thus be avoidable. Therefore, when population-wide intervention programmes are too expensive to implement, it is important to target and channel the scarce resources and efforts to higher risk areas where adverse health events are more likely to occur[32]. Before Tanzania can achieve MGD5, there is an urgent need to identify causes of maternal deaths, where these maternal deaths are occurring, and the associated risk factors. Use of spatial patterns to map high risk areas with greatest needs will provide information against which decisions can be made on where to target interventions for the greatest impact.

1.2 Statement of the Problem

Tanzania, like any developing country, has limited information on maternal mortality and causes of maternal deaths due to the lack of adequate vital registration systems and poor certification of causes of deaths, since most deaths occur outside health facilities. Demographic and Health Surveys (DHSs), which are the main sources of maternal mortality figures, are not large enough to provide valid estimates, and hospital data underestimate MMR[33].

In spite of national efforts, Tanzania has one of the highest MMRs in Sub-Saharan Africa with national estimates ranging from 1 100 per 100 000 live births in 1995, to 1500 per 100 000 live births in 2006[4,5]. The 2010 Tanzania DHS reported 454 maternal deaths per 100 000 live births[34]

1.3 Justification for the Study

In 2005, Mathers et al. reported the status of death registration data for 2003[35]. Of 115 countries for which data were available, only 64 had essentially complete data. They also found that 90% of African countries have no information on cause of death for any year after 1990.

In the absence of a comprehensive vital registration system in Tanzania, HDSS data provide a valuable source of information for studying MMRs, trends and risk factors. HDSS sites implementing the VA method of determining possible causes of death are the most reliable source in developing countries from which to observe cause-specific mortality on a longitudinal basis, and are valuable for assessing mortality trends[20].

Most of the studies on maternal mortality in Tanzania did not use longitudinal data, and do not show maternal mortality trends or any spatial pattern to tell us where those deaths occurred. This information is vital to help target efforts and limited resources to high risk areas. This study will provide valuable information that can be used to improve maternal health in Tanzania.

This study, which aims to assess maternal mortality patterns over a five year period and the associated risk factors in the Tanzanian Ifakara HDSS (IHDSS) site, is in line with the drive and efforts toward achievement of MGD5.

1.4 Literature Review

Many studies have been done on maternal mortality (see Table 1), but most of them were based on hospital- or institution-acquired data[22]. It is only recently that research has attempted to overcome the limitations of using these data, such as under-reporting[25,27] and bias due to selection in hospital admissions[19]. Community-based surveys more accurately

reflect the true magnitude of maternal mortality in developing countries, where most of the deaths occur outside formal health facilities[22].

The importance and usefulness of longitudinal data to determine spatial-temporal patterns and risk factors as demonstrated by Sartorius et al.[20] are yet to be widely explored in maternal mortality studies in settings such as rural Tanzania.

Table 1 Studies done on MMR in Tanzania, 1987-2010

Author	**Year of analysis**	**Source of data**	**MMR (per 100 000 live births)**
Ministry of health[36]	1987	Hospital	190
Maller et al.[37]	1990	Community survey	600
WHO and UNICEF report[9]	1990	Estimate based on household surveys	750
Jana MacLeod and Richard Rhode[22]	1993	Community survey	961
Walraven et al.[33]	1994	Community survey	241
WHO, UNICEF, UNFPD and World Bank report[5]	1995	Estimate based on household surveys	1100
WHO report[3]	2006	Estimate based on household surveys	1500
Tanzania Demographic and Health Survey[38]	1996	Community survey	529
Tanzania Demographic and Health Survey[39]	2004/05	Community survey	578
Tanzania Demographic and Health Survey[34]	2010	Community survey	454

Studies in the late 1990s show that, in Kilombero district in rural Tanzania, one out of 39 women who lived until reproductive age, died of maternal causes before the of age 50[40].

Maternal mortality studies done in Tanzania[10-12], other African countries and Asia[14-18] showed that age, parity, education of mothers, obstetric factors, unavailability of health facilities and trained health personnel, socio-economic factors, and ethnic and religious affiliations are risk factors, but they do not tell us where those deaths are occurring for more focused interventions.

1.5 Aim and Objectives

The aim of this study was to assess the spatial patterns and trends of, and causes and risk factors associated with, maternal mortality in the Ifakara Health and Demographic Surveillance Site (IHDSS) in Tanzania, from 2006 to 2010, with a view to providing information that may help reduce the MMR in Tanzania.

The objectives were to 1) calculate maternal mortality rates, 2) describe the causes of maternal mortality, 3) assess the spatial patterns and trend of maternal mortality, and 4) identify and quantify the risk factors.

CHAPTER TWO: METHODOLOGY

2.1 Study Setting

The IHDSS is located in rural southern Tanzania, in two districts, Kilombero and Ulanga, both of which are in the Morogoro region (latitude 8°00' to 8°35'S, longitude 35°58' to 36° 48'E) as shown in figure 2.1. The closest city, Dar es Salaam, is approximately 320 km from the site. The IHDSS covers areas of 80 km ×18 km in Kilombero District and 40 km ×25 km in Ulanga District, a total of 2 400 km^2 of Guinea Savannah in the floodplain of the Kilombero River which divides the two districts. The area is predominately rural with scattered households.

The IHDSS was incepted in September 1996. A baseline census was conducted from September to December 1996 in 25 villages with a population of about 65 000 people in 14 000 households. Subsequently, each household has been visited annually every four months (three times in a year) to record core events such as births, pregnancies, deaths and migration. In order to document community-based causes of death, the IHDSS study team started conducting VA interviews in September 2000.

Figure 2.1: Map showing location of the IHDSS within the Morogoro region, Tanzania.
Source: Sankoh et al.[41]

The area covered by the HDSS is very poor and typical of poor disadvantaged rural districts across the country. The population is predominantly rural, practicing subsistence farming and fishing as the main occupations with rice and maize as the predominant food crops. Other occupations are petty trading. There is a handful of trained artisans and craftsmen, and a few civil servants, mainly migrant employees of government ministries, departments and agencies.

Most families live in houses with mud walls and thatched roofs but they also have a second house known as ***shamba*** house (farmhouse) where they stay during the planting and harvesting seasons. The population is highly mobile, with most families moving to the *shamba* areas for few weeks at a time.

The main ethnic groups are Wapogoro, Wandamba, Wabena and Wambunga, with several others in smaller proportions. The literacy rate in adults is high, at 88% for men and 69% for women. The mean household size is five people who usually live in a compound, comprising one or two houses. IHDSS currently covers nearly 113 589 people (2010 midyear population estimate).

The public health system in the demographic surveillance area (DSA) consists of village health workers, dispensaries, health centres, and hospitals. There are 13 dispensaries and two health centres in the DSA, providing preventive and curative services to the population. Additionally, there are two district hospitals outside the DSA that serve as referral points. Health services are delivered from these health facilities and health care accessibility by adults is purely “cash and carry”. Antenatal care for pregnant women and health care children under five years of age is free.

2.3 Study Design

This study was a secondary data analysis of a longitudinal dataset collected over a five year period (2006 – 2010) from IHDSS. Several databases were used to identify maternal deaths, which included those related to each individual (member), mortality, pregnancy and pregnancy outcome. Data generated from VAs and the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, 1992 (ICD-10) and WHO[42] were used to identify maternal deaths and probable causes of death.

2.4 Study Population

The study population comprised women residents of reproductive age (15-49 years) in the IHDSS in the time period 1 January 2006 to 31 December 2010. At 31 December 2010, there were 38 495 such women (33.84% of the total population), 667 (1.73%) of whom had died.

2.5 Measurement and Data Sources

The outcome variable was maternal death. This was coded as a binary variable with all women who experienced a death coded as 1, and those who survived or out migrated coded as 0.

The exposure variables were divided into socio-economic and demographic variables. Socio-economic variables included socio-economic status (SES) which was measured using an index based on social status, assets ownership and availability of utilities. The index measures were combined into a wealth index, using weights derived through principal component analysis (PCA)[43]. The proxies from the PCA were divided into five quintiles: poorest, very poor, poor, less poor and least poor. The SES was calculated at the household level and assigned to women from the same household as a proxy measure.

Other exposure variables were age, level of education, occupation, marital status, place of delivery, distance to health facility, antenatal clinic attendance, and parity. These variables were identified from published literature.

2.6 Data Management and Processing

The IHDSS database is built on a platform of FoxPro (Microsoft Cor., Seattle, USA) database environment but the data are captured and processed using a database called Household Registration System (HRS2) which is a relational model commonly used for HDSS. The tables are in DBF format and the database is composed of a number of different tables that are related to each other by unique identifiers.

The DBF tables with variables necessary to answer the research questions were extracted and Stat/transfer software was used to transfer the data to statistical software, STATA version 11, with which all analyses were conducted. The extracted data were cleaned to identify all missing values and to check for internal consistency of the responses. Any irregularities in the data were corrected by using the hard copies of the completed questionnaires and effecting the necessary changes. Variables were recoded where necessary, using STATA 11.

All the variables for this study were extracted from the following tables:

Membership: This applies to membership of a social unit (household). It contains records of every individual who has ever resided in the DSA. The records are uniquely identified by an individual's permanent ID. The table contains individual variables such as names, date of birth, gender, entry and exit dates.

Family: Contains records of each family/household in the DSA. It contains variables such as family ID, household head's name, date of last visit, village, etc.

Pregnancy Outcome: Stores information about pregnancy outcome, including mother's ID, date and type of outcome, place of birth, etc.

Socio Economic Status: Contains information about household characteristics and assets which are updated annually and are used in the estimation of the household wealth index, including roof type, source of power (firewood, kerosene/biogas or electricity), and ownership of a bicycle, radio, car, motorbike, mobile phone and livestock.

Education: Stores information about the number of years of education completed by an individual in the DSA.

GIS: The IHDSS had all households, roads and small paths, health facilities and schools in the DSA geo referenced in 2006. Mapped households and health facilities, using the global positioning system (GPS), enabled mapping of spatial distributions and patterns and analyses of distances between household and health facilities that greatly minimized errors attributed to subjective reporting of distances or travel time by the respondents. Euclidean (straight line) distance from home to nearest health facility was analyzed. Using ArcView version 9.1, software, shape files for road, household and health facility were developed. With the help of network analyst tool in ArcView, a route feature layer was generated after the analysis which stored the shortest Euclidean route from each household to the nearest health facility.

All these tables were linked by either the individual permanent ID or the household ID and, through these unique identifiers, all the required variables were extracted and stored into one table. The coding and editing was done on the extracted variables, using STATA.

2.7 Data Analysis

2.7.1 Descriptive Analysis

Proportions and frequencies were used to describe the demographic characteristics of the study population. Descriptive statistics were used to address the first and second objectives. The maternal mortality rate was calculated by dividing the total number of maternal deaths by the total person years observed from 2006 to 2010 and was expressed per 1 000 person years. Proportional maternal mortality was displayed as pie charts. Cause-specific maternal mortality rates for each calendar year were calculated, stratified by age, using person years analysis.

2.7.2 GIS Methods and Risk Maps

A worksheet was prepared with village centroid and corresponding data on the cumulative number of deaths of women for each year by village. The deaths were divided into broad and specific causes of direct maternal death for the five years of follow up. The point data were imported into ArcGIS and displayed using the ArcMap application (ESRI, Inc. USA**).**

Based on the assumption that geographical features near each other are likely to be more related than features that are distant apart[44,45], the mortality distribution was determined using the inverse distance weighted (IDW) method of interpolation in ArcGIS. This is a deterministic interpolation model that assigns values to locations where no measurements have been taken, based on how far those locations are to sentinel locations where measurements have been taken. This way, the interpolation surface was used to make predictions from the households where the deaths occurred, for all locations in a raster dataset, representing the study area[46]. The interpolation maps were then visually inspected to identify similarities in the location of distinctive hotspots (areas with highest maternal

mortality), indicating the pattern of death of women in their reproductive age and maternal deaths in the study area.

2.7.3 Inferential Analysis

Inferential analysis was used to address the third and fourth objectives. Principal component analysis (PCA) was used to construct wealth indices, using household asset ownership, building material of main dwelling, and level of education as a proxy measure for each individual's SES. Concentration indices were also constructed and individuals were categorized into the five SES quintiles described earlier.

The associations between maternal death (dependent variable) and risk factors (independent variables) were assessed using survival analysis with non-parametric Cox proportional hazards regression to predict or model maternal mortality from independent variables in the univariable and multivariable models, taking into account the possible confounders and interaction factors. The assumption of proportional hazards was tested using the stphtest command in STATA that is based on the Schoenfeld residuals.

Only variables with p values of 5% or less in the univariable model were included in the multivariable analysis.

Since the study used longitudinal data, use of event history analysis, which is due to continuous changes in the risk of maternal mortality as women grow older, is essential. Therefore, a person time contribution for every woman, as part of the denominator, was critical. Hazard ratios (HRs) with 95% confidence intervals were calculated. Statistical significance was considered at the 5% level. A final multivariable model was fitted and the trend over the five-year period was determined.

2.10 Ethical Considerations

Ethical clearance and approval for the research was granted by both the Ifakara Health Institute (IHI) Institutional Review Board (IRB) and Human Research Ethics Committee (Medical) of the University of the Witwatersrand before commencement of the research (see appendices 1 and 2).

The extracted data were used strictly for the purposes of this study. Confidentiality and anonymity were maintained by ensuring that all identifying features and names of individuals were removed.

Access to the data was restricted to only IHDSS staff and all study tools were secured in a safe room for storage after all the data had been extracted.

CHAPTER THREE: RESULTS

The results of this study are divided into descriptive and inferential sections. The first part of the descriptive section presents the proportions of all burden of mortality within the age group, specific causes, spatial patterns of maternal mortality and trend of maternal mortality rates over the five year period, as well as the socio-demographic characteristics of the women in the study. The second, inferential section quantifies and identifies the association between risk factors and maternal mortality in IHDSS from 2006 to 2010.

3.1 Descriptive Analysis

3.1.1 Socio Demographic Characteristics of the Study Cohort

There were a total of 36 792 women aged 15 to 49 years from 2006 to 2010 in the IHDSS (see table 3.1). Most of the women were aged 20 to 39 years (72.72%), were married (94.65%), and had subsistence farming as their main income generating activity (82.51%). A large percentage of the women belonged to the poorest or poorer SES groups (29.52% and 30.96%, respectively). With regard to education, 53.79% had a primary education. Most (41.20%) had parity of five or more.

Many of the women (69.66%) reported to have not been to an antenatal clinic or to have had only one visit during their last pregnancy; 62.03% were assisted by a health care worker (doctor or nurse) during their last child delivery. A total of 6 827 (62.24%) of the women delivered in a health facility, indicating that they had access to health facilities, whether as their preferred choice for place of delivery or only if they had a complication; 819 (80.69%) lived less than 5 km from the nearest health facility.

Table 3.1: Socio-demographic characteristics of women aged 15 to 49 in IHDSS from 2006-2010

Maternal mortality Risk factors	Number (n)*	Proportion (%)
Maternal Age (years)		
< 20	4 218	11.46
20-29	16 042	43.60
30-39	10 715	29.12
40-49	5 817	15.81
Marital status		
Single	567	1.54
Married	34 821	94.65
Divorced/Separated	1 179	3.20
Widowed	224	0.61
Occupation		
Business	98	1.32
Employed	167	2.25
Farming	6 136	82.51
Fishing	104	1.40
Others	361	4.85
Trading	571	7.68
Education		
No Education	8 381	35.93
Primary	12 549	53.79
Secondary and above	2 399	10.29
Parity		
Parity 1	2 962	21.75
Parity 2-4	5 044	37.04
Parity 5+	5 610	41.20
Number of antenatal clinic visit		
4 and above	1 919	14.09
0 to 1	9 490	69.66
2 to 3	2 214	16.25
Who assisted in delivery		
Health worker	6 895	66.03
Non health worker	3 548	33.97
Delivery place		
Health facility	6 897	62.24
Outside health facility	4 184	37.76
SES		
poorest	3 733	29.53
poorer	3 914	30.96
poor	2 554	20.20
less poor	802	6.34
least poor	1638	12.96

Distance of woman's home to health facility		
Near (< 5Km)	819	80.69
Far (>= 5Km)	196	19.31
Total person years	**97 999.54**	

Note: *For each risk factor, number of women varies due to missing data

3.1.2 Maternal Mortality Rates in IHDSS

Table 3.2 presents the maternal mortality rates across the five year period in IHDSS. There were 77 maternal deaths during the study period and 2 271 other causes of death. The largest proportion of maternal deaths occurred in 2007 (27.27%), followed by 25.97% in 2006, 16.88% in 2009, 15.58% in 2010 and 14.29% in 2008.

The maternal mortality rate was estimated as 0.79 deaths per 1000 person years of observation (95% CI: 0.63 - 0.98) over the five year study period (2006 to 2010).

Table 3.2: Maternal mortality rate from 2006 - 2010 in IHDSS

Year	Number of deaths (n)	MMRATE per 1000 person years	95% CI
2006	20	90.416	(58 - 140)
2007	21	115.012	(75 - 176)
2008	11	84.152	(47 - 152)
2009	13	50.642	(29 - 87)
2010	12	57.416	(33 - 101)

3.1.3 Spatial pattern of mortality in women age 15 to 49 in IHDSS, 2006 – 2010

The spatial patten showed a marked geographical differences in both the broad causes of mortality and direct maternal causes, indicating a variation in pattern. The results also showed that most of the deaths occurred in areas in close proximity to Kivukoni, Namwawala, Zahanati ya Mbingu and Idele health facilities as shown in figure 3.1 and 3.1.1. Hence, the problem may not be geographical access to care but rather, quality and availability

of care. This comfirm the fact that, unless primary health care is supported by district hospitals capable of providing care for obstetric emergencies, reducing maternal mortality will not occur.

Broad causes of death 2006 -2010 **Direct maternal causes of death 2006 - 2010**

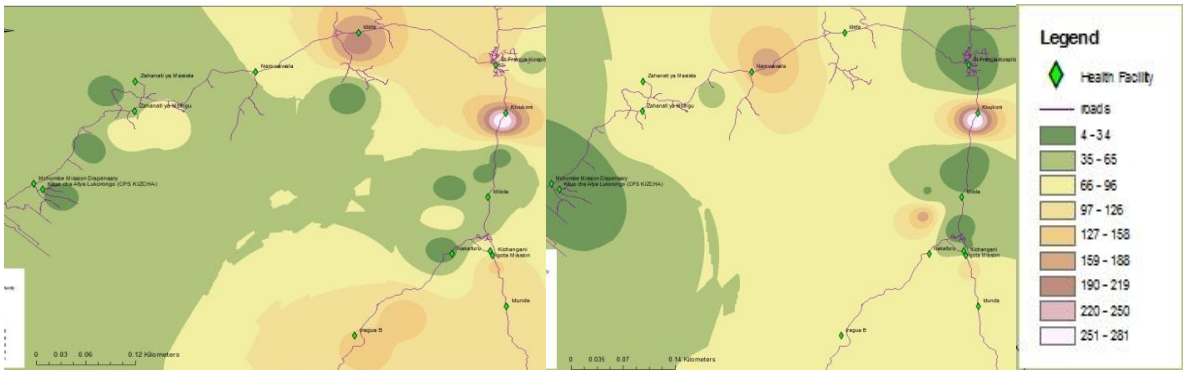
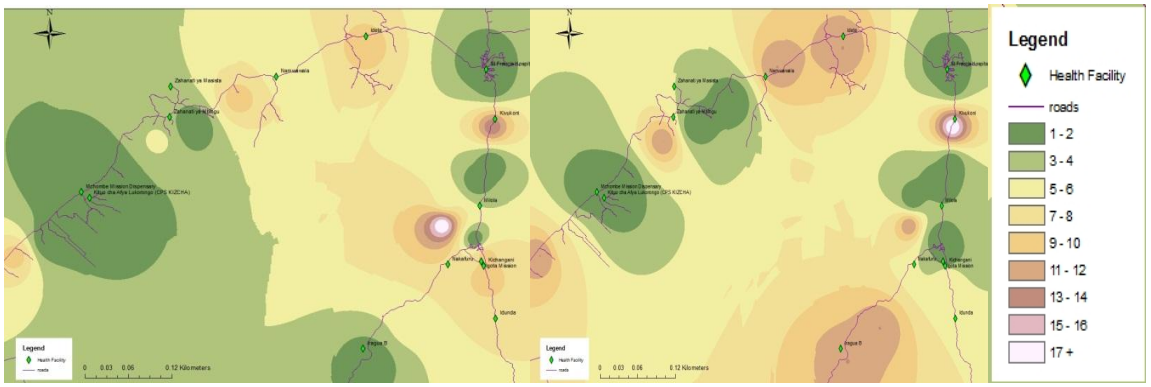
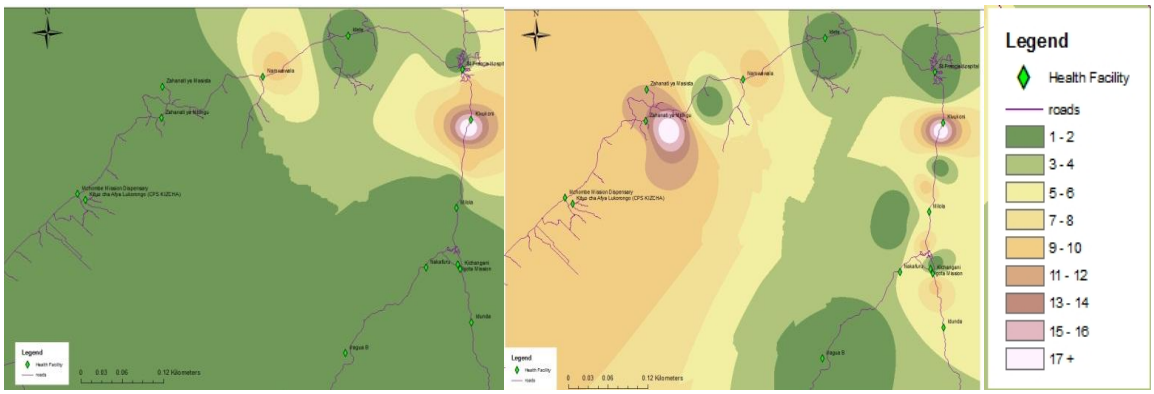


Figure 3.1: Mortality patterns from 2006 - 2010 in IHDSS

2006 **2007**



2008 **2009**



2010

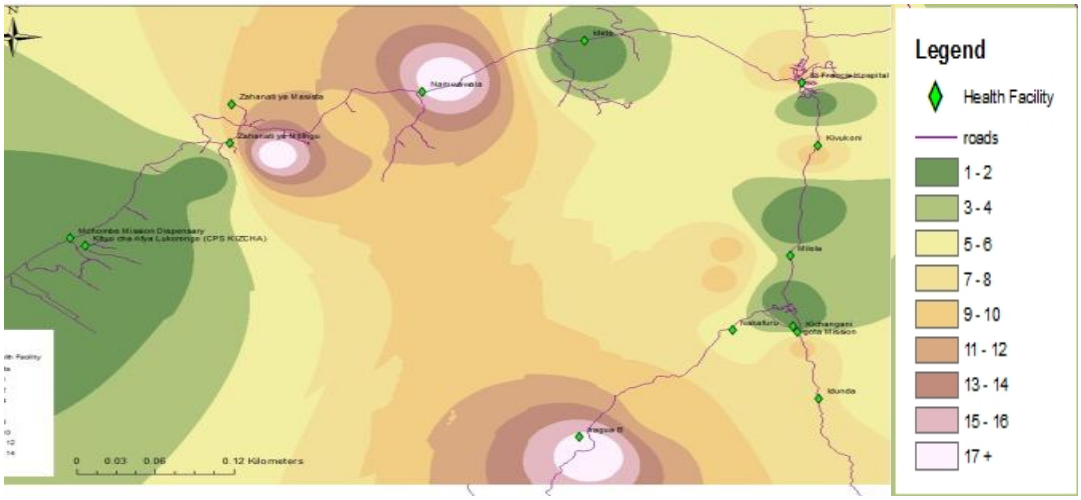


Figure 3.1.1: Yearly maternal mortality pattern in IHDSS, 2006 - 2010

3.1.4 Trend of Maternal Mortality in IHDSS

The trend line in figure 3.1 reveals that the maternal mortality rate declined over the study period with a gradient of -13.04 on a linear scale. Therefore, maternal mortality appears to be reducing in the study area.

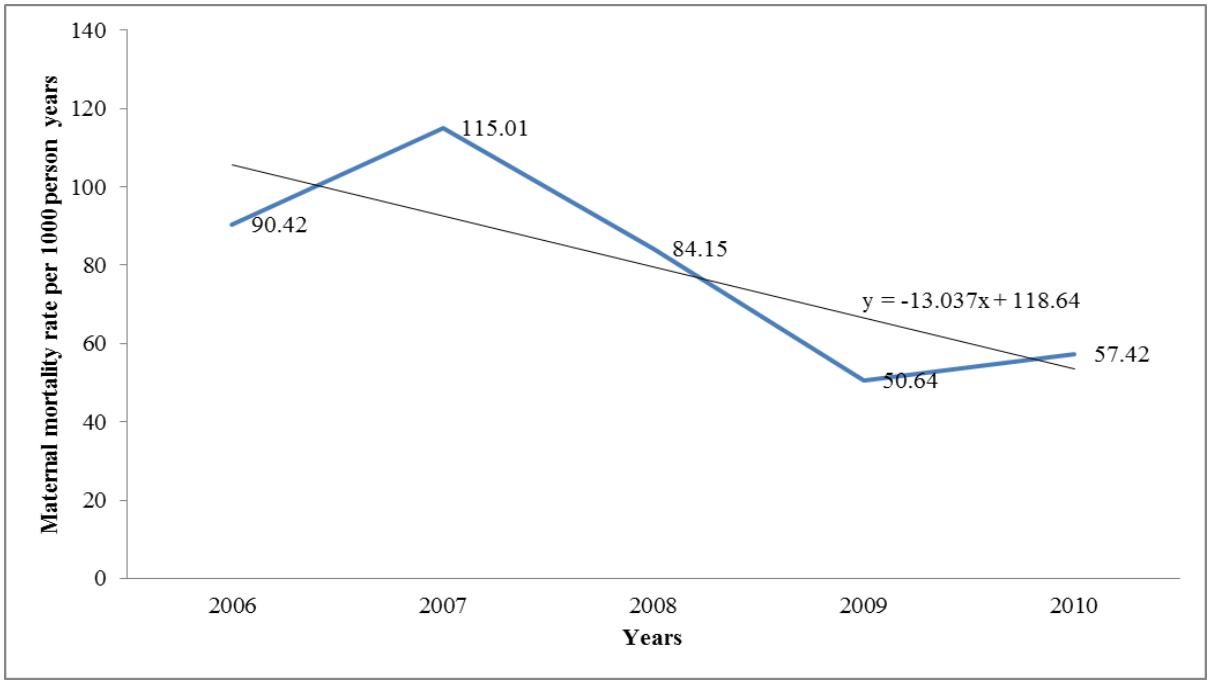


Figure 3.2: Maternal mortality trend from 2006 - 2010 in IHDSS

3.1.5 Causes of death of women aged 15 to 49 years in IHDSS

Figure 3.3 shows the broad causes of death of women in their reproductive ages. Figure 3.4 displays the direct causes of maternal deaths, figure 3.5 shows non-direct causes of death, and figure 3.6 illustrates external causes of death of the women in the study.

Figure 3.3 depicts the VA-assigned causes of death of women aged 15 to 49 years across the five year period. Malaria took the heaviest toll on the population, accounting for 13% of the total burden, followed by cardiovascular diseases contributing 10% of the total burden. Human Immunodeficiency Virus (HIV)/Autoimmune Deficiency syndrome (AIDS) and pneumonia accounted for 8% each, respectively. Anaemia accounted for 6%, while external causes such as injuries and pregnancy-related causes (maternal causes) contributed 3% each.

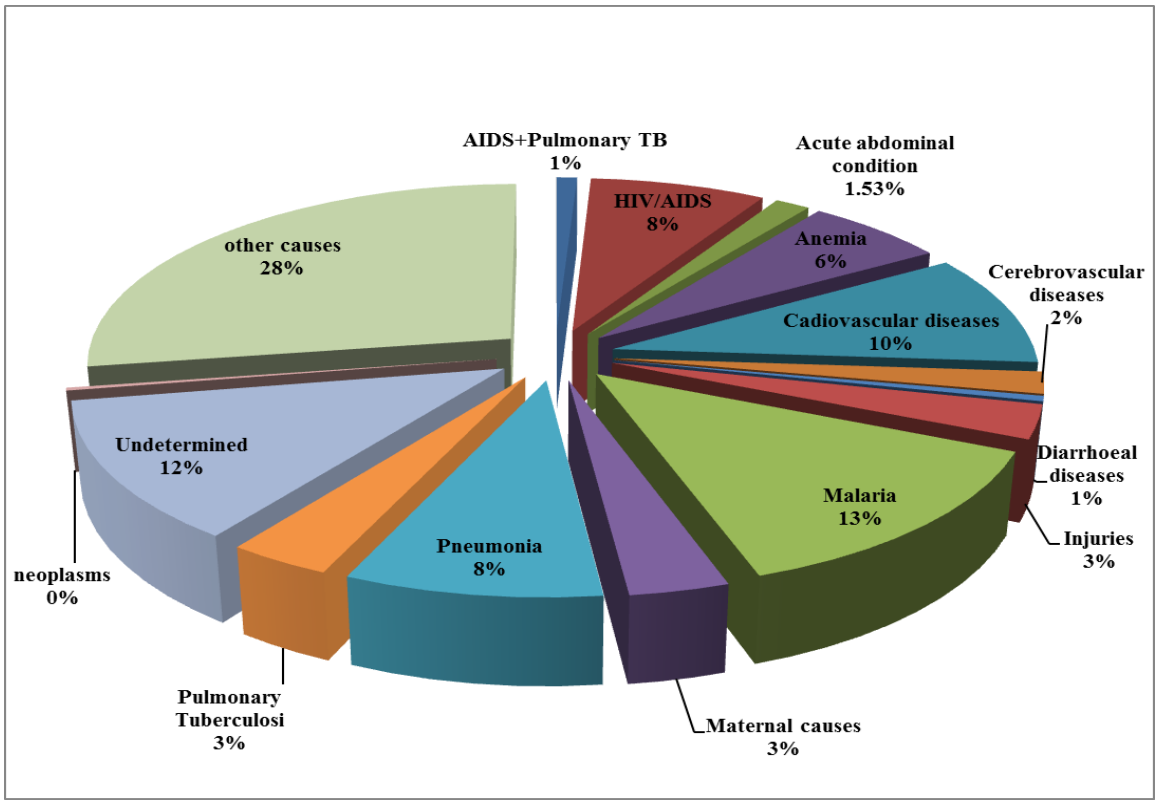


Figure 3.3: Broad Causes of death of women aged 15 to 49 years in IHDSS
n = 2 348

Out of the 77 deaths from obstetric causes as shown in figure 3.4, eclampsia and haemorrhage had the heaviest toll, contributing 23% and 22% respectively, followed by abortion (10%) and obstructed labour (7%). Other specified and unspecified direct causes contributed a total of 37%; puerperal sepsis contributed the smallest amount (1%).

The breakdown of the obstetric direct maternal causes of death are presented by year in figures 3.4.1 to 3.4.5.

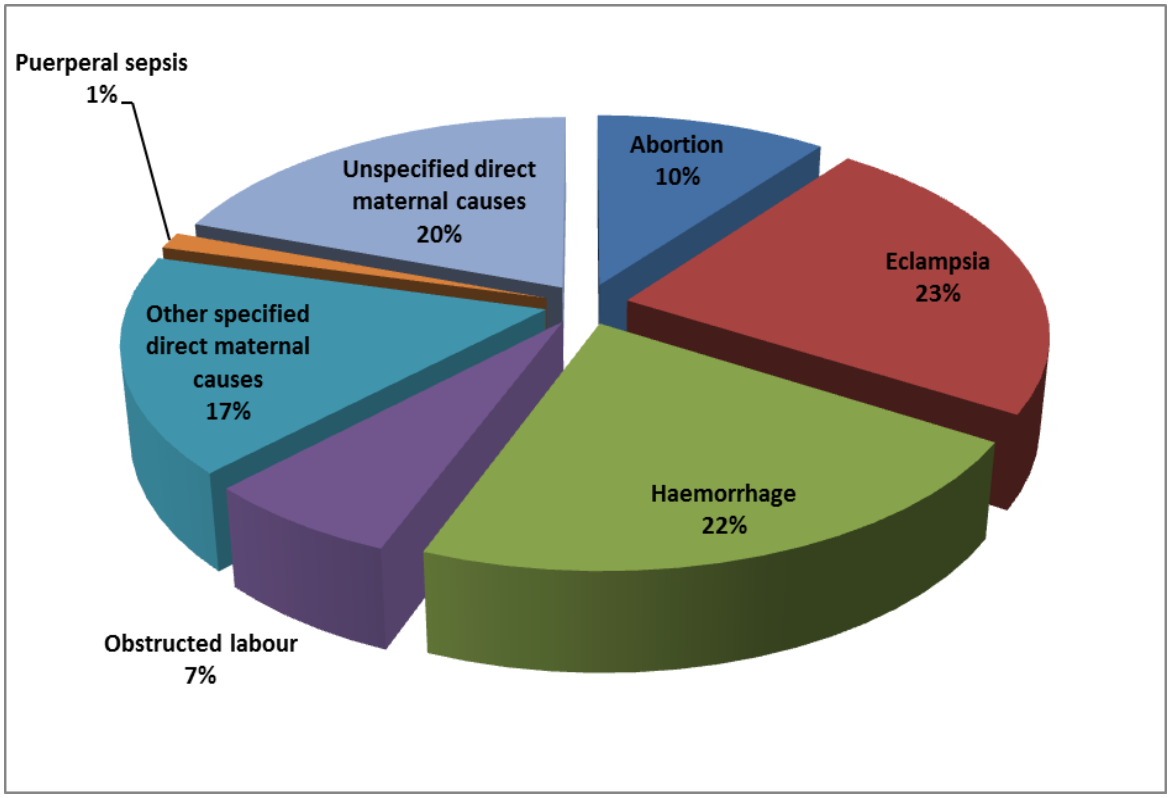


Figure 3.4: Direct causes of maternal deaths in IHDSS from 2006 - 2010

n=77

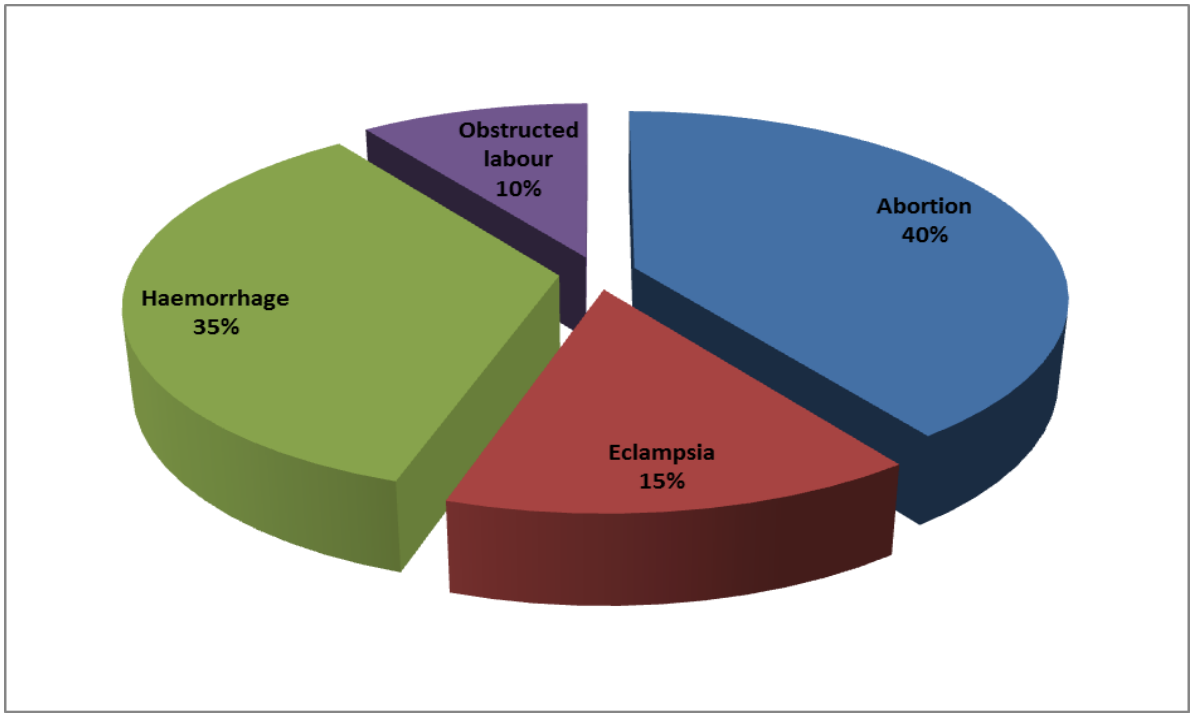


Figure 3.4.1: Direct causes of maternal death in IHDSS, 2006
n= 20

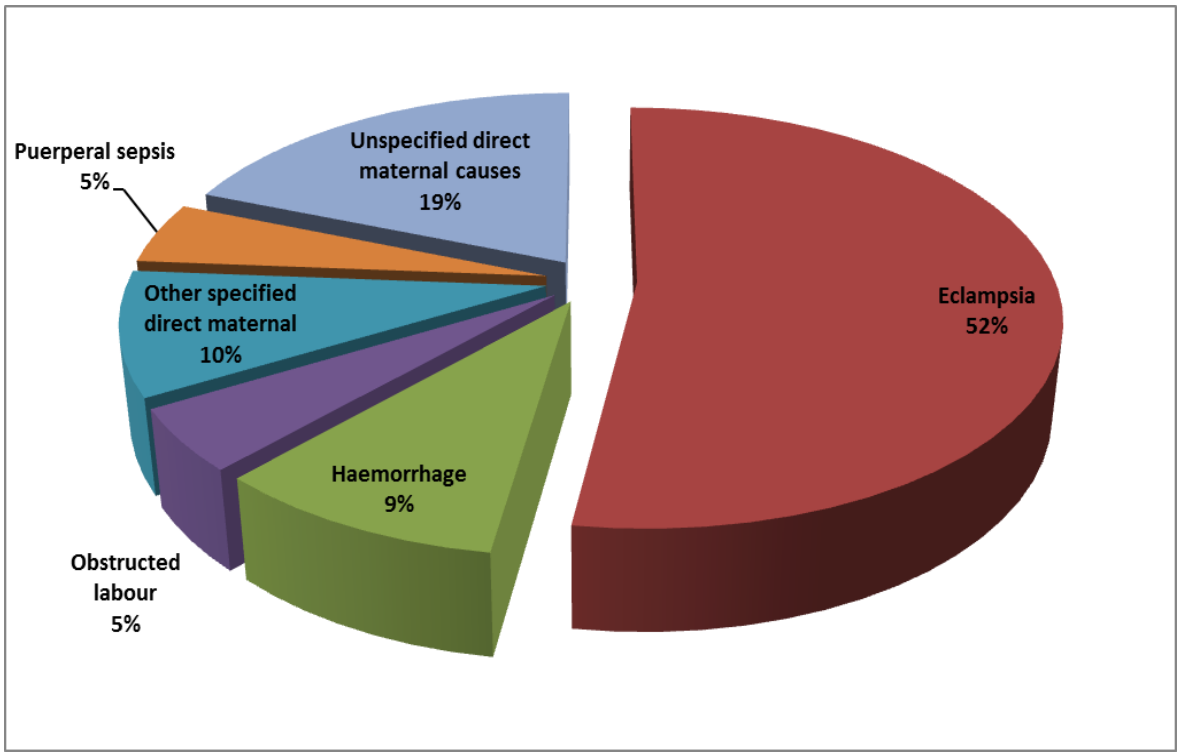


Figure 3.4.2: Direct causes of maternal mortality in IHDSS, 2007
n = 21

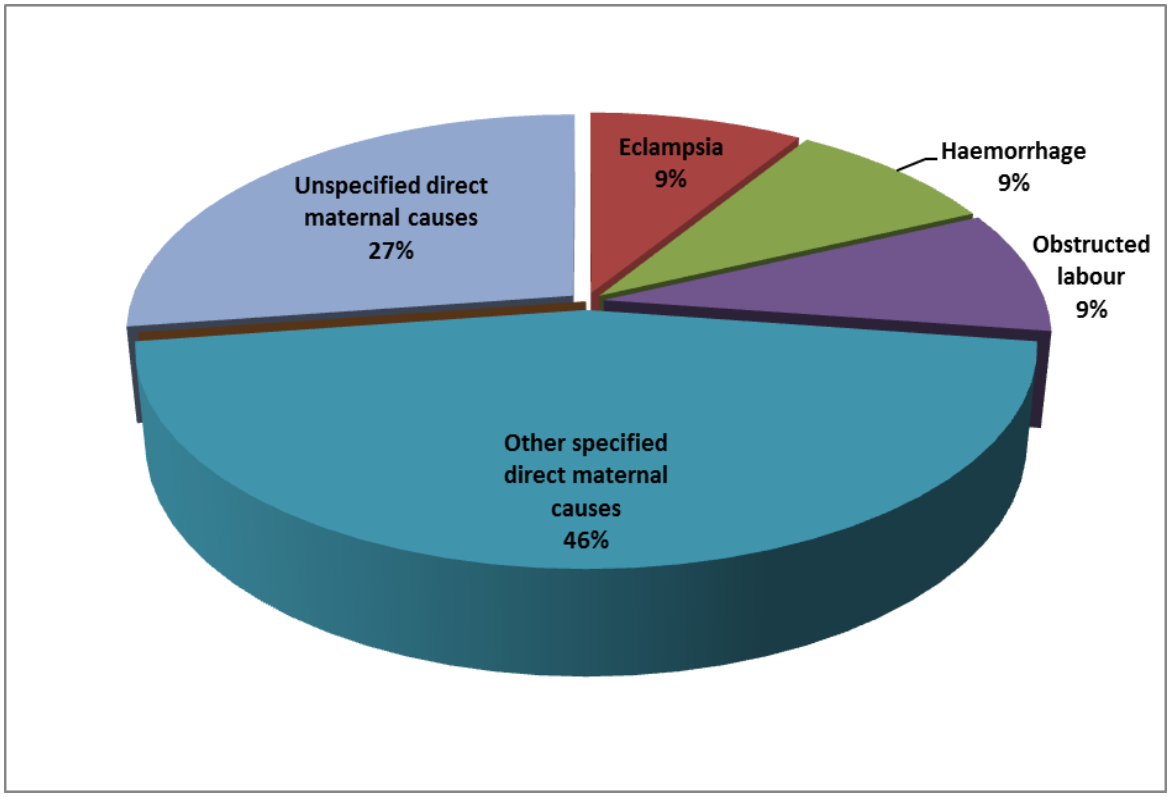


Figure 3.4.3: Direct causes of maternal mortality in IHDSS, 2008
n = 11

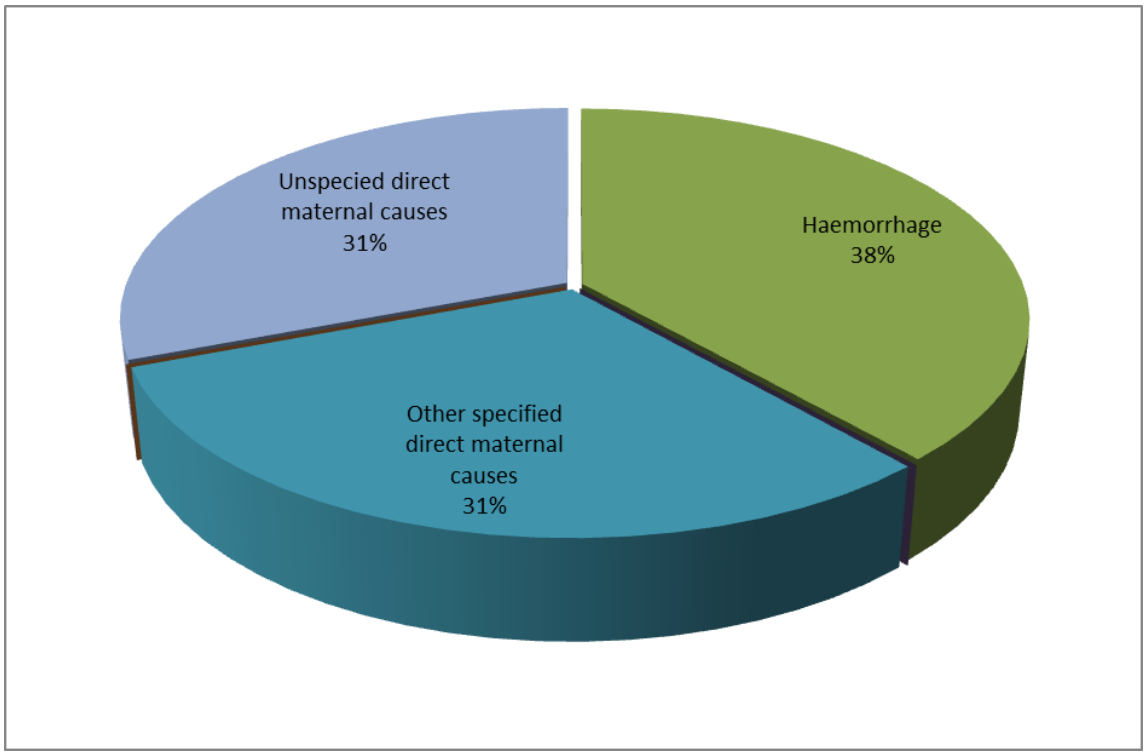


Figure 3.4.4: Direct causes of maternal mortality in IHDSS, 2009
n= 13

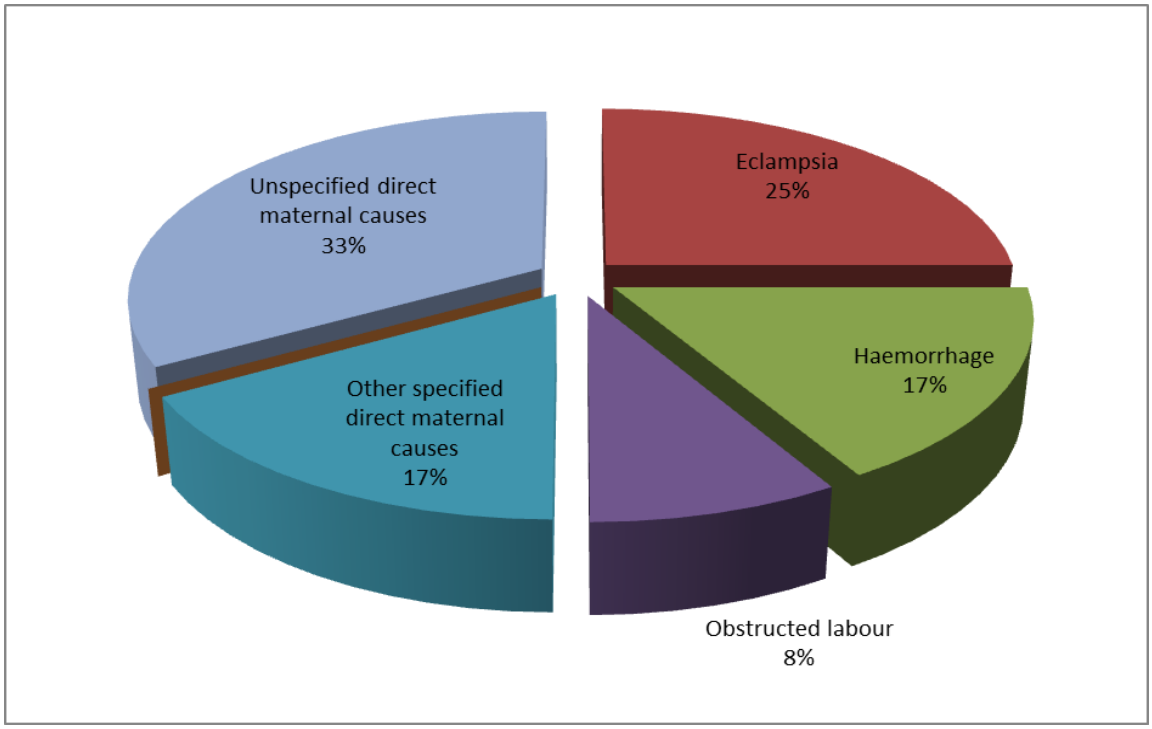


Figure 3.4.5: Direct causes of maternal mortality in IHDSS, 2010
n = 12

In the year 2006, abortion and haemorrhage were the two top causes of mortality followed by eclampsia and obstructed labour. Elampsia took the heaviest toll in the year 2007 followed by unspecified maternal causes and other specified causes. In 2008, other specified causes and unspecified causes were the major contributors to mortality. In 2009, haemorrhage was the major cause of mortality while, in 2010, unspecified direct causes and eclampsia were the two main contributors.

Figure 3.5 shows that there were 46 deaths of women in their reproductive ages arising from non-obstetric causes. Of these, anaemia contributed the highest proportion (22%), followed by HIV/AIDS (15%), cadiovascular disease (13%) and malaria (7%).

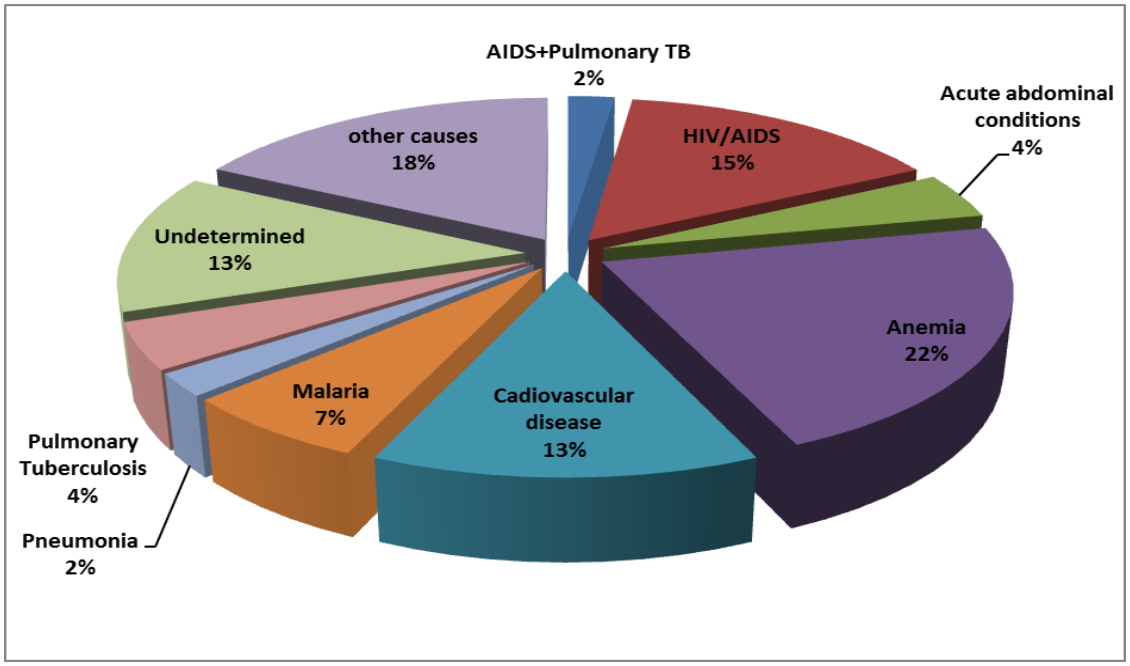


Figure 3.5: Non-direct causes of maternal deaths of women aged 15 to 49 in IHDSS
n= 46

Out of the 74 deaths from external causes, as shown in figure 3.6, other specified unintentional injury contributed 42%, road trafic accident contributed 19%, homicidal injury contributed 14%, and assult accounted for 12%. Accidental poisoning accounted for 7% of the total external causes, while suicidal injury and falls accounted for 3% each.

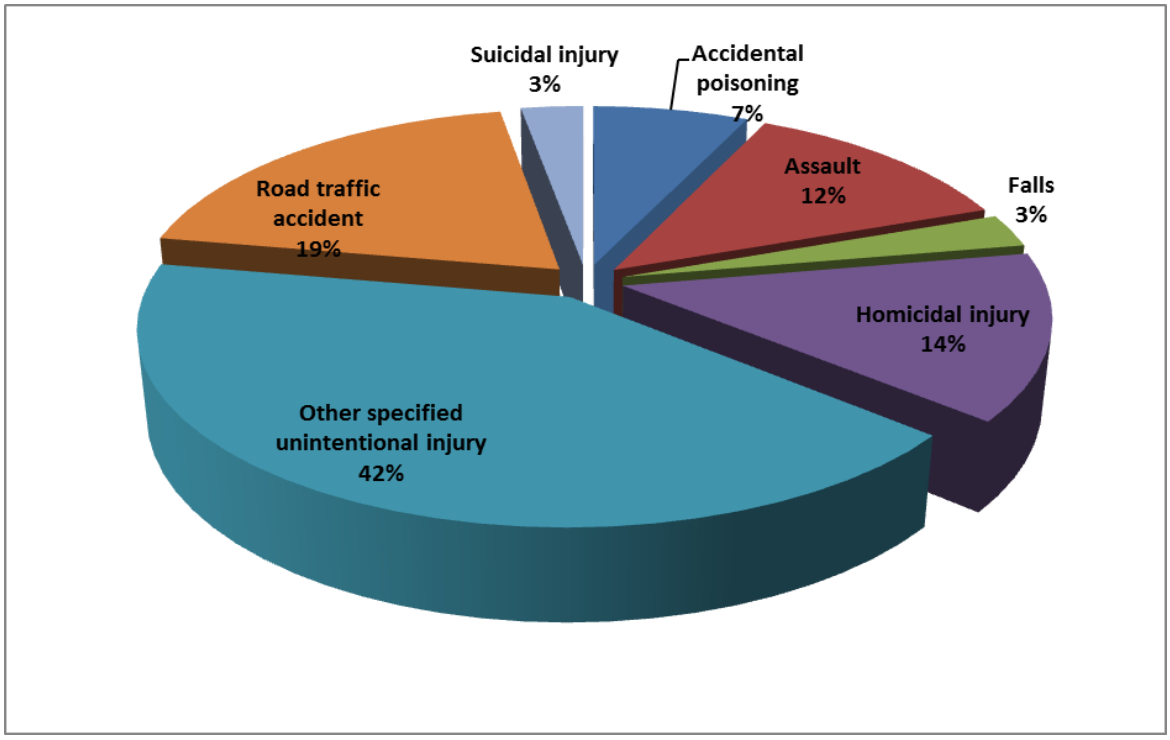


Figure 3.6: External Causes of death of women aged 15 to 49 in IHDSS
n= 72

3.2 Inferential Analysis

Tables 3.3 and 3.4 present the results of the univariable and multivariable analysis of the maternal mortality risk factors, respectively.

3.2.1 Univariable Analysis

The results of the undjusted hazard ratios with a 95% confidence interval (CI) obtained from the univariable Cox proportional regression model for the analysis of the potential risk factors associated with maternal mortality are presented in table 3.3. Maternal age, SES, marital status, birth attendant, place of delivery and parity were statistically significant risk factors for maternal mortality.

Women aged 20 to 29 years were 43% less likely to experience maternal mortality compared to those younger than 20 years (HR: 0.57, 95% CI: 0.16 - 1.99). Women aged 30 to 39 years

were 3% more likely to experience maternal death compared with those younger than 20 years (HR:1.03, 95% CI: 0.30 - 3.49). On the other hand, being older (40-49 years) was protective: such women were 80% less likely to die from maternal causes of death compared to those younger than 20 years (HR:0.20, 95% CI: 0.04 - 1.00)

SES was associated with maternal mortality: higher socio-economic status was protective against maternal mortality. There was an 84% reduction in maternal mortality in women of poorer status compared to those in the poorest category (HR: 0.16, 95% CI: 0.06 - 0.42), a 71% reduction in those in the poor socio-economic category (HR: 0.29, 95% CI: 0.12 - 0.69), a 63% reduction in those in the less poor category (HR: 0.37, 95% CI: 0.09 - 1.53), and a 72% reduction in women in the least poor category (HR: 0.28, 95% CI: 0.10 - 0.80).

Marital status was also associated with maternal mortality. There was a 95% reduction in maternal mortality among woman who were married, compared to those who were single (HR: 0.05, 95% CI: 0.01 - 0.25). Women who were divorced/separated had an 8.64 times increased risk of maternal mortality compared to those who were single (HR:8.64, 95% CI: 2.08 - 35.98), and there was a 5.60 times increased risk among widowed women compared to their single counterparts (HR: 5.60, 95% CI: 1.09 - 28.86).

In assisted delivery, women who were assisted by non-health workers were 84% more likely to experience maternal mortality compared to those who were assisted by a health worker (HR: 1.84, 95% CI: 1.14 – 2.98). Place of delivery was also a significant risk factor for maternal mortality: women who delivered outside a health facility were 68% more likely to experience maternal mortality comarred to their counterparts who delivered in a health facility (HR: 1.68, 95% CI: 1.05 - 2.69).

Parity was strongly associated with maternal mortality in the study. As parity of the women increased, there was a significantly increased risk of maternal mortality. Women of parity of 2 - 4 were 2.97 times more likely to experience maternal mortality compared to those with parity of 1 (HR: 2.97, CI: 1.04 - 8.51). Those with parity of 5 or more were 5.29 times more likely to experience maternal mortality compared to those with parity of 1 (HR: 5.29, CI: 1.84 – 15.25).

None of the other potential risk factors showed any statistically significant association with maternal mortality (Table 3.3), although the results indicated that higher education might be protective of maternal mortality (not statistically significant).

Table 3.3: Univariable Hazard ratios of maternal mortality risk factors in IHDSS, 2006-2010 (Unadjusted)

Maternal mortality risk factors	Hazard Ratio (HR)	95% CI	P – Value
Maternal Age (Years)			
< 20 (Ref.)	1		
20-29	0.57	(0.16- 1.99)	0.377
30-39	1.03	(0.30- 3.49)	0.968
40-49	0.20	(0.04- 1.00)	0.050 †
SES			
Poorest (Ref.)	1		
poorer	0.16	(0.06- 0.42)	0.000 †
poor	0.29	(0.12- 0.69)	0.005 †
less poor	0.37	(0.09- 1.53)	0.169
least poor	0.28	(0.10- 0.80)	0.017 †
Education			
No Education (Ref.)	1		
Primary	0.77	(0.45- 1.29)	0.324
Secondary and above	0.53	(0.13- 2.24)	0.389
Occupation			
Business (Ref.)	1		
Farming	0.25	(0.03- 1.86)	0.174
Others	5.71	(0.70-42.05)	0.087
Trading	1.55	(0.20- 11.71)	0.674
Marital Status			
Single (Ref.)	1		
Married	0.05	(0.01 - 0.25)	0.000 †
Divorced/Separated	8.64	(2.08 - 35.98)	0.003 †
Widowed	5.60	(1.09 - 28.86)	0.040 †

Number of antenatal clinic visit			
4 and above (Ref.)	1		
0 to 1	1.12	(0.35 - 3.64)	0.848
2 to 3	0.91	(0.23 - 3.65)	0.897
Who assisted in the delivery			
Health worker (Ref.)	1		
Non health worker	1.84	(1.14 - 2.98)	0.012 †
Delivery place			
Health facility (Ref.)	1		
Outside health facility	1.68	(1.05 - 2.69)	0.032 †
Parity			
Parity 1 (Ref.)	1		
Parity 2-4	2.97	(1.04 - 8.51)	0.043 †
Parity 5+	5.29	(1.84 - 15.25)	0.002 †
Distance of woman's home to health facility			
Near (< 5Km) (Ref.)	1		
Far (>= 5Km)	0.98	(0.57 - 1.67)	0.929

Note: † Statistically significant. Global test of p=0.9175.

3.2.2 Multivariable Analysis

In the multivariable Cox proportional hazard model, maternal age, marital status and SES were still found to be statistically significantly associated with maternal mortality at a 5% level of significance. As shown in Table 3.4, after adjusting for marital status, SES, level of education, place of delivery, antenatal clinic visit, and who assisted in delivery; maternal age was still significant. Women aged 20-29 years of age were 82% less likely to experience maternal death compared to women younger than 20 years of age (p=0.018; HR: 0.18, 95% CI: 0.05 - 0.74), while those aged 30-39 were 78% less likely to experience maternal death (p=0.038; HR: 0.22, 95% CI: 0.05 - 0.92) compared to those younger than 20 years. Women aged 40-49 years were 79% less likely to die from maternal causes of death compared to those younger than 20 years (HR:0.21, 95% CI: 0.04 - 1.20).

After adjusting for SES, place of delivery, antenatal clinic visit, who assisted delivery and maternal age, marital status was still associated with maternal mortality. Women who were married were 94% less likely to experience maternal mortality compared to those who were single (p=0.010; HR: 0.06, 95% CI: 0.01 – 0.51). Women who were divorced or separated were 7.15 times more likely to experience maternal mortality compared to those who were single (HR: 7.15, 95% CI: 0.96 - 53.41). Widows were 9.13 times more likely to experience maternal mortality compared to those who were single (p=0.048; HR: 9.13, 95% CI: 1.02 – 18.94).

Having adjusted for marital status, place of delivery, antenatal clinic visit, who assisted in delivery and maternal age, there was a general reduction in risk of maternal mortality across all categories of SES compared to the reference category. In the model, the hazard of maternal mortality was 70% less in the poorer socioeconomic group (p=0.018; HR: 0.30, 95% CI: 0.11 - 0.81), 52% less in the poor socioeconomic group (HR: 0.48, 95% CI: 0.20 - 1.19), 52% less in the less poor socioeconomic group (HR: 0.48, 95% CI: 0.108 - 2.103), and 75% less in the least poor socioeconomic group (HR: 0.25, 95% CI: 0.06 - 1.09) compared to the poorest socioeconomic group.

While the risk of maternal death increased with increasing parity, it was not statistically significant after adjusting for other risk factors. Women who were delivered by non-health workers were 5.83 times more likely to experience maternal death (HR: 5.83%, 95% CI: 0.70 – 48.90) compared to those who were delivered by a health worker (also not statistically significant), as shown in Table 3.4.

The proportional hazard assumption was investigated in the model and it was upheld.

Table 3.4: Multivariable hazard ratios of maternal mortality risk factors in IHDSS, 2006-2010 (Adjusted)

Maternal mortality risk factors	Hazard Ratio	95% CI	P – Value
Maternal Age (Years)			
< 20	1		
20-29	0.18	(0.05 - 0.74)	0.018 †
30-39	0.22	(0.05 - 0.92)	0.038 †
40-49	0.21	(0.04 - 1.20)	0.080
Marital Status			
Single	1		
Married	0.06	(0.01 - 0.51)	0.010 †
Divorced/Separated	7.15	(0.96 - 53.41)	0.055
Widowed	9.13	(1.02 – 81.94)	0.048 †
Parity			
Preg1	1		
Preg2-4	1.94	(0.37 - 10.12)	0.433
Preg5+	2.25	(0.44 – 11.46)	0.328
Who assisted in the delivery			
Health worker	1		
Non health worker	5.83	(0.70 – 48.90)	0.104
Delivery place			
Health facility	1		
Outside health facility	0.28	(0.04 – 2.33)	0.241
SES			
poorest	1		
poorer	0.30	(0.11 - 0.81)	0.018 †
poor	0.48	(0.20 - 1.19)	0.115
less poor	0.48	(0.11 - 2.10)	0.328
least poor	0.25	(0.06 – 1.09)	0.065

Note: †: Statistically significant

CHAPTER FOUR: DISCUSSION

The aim of this study was to assess the spatial patterns and trends of, and causes and risk factors associated with, maternal mortality in the Ifakara Health and Demographic Surveillance System in Tanzania, with the view of providing information that may help reduce maternal mortality in Tanzania.

The results revealed causes and risk factors that were associated with maternal mortality over the five year period of follow up. This chapter presents a discussion of the findings.

4.1 Spatial pattern and trend of maternal mortality in IHDSS

The results show that maternal mortality was not evenly distributed across the study area within the five year period. Since understanding spatial patterns of a health-related problem is one of the basic tenets of public health[47], these results provide evidence for the need to target intervention programmes to high risk areas where health events are most likely to occur. Population-wide interventions may be too costly to implement and studies have shown that community-level interventions bring about reduction in maternal mortality[48].

The analyses also revealed that distances to the nearest primary health care facility and the number of antenatal clinic visit were not significantly associated with maternal mortality. The maternal mortality patterns suggest that understanding of other factors that may obstruct access to health care utilization, such as quality of care, level of available care, cost, and social and behavioral factors, as suggested in other studies[20, 49], are important

There was a declining trend in maternal mortality over the five year period, in line with the declining global trend and the trend in Tanzania[34,50]. This declining trend could be attributed to various interventions at both national and district levels, such as community health funds for better health care, improvement of antenatal services, obstetric care and food security in

Tanzania. Although it was difficult to compare maternal mortality figures in this study due to different scales of measurements (rate and ratio), the declining patterns observed in other studies were also observed in this study.

4.2 Cause of maternal mortality in IHDSS

The finding that the major direct cause of maternal mortality in IHDSS is eclampsia supports reports from other studies[50, 51]. The main indirect causes of maternal death was anaemia, followed by HIV/AIDS, cardiovascular diseases, and malaria. This supports other findings that HIV and cardiovascular diseases are among the leading causes of mortality in Sub-Saharan Africa[52-55] and shows the changing pattern of epidemiology of diseases and mortality in Africa. As reduction in the proportion of deaths due to malaria, and the increase in those due to HIV and cardiovascular disease[53] challenges the attainment of the millennium development goals. The findings of this study support other research showing that the global burden of diseases (and, hence, causes of mortality) is shifting from communicable to non-communicable diseases.

Road traffic accidents, homicides and assaults are the three leading contributors of external causes of death of women in their reproductive age in the DSA. This finding confirms the global pattern of road traffic accident and injuries as a cause of mortality[56-58]. Injuries, suicides, homicides and other specified unintentional traumatic injuries as an increasing source of maternal mortality in recent times[59], is consistent with the findings in this study. This was due to the inclusion of late maternal deaths onto the maternal mortality estimates. It is necessary to include clearly violent deaths in pregnancy in official statistics on maternal mortality to guide appropriate care and intervention programs. The present global priorities for adolescent health policy, which focus on HIV/AIDS and maternal mortality, are an

important but insufficient response to prevent mortality in an age-group in which more than two in five deaths are due to intentional and unintentional injuries[58].

4.3 Risk factors for maternal mortality in IHDSS

Maternal mortality studies conducted in Tanzania[5,6,60-62], Latin America[63], Uganda[64], Gambia[65], Senegal[16], Nigeria[17], and India[15] have shown the association of various risk factors with maternal mortality. Results from our study revealed that maternal age, marital status, and SES are significantly associated with maternal mortality in IHDSS.

These results are consisted with the findings of a study in Uganda[64] where a higher incidence of maternal deaths was found in women aged 15 to 19 years. Our result showed that the risk of maternal death was lower among women who were older than 20 years of age compared to those younger than 20. Others also observed that the risk of maternal mortality is highest for adolescent girls younger than 19[58, 63, 64], consistent with our findings. Results from elsewhere also show that complications in pregnancy and childbirth are the leading causes of death among adolescent girls in most developing countries[58].

Urassa et al. reported that single and divorced women were at risk of maternal death in the city of Dar es Salaam[62]. In our study, married women were much less likely to experience maternal death compared to women who were single, while women who were divorced or separated were many times more likely to die of maternal causes (as were widows, although the results were not statistically significant).

Loudon et al.[10], studying the association between age and parity, showed that, for all ages, there was a higher risk of maternal death in first births than in second or third births. From the fourth birth onwards, increasing parity led to higher maternal mortality, regardless of maternal age. Furthermore, several studies found an increased risk of maternal death with

increasing parity[15, 62]. In our study, we also found that the risk of maternal mortality increased with increasing parity, although it was not statistically significant.

Studies have shown that a household social class measure is a better predictor of reproductive outcome than is individual social class standing[66]. Urassa et al.[62] showed that factors reflecting living standards, such as type of housing, access to tap-water, electricity, availability of a toilet and the living standard as estimated by the interviewer, were all statistically significant for the risk of maternal death. The findings of our study are consistent with other studies where factors reflecting living standards of women's household was used as a proxy measure for maternal SES and women with higher SES were less likely to experience maternal mortality compared with those with very low SES. It is clear from our study that less poor women have fewer children and are delivered in a health facility by health a health worker.

Although this study showed no association between women's education and risk of maternal death, previous studies have shown conflicting results. Where some reported similar results to ours[14, 15, 61], others found that maternal education does influence maternal mortality[16, 17, 62].

Some studies have found that home delivery and inadequately trained birth attendants are risk factors for maternal death[33, 67], but this study did not show a statistically significant association even though women who were assisted by non-health workers during delivery were 483% more like to experience maternal death compared to those who were assisted by health workers. While distance from a woman's home to the nearest health facility was not a risk factor in our study, Wagle et al.[67] found that is was in their study in Nepal.

4.4 Limitations of the Study

In considering the findings of this study, it is important to bear in mind the following limitations.

Our study used secondary data and therefore was limited to variables that were present in the dataset; potential risk factors identified in other studies were missing and could not be analysed. These included: type of delivery, birth interval, type of birth and birth order. Secondly, the validity and the reliability of these data depend on how well they were collected by the IHDSS field staff.

The VA method used to ascertain the probable cause of death of the study participants using information on symptoms and signs gathered during bereavement interviews of persons who were caring for the deceased, is not ideal as there are issues regarding validity in assessing the cause of death due to recall bias, response errors or misclassification of mortality during the coding process.

One key limitation of a HDSS is its representativeness as it encapsulates a small geographic area relative to the whole country.

4.5 Strengths of the Study

The large population under surveillance in IHDSS and the rigorous DSS which continuously captures vital population statistics (births, deaths and migration) longitudinally provided a platform for a reliable person-time of exposure which enabled the calculation of accurate maternal mortality rates which were free from influence of stillbirth prevalence and induced abortion that are present in the maternal mortality ratio calculation.

The use of a population-based sample limits the issue of selection bias that would otherwise be introduced by hospital-based studies and results obtained are consistent and comparable with other research findings in other settings; hence, the authenticity of the results was not compromised.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The availability of the HDSS sites and the VA method of obtaining information on causes of death for mortality estimation purposes is the most viable interim solution to meet requirements of data collection for both health policy and monitoring the impact of health programs, interventions and the millennium development goals, in settings where there are lack of adequate vital registration systems and poor causes of death certification.

Although there appears to be a declining trend of maternal mortality in southern rural Tanzania, there are marked geographical differences in maternal mortality, with variations across a relatively small geographical area. The high levels of maternal mortality in some instances occurred in homes in close proximity to health facilities, suggesting a need to strengthen the capacity of sub-district health facilities for emergency obstetric care, to improve quality of care and the level of available care, and to assess cost, social and behavioral barriers that might obstruct access to health care services.

Being younger than 20 years, unmarried, and poor were found to be risk factors for maternal mortality in southern rural Tanzania. The two leading direct causes of maternal mortality in the study population were eclampsia and haemorrhage. While anemia, HIV and cardiovascular diseases were the leading indirect killers, road traffic accidents, homicides and assaults were the also important contributors.

5.1 Recommendations

Though a declining trend in maternal mortality was observed in southern rural Tanzania, in line with the declining global trend, there is need for the following actions:

1. The government of The United Republic of Tanzania and other stakeholders must identify and implement appropriate intervention programmes in areas with high maternal mortality since a population-wide intervention will be expensive and slow.

2. Training in managing haemorrhage and hypertensive disorders in pregnancy must be scaled up through the use of appropriate drug regimens and monitoring of women during pregnancy and after delivery.

3. There must be a clear national adolescent health policy which focusses on HIV/AIDS, maternal mortality, and intentional and unintentional injuries to prevent mortality among adolescent girls.

4. There is the need for more research in the area of maternal mortality.

Recommendations from this study will have applications to other similar rural settings within Tanzania and, potentially, beyond.

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APPENDICES

Appendix 1: Permission Letter from IHI to use IHDSS data

12th June 2012

Please reply to:
Ifakara Health Institute
Dar es Salaam,
Mikocheni Office

Dear Alfred,

Re: Permission to use Ifakara HDSS data-Alfred Kwesi Manyeh

We have received your letter that informs us about the change of your Msc. Project title.

Reference is made to the letter dated 3rd October 2011 where Ifakara Health Institute granted you permission to use part of the IHDSS data for your Msc project with the title "**Spatial and temporal patterns of maternal mortality over a five year period and their associated risk factors in Ifakara Health and Demographic Surveillance Site (IHDSS) 2006 – 2010".** Following change of your title, permission is granted for using part of the IHDSS dataset for your MSc. project entitled **"spatial patterns and trends of maternal mortality over a five year period and their associated risk factors in ifakara health and demographic surveillance site (ihdss)"**

Conditions attached to this permission:

1. Data will be made available only for the stated years (2006-2010) and only that is necessary for your study
2. The dataset will be used exclusively for the stated study
3. You will give a presentation on your proposed study and findings to the IHI scientists
4. A copy of your report should be submitted to IHI

Yours Sincerely

Rose Nathan,

Training -IHI

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Mtwara
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Kigoma
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Appendix 2: University of the Witwatersrand Human Research Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mr Alfred Kwsei Manyeh

CLEARANCE CERTIFICATE	M111130
PROJECT	Spatial and Temporal Patterns of Maternal Mortality Over a Five Year Period and Their Associated Risk Factors in the Ifakara Health and Demographic Surveillance (HDSS)
INVESTIGATORS	Mr Alfred Kwsei Manyeh .
DEPARTMENT	School of Public health
DATE CONSIDERED	28/10/2011
M1111300DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 28/10/2011 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Dr Gill Nelson

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 3: University of the Witwatersrand Faculty of Health Science Approval

Faculty of Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011) 717-2108

Reference: Mrs Mathikhui Moshabesha
Email: Mathikhui.moshabesha@wits.ac.za
13 June 2012
Person No: 576824
TAA

Mr Alfred Kwesi Manyeh
Dodwa Health Research Centre
P O Box DD1
Ghana

Dear Mr Manyeh

Master of Science in Epidemiology in the field of Population-based Field Epidemiology: Approval of change of title

We have pleasure in advising that your proposal entitled "Spatial patterns and trends of maternal mortality over a five year period and their associated risk factors in Ifakara Health and Demographic Surveillance Site (IHDSS)" has been approved. Please note that any changes to this title has to be endorsed by the Faculty's Higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix 4: Adult Verbal Autopsy Questionnaire

INDEPTH- NETWORK Standard Verbal Autopsy Questionnaire

PART 3: ADOLESCENT AND ADULT DEATHS (persons of the age of 12 years and over)

Instructions to interviewer: Introduce yourself and explain the purpose of your visit. Ask to speak to the caretaker or any other person who was present during the illness that led to death. If this is not possible, arrange a time to revisit the household when caretaker will be home. Before interviewing the person explain to him/her that participation in the interview is voluntary; s/he can refuse to answer any question and s/he can stop the interview at any time. Explain to him/her that the information provided is only for research purposes and will be confidential.

I. IDENTIFICATION & DEMOGRAPHIC DATA OF THE DECEASED

1.1 Name of deceased…….…… ID:		PERMID
1.2 Village name:…….. ID:		VILLGID
1.3 Compound/household number		COMPID
1.4 Age of deceased:		AOD
1.5 Sex of deceased:	1. Male / 2. Female	SEXD
1.6 Date of Interview: (dd/mm/yy)		DINT

1.7 What was the marital status of the deceased?

1. Unmarried	3. Divorced/separated	4. Widowed	MSD

1.8 Number of years of formal education of the deceased.		EDUC
	999.NK	

1.9 Highest level of education of deceased:

	1. Primary	2. Secondary	3. Tertiary	4. None	HEDUCD
1.10 Occupation of deceased:	1. Farmer	2. Trader	3.Gov't/Priv't comp. Employee		OCCD
	4. Other(specify):……				

II. IDENTIFICATION OF RESPONDENT

2.1 Name of respondent: _____

2.2 Relationship of respondent to the deceased:

1. Spouse	2. Daughter	3. Son	4. Mother	5. Father	ROR
6. Other (specify): ……					

2.3 (Optional) Number of years of formal education of the respondent:		EDUC_R

2.4 (Optional) Highest level of education of respondent:

1.Primary	2. Secondary	3. Tertiary	4. None	HEDUC_R

III. BACKGROUND INFORMATION ON THE DEATH

3.1 Date of death (dd/mm/yy):	| | | | | | | | | | | |	DOD
3.2 For how long (days) was s/he ill before s/he died?	| | | 999. NK	ILLD
6.3 Where did s/he die ?	1. Hospital | 2. Other health facility | 3.On route to hospital or health facility	DIEL
	4: Home | 5. Other (specify):……	
3.4 If the deceased is a woman of childbearing age, please ask whether she met one of the followings	1.Pregnant | 2.Not pregnant | 3.Delivered less than 42 days ago	DSTA
	4. Delivered more than 42 days | 5. Aborted | 999.NK	

IV. OPEN HISTORY QUESTION

4.1Could you tell me about the illness/events that led to her/his death? Prompt: Was there anything else?

Instructions to interviewer - Allow the respondent to tell you about the illness in his or her own words. Do not prompt except for asking whether there was anything else after the respondent finishes. Keep prompting until the respondent says there was nothing else. While recording, underline any unfamiliar terms.

_____

_____

_____

_____

_____

_____

_____

4.2 Summary of signs & symptoms reported by respondent

Symptoms	Day since start of illness	Duration (Days)	Severity Mild/Moderate=1 Severe=2
4.2.1			
4.2.2			
4.2.3			
4.2.4			
4.2.5			
4.2.6			

4.3 list of hospitalizations (hospital admission) in the past 2 years (begin with more recent hospitalisations in descending order)

Name of Health facility	Date (Month/year)	Reasons for hospitalisation
1.	/ /	
2.	/ /	
3.	/ /	

4.4 Place of death:

1. Home	2. Hospital/clinic	3. On route to hospital/clinic	POD
4. At work	5. Other (specify …….	999. NK	

4.5 Do you know the cause(s) of his/her death?	1. Yes	2. No	999.NK	RKC

4.6 If the answer is YES probe to specify the cause(s):

Cause (1)……		CAUS1
Cause (2)……		CAUS2

Please record corresponding ICD10 code in the box

4.7 Did the deceased suffer from any of the following illness?

Hypertension:	1. Yes	2. No	999. NK	HYP
Other heart diseases	1. Yes	2. No	999. NK	OHEA
Diabetes:	1. Yes	2. No	999. NK	DIAB
Epilepsy:	1. Yes	2. No	999. NK	EPI
TB:	1. Yes	2. No	999. NK	TB
HIV/AIDS:	1. Yes	2. No	999. NK	HIV
Leprosy	1. Yes	2. No	999. NK	LEP
Asthma	1. Yes	2. No	999. NK	ASTH
Cancer	1. Yes	2. No	999. NK	CAN
If yes to cancer, please specify which type? ……			999. NK	CANTYP
4.8 Did the deceased suffer from any other illness?	1. Yes	2. No	999. NK	ODIS

If yes, please specify _____

V. INJURY/ACCIDENTS:

5.1 Did s/he sustain any injury which led to his/her death?	1. Yes	2. No	999. NK	INJ

If the answer is 2 or 999 proceed to Q6.1

5.1.1 *If yes ask* What kind of injury or accident? *Allow respondent to answer spontaneously*.

1. Transport accident (pedestrian)	2. Transport accident (passenger/driver)	3.Fall	4. Drowning	5. Poisoning (specify) ……	TINJ
6. Animal bite	7. Other bites or sting	8. Burn	9. Firearm	10. Sharp object- e.g. knife	11. Circumcision
12. Assault/abuse (specify): ……..		13. Other (specify):			

5.1.2 If answer to 5.2 is 6, please specify.	1. Dog	2. Snake	3. Other (specify) ……	999.NK	ANBI

5.1.3 Was the injury accidental or intentional ?	1. Accidental	2. Intentional	999.NK	INJTY

5.1.4 Did s/he die at the site where the accident or injury occurred?	1. Yes	2. No	999.NK	DSPOT

5.1.5 How many days did s/he survive before s/he died?	1<24 hours	2.>24 hours	999. NK	INJDU

5.1.6 Did s/he receive medical care before death?	1. Yes	2. No	999.NK	MDCARE

5.2 Did s/he have an ongoing chronic illness or was sick in the month before the accident or injury?	1. Yes	2. No	999.NK	OILL

5.3 Do you think that s/he committed suicide?	1. Yes	2. No	999. NK	SUI

If the answer is 2 or 999 proceed to VI

5.3.1 How did s/he commit suicide? *Allow respondent to answer spontaneously.*

1. Hanging	2. Poisoning	3. Burns	4.Gunshot	5. Others (specify) ……	999 NK	TSU

VI: LEADING QUESTIONS TO ELICIT SIGNS & SYMPTOMS OF THE FINAL ILLNESS

6.1 FEVER:

6.1.1 During illness that led to death did s/he have fever?	1. Yes	2. No	999. NK	FEV

(If the answer is 2 or 999 proceed to Q 6.2)

6.1.2 How many days did s/he have fever?		888 NA	999.NK	DFE
6.1.3 Was the fever:	1.Mild/moderate	2.Extremely high	888. NA / 999. NK	SFE
6.1.4 Was the fever continuous or on and off?	1. Continuous	2. On & Off	888. NA / 999. NK	TFE
6.1.5 Did s/he have chills/rigor	1. Yes	2.No	999. NK	RIG

6.2 RASH:

6.2.1 During illness that led to death, did s/he have rash?	1. Yes	2. No	999. NK	RAS

If the answer is 2 or 999 proceed to Q6.2.6)

6.2.2 Where was the rash located?	Face	1. Yes	2. No	999. NK	RFACE
	Trunk	1. Yes	2. No	999. NK	RSTRG
	Extremities	1. Yes	2. No	999. NK	REXTR
	All over the body	1. Yes	2. No	999. NK	RALLB
	Other: (specify)	1. Yes	2. No	999. NK	ROTHE
6.2.3 How many days did s/he have rash?			888. NA	999. NK	DRA
6.2.4 Did the skin crack/split or peel after the rash started?		1. Yes	2. No	999. NK	SKIRAS

6.2.5 What did the rash look like?

1. Measles rash	2. Rash with clear fluid	3. Rash with pus	999. NK	TRA
4. Other (specify) ……				

6.2.6 Did s/he have red eyes?	1. Yes	2. No	999. NK	SEY
6.2.7 Did s/he have itching of skin?	1. Yes	2. No	999. NK	ITC
6.2.8 Did s/he have bleeding from the body openings? *Do not include menstruations*.	1. Yes	2. No	999. NK	BLEEO
6.2.9 Did s/he have pins and needles in feet?	1. Yes	2. No	999. NK	PNEEF

6.3 WEIGHT LOSS:

6.3.1 Had s/he lost weight recently before death?	1. Yes	2. No	999. NK	LOW

If the answer is 2 or 999 proceed to Q6.4

6.3.2 How long before death?	1. Days	2. Months	3. Years	888.NA	999. NK	DLOW
6.3.3 Was the loss of weight:	1. Mild/Moderate (a little)	2. Severe (a lot)		888. NA	999. NK	SLW
6.3.3 How did s/he look like at the end of her/his life?	1. Normal	1. Extremely thin and wasted		888. NA	999. NK	SLW

6.4 PALLOR/JAUNDICE

6.4.1 Did s/he look pale (anaemic)?	1. Yes	2. No	999. NK	PAL
6.4.2 Did s/he have yellow discoloration of the eyes?	1. Yes	2. No	999. NK	JAU

6.5 OEDEMA/SWELLING:

6.5.1 Did s/he have ulcer on any part of the body	1. Yes	2. No	999. NK	ULC
6.5.1.1 *If yes to 6.5.1* , please specify where is the ulcer located ?			999. NK	ULCL
6.5.2 Had s/he have swelling around ankle?	1. Yes	2. No	999. NK	SAA

6.5.2.1 How many days did s/he have the swelling?		888.NA	999.NK	DSAA
6.5.3 Did s/he have puffiness of the face?	1. Yes	2. No	999. NK	PUF
6.5.3.1 *If yes*, ask how many days did the swelling last		888.NA	999. NK	DPUF
6.5.4 Did s/he have swelling in the neck?	1. Yes	2. No	999. NK	SWN
6.5.4.1 *If yes*, ask how many days did the swelling last		888.NA	999. NK	DSWN
6.5.5 Did s/he have swelling in the armpit?	1. Yes	2. No	999. NK	SWA
6.5.5.1 *If yes*, ask how many days did the swelling last		888.NA	999. NK	DSWA
6.5.6 Did s/he have swelling in the groin?	1. Yes	2. No	999. NK	SWG
6.5.6.1 *If yes*, ask how many days did the swelling last?		888.NA	999. NK	DSWG
6.5.7 Did s/he have swelling of joints?	1. Yes	2. No	999. NK	SWJ
6.5.7 1 *If yes*, ask how many days did the swelling last?		888.NA	999. NK	DSWJ

6.6 COUGH:

6.6.1 Did s/he have cough?	1. Yes	2. No	999. NK	COU
(If the answer is 2 or 999 proceed to Q6.6.5)				
6.6.2 How many days did s/he have cough?		888.NA	999. NK	DCO
6.6.3 Was the cough productive (sputum)?	1. Yes	2. No	888. NA	999. NK	PCO
6.6.4 Did s/he cough blood?	1. Yes	2. No	888. NA	999. NK	BCO
6.6.5 Did s/he have night sweats?	1. Yes	2. No	999. NK	NCOU
6.6.6 When was the cough worse?	1.Day	2.Night	3. Same	999. NK	COUW
6.6.7 Did s/he have shortness of breathing?	1. Yes	2. No	999. NK	DIB
If the answer is 2 or 999 proceed to Q6.7				
6.6.8 How many days did s/he have breathlessness?		888.NA	999.NK	DDB
6.6.9 Did s/he have noisy breathing?	1. Yes	2. No	999. NK	CHP

6.7 CHEST PAIN:

6.7.1 Did s/he have chest pain?	1. Yes	2. No	999. NK	CHP

(If the answer is 2 or 9 proceed to Q 6.8)

6.7.1.1 How did the pain start?	1. Suddenly	2. Gradually	999. NK	HCHP

6.7.2 Where was the pain?	Over the sternum	1. Yes	2. No	999. NK	PSTER
(Please show where the sternum is located)	Over the heart/in the arm	1. Yes	2. No	999. NK	PHEAR
	Ribs	1. Yes	2. No	999. NK	PRIBS
	Other (specify) ……	1. Yes	2. No	999. NK	POTHE

6.7.3 When resting, was the pain:	1. Continuous	2. On & Off	888. NA	999. NK	RPAIN

6.7.4 When in activity, was the pain:	1. Continuous	2. On & Off	888. NA	999. NK	APAIN

6.7.5 When s/he had an attack of severe pain, how long did it last?

	<30min	2. >30min but <24hours	3. >=24 hours	888. NA	999. NK	DCP

6.7.6 Did s/he have palpitation?	1. Yes	2. No	999. NK	PALP

6.8 DIARRHOEA:

6.8.1 Did s/he have diarrhoea?	1. Yes	2. No	999. NK	DIAR

If the answer is 2 or 999 proceed to Q6.9

6.8.2 How many days did s/he have diarrhoea?		888.NA	999.NK	DDI
6.8.3 Was the diarrhoea continuous?	1. Yes	2. No	888. NA	999. NK	TDI

6.8.4 What was the consistency of stools?	2. Soft	3.Watery	999. NK	CSDIA
6.8.5 When the diarrhoea was severe, how many times did s/he pass stool in a day?		888.NA	999. NK	FDI

6.8.6 Did s/he pass blood in the stool?	1. Yes	2. No	888. NA	999. NK	BTS

6.8.7 Did s/he have sunken eyes?	1. Yes	2. No	999. NK	SUNK

6.9 VOMITING:

6.9.1 Did s/he have vomiting?	1. Yes	2. No	999. NK	VOM

If the answer is 2 or 9 proceed to Q6.10

6.9.2 How many days did s/he have vomiting?		888. NA	999. NK	DVO
6.9.3 When the vomiting was severe, how many times did s/he vomit in a day?		888. NA	999. NK	FVO

6.9.4 What did the vomit look like?

1. Watery fluid	2. Yellowish fluid	3. Coffee coloured fluid	4. Blood	CVO
5. Faecal matters	6. Other (specify) ……..	888. NA	999. NK	

6.10 ABDOMEN:

6.10.1 Did s/he have abdominal pain?	1. Yes	2. No	999. NK	ABP

(If the answer is 2 or 9 proceed to Q6.10.6

6.10.2 What type of pain was it?

1. Cramp	2. Dull ache	3. Burning pain	4. Others	8. NA	999. NK	CAP

6.10.3 How many days did s/he have the pain		888.NA	999.NK	DAP

6.10.4 Where exactly was the pain?

1. Lower abdomen	2. Upper abdomen	3. All over the abdomen		SAP
4. Middle abdomen	5. Others (specify): ……	888.NA	999. NK	

6.10.5 What was the severity of the pain?

1. Mild/moderate	2. Severe	888. NA	999. NK	TAP

6.10.6 Was s/he unable to pass stool for some days before death?	1. Yes	2. No	999. NK	CON

6.11 ABDOMINAL DISTENSION:

6.11.1 Did s/he have distension of abdomen?	1. Yes	2. No	999. NK	ABD

If the answer is 2 or 999 proceed to Q6.12

6.11.2 How many days did s/he have abdominal distension?		888.NA	999.NK	DAD

6.11.3 Did the distension develop rapidly within days or slowly over weeks?

1. Rapid	2. Slow	888. NA	999. NK	TAD

6.12 SWALLOWING:

6.12.1 Did s/he have difficulty/pain on swallowing?	1. Yes	2. No	999. NK	DSW

If the answer is 2 or 999 proceed to Q6.13

6.12.2 How many days did s/he have difficulty/pain on swallowing?		888. NA	999.NK	DDS

6.13 MASS:

6.13.1 Did s/he have any mass in the abdomen?	1. Yes	2. No	999. NK	ABM

If the answer is 2 or 9 proceed to Q6.14

6.13.2 Where exactly was the mass?

Right upper abdomen	1. Yes	2. No	999. NK	RUAB
Left upper abdomen	1. Yes	2. No	999. NK	LUAB
Lower abdomen	1. Yes	2. No	999. NK	LWAB
Other: (specify)	1. Yes	2. No	999. NK	OTAB

6.13.3 How long (days) did s/he have the mass *(convert if months or years)*		888.NA	999.NK	DAM

6.14 HEADACHE:

6.14.1 Did s/he have headache?	1. Yes	2. No	999. NK	HEA

6.15 STIFF NECK:

6.15.1 Did s/he have neck pain?	1. Yes	2. No	999. NK	STN
6.15.2 Did s/he have stiff neck?	1. Yes	2. No	999. NK	STN
6.15.3 *If yes*, for how many days?		888.NA	999.NK	DSN

6.16 LEVEL OF CONCIOUSNESS/CNS:

6.15.1 Did s/he experience any change in the level of consciousness?	1. Yes	2. No	999. NK	STN

If 2 or 999 please skip to question 6.17

6.16.2 What was the level of his/her consciousness?

1. Confused	2. Unconscious	3. Other	888. NA	999. NK	TUC

6.16.3 If confused or unconscious, for how many days?		888.NA	999.NK	DUC

6.16.4 How did it start?

1. Suddenly	2. Rapidly within a day	3. Slowly over few days	FFI1
4. Others (specify): ……	888. NA	999. NK	

6.17 FITS:

6.17.1 Did s/he have fits?	1. Yes	2. No	999. NK	FIT

If the answer is 2 or 9 proceed to Q6.18

6.17.2 How many days did s/he have fits		888.NA	999.NK	DFI
6.17.3 When fits were most frequent, how many did s/he have per day?		888. NA	888. NA	FFIN
6.17.4 Between fits was s/he	1. Awake	2. Unconscious	888. NA	999. NK	BFA
6.17.5Did s/he have difficulty in opening the mouth during fits?	1. Able to open	2. Unable to open	999. NK	LOC

6.17.6 Did s/he have stiffness of the whole body during fits?	1. Yes	2. No	999. NK	OPI

If the answer is 2 or 999 proceed to Q6.18

6.17.7 How many days did s/he have stiffness?		888.NA	999.NK	DSTIF

6.18 PARALYSIS:

6.18.1 Did s/he have paralysis of one side of the body?	1. Yes	2. No	999. NK	HEM

6.18.2 How long did the paralysis take to develop?	1. Instantly	2. Over hours	3. Over days	HQUI
	4. Over months	5. Over years	999. NK	

6.18.3 How many days did s/he have paralysis		888.NA	999.NK	DHE
6.19 Did s/he have paralysis of lower limbs?	1. Yes	2. No	999. NK	PAR
6.19.1 How many days did s/he have the paralysis?		888.NA	999.NK	DPA

6.20 URINE COLOUR:

6.20.1 Was there any change in the colour of urine?	1. Yes	2. No	999. NK	BIU

6.20.2 What was the colour of urine?

1. Dark yellow	2. Coffee like	3. Blood stained	888. NA	999. NK	URC
6.20.3 How many days did s/he have the change in urine?			888.NA	999.NK	DBU

6.21 URINE AMOUNT:

6.21.1 Was there any change in the amount of urine s/he passed daily?	1. Yes	2. No	999. NK	CQU

6.21.2 How much urine did s/he pass in a day?

1. Too much	2. Too little	3. No urine at all	888. NA	999. NK	AQU

6.21.3 How many days did s/he have the change in amount of urine?		888 NA	999. NK	DQU
6.22 Did s/he have difficulty or pain in passing urine?	1. Yes	2. No	999. NK	DPU

6.22.1 What type of difficulty did s/he have?

1. Unable to pass urine	2. Continuous dribbling of urine		
3. Burning sensation while passing urine	4.Intense pain		TDP
5. Other (specify)	888. NA	999. NK	

7.1 SURGERY/OPERATION:

7.1.1 Did s/he have any operation before death?	1. Yes	2. No	999. NK	HOP	
7.1.2 How many days before death did s/he have the operation?		888. NA	999.NK	OPD	
7.1.3 If yes ask for the site of operation	1. Abdomen	2. Heart	3.Head	4. other	888. NA	999. NK	SSITE

NOTE: **If the deceased is a female and >50 years old proceed to Q9**

If the deceased is a male, proceed to Q9

8.0: PREGNANCY/DELIVERY:

8.1 Was she pregnant at the time of death?	1. Yes	2. No	999. NK	PRE
8.2 How many months was she pregnant?			999.NK	MPR

If not pregnant at time of death, please ask:

8.3 Did she deliver within 42 days (6 weeks) before death?	1. Yes	2. No	999. NK	DEL

If the answer is 2 or 999 proceed to Q8.15

8.4 How many days before her death, did she deliver?		999.NK	EDD
8.5 Did she have high fever during the pregnancy or after delivery (within a days/weeks before she died)	1. Yes	2. No	999. NK	FPR

8.6 Where did she deliver?	1. Hospital	2. Other health facility	3.On route to hospital or health facility	DELIV
	4: Home	5. Other (specify):……	999. NK	

8.7 Who managed the delivery when the child was born?	1.Health professional (Doctor, midwife, nurse)		2. Traditional birth attendant	WMAD
	3. Relatives	4. Mother alone	5.Other (specify) ……..	

8.8 Did she have obstructed labour?	1. Yes	2. No	999. NK	OBS

8.9 How long was she in labour?	1. <24hours	2. >=24hours	999. NK	DDE
8.10 Did she have difficulty in delivering placenta?	1.Yes	2. No	999. NK	DDE
8.11 Did she have too much bleeding before the baby was born	1. Yes	2. No	999. NK	BBEF

8.12 Did she have too much bleeding after the baby was born?

1. Yes	2. No	999. NK	BAFT

8.13 What was the mode of delivery?

1. Vaginal delivery	2. Vacuum or forceps	3. Abdominal Operation	999. NK	MDE

8.14 Was baby born alive?

1. Alive	2. Stillborn	999. NK	BALV

8.14.1 If baby born alive, ask how is the baby now?

1. Died before 7 days	2. Died after 7 days	BAFT

Healthy	Unhealthy	999. NK

8.15 Did she have an abortion before her death?

1. Yes	2. No	999. NK	ABOR

If response is 2 or 999 skip to Q 8.20

8.16 How many days before her death, did she have an abortion?		999.NK	DABO
8.17 Did she have heavy bleeding after the abortion?	1. Yes	2. No	999. NK	BLAB
8.18 Did she have high fever after the abortion?	1. Yes	2. No	999. NK	FABO
8.19 Was the abortion induced?	1. Yes	2. No	999. NK	INAB
8.20 Did she have seizures shortly before she died?	1. Yes	2. No	999. NK	SEIZ
8.21 Did she have any previous complicated delivery?	1. Yes	2. No	999. NK	PCD
8.22 Did she have any swelling or ulcer in the breast?	1. Yes	2. No	999. NK	BTU

9.0 LIFE STYLE (OPTIONAL)

9.1 ALCOHOL ABUSE

9.1.1 Did the deceased ever drink alcohol?

1. Yes	2.No	999. NK	ALC

9.1.2 If yes how long had s/he been drinking alcohol?

1.Less than a year	2. 1-5 years	3. 6-10 years.	ALCD

4. 11-15 years	5. >15 years	999. NK

9.1.3 How often did he/she drink alcohol?

1.Daily	2. Weekly	3.Fortnightly	ALCOF

4. Once in a while	999. NK

9.1.4 How often did he/she get drunk?

1.Daily	2. Weekly	3.Fortnightly	ALCDK
4. Once in a while		999. NK	

9.1.5 Which kind of alcohol did the deceased consume?

Beer	1. Yes	2.No	999. NK	BEER
Spirits	1. Yes	2.No	999. NK	SPIR
Wines	1. Yes	2.No	999. NK	WINE
Traditional brews	1. Yes	2.No	999. NK	TBRW
Traditional illicit brews ……	1. Yes	2.No	999. NK	TIBRW
Others (specify) ……	1. Yes	2.No	999. NK	OTDK

9.1.6 What was the source of the alcohol s/he drank?

Bar	1. Yes	2.No	999. NK	BAR
Brewed it himself/herself home	1. Yes	2.No	999. NK	HOM
Friends and/or relatives brews	1. Yes	2.No	999. NK	FRIE
Local traditional brewer	1. Yes	2.No	999. NK	LTRA
Others (specify) ……	1. Yes	2.No	999. NK	OTSO

9.1.7 Was the deceased ever in trouble as a result of drinking alcohol?	1. Yes	2.No	999. NK	ALCTR

9.1. 8 If yes, what kind of trouble was s/he in

Trouble with the law	1. Yes	2.No	999. NK	TLAW
Violence (domestic rape etc?)	1. Yes	2.No	999. NK	VIOL
Got ill (type of illness)	1. Yes	2.No	999. NK	ILL
Neglect of responsibility (family break-ups, job loss etc	1. Yes	2.No	999. NK	NRES
Other specify ……	1. Yes	2.No	999. NK	TOTH

9.2. CIGARETTE SMOKING

9.2.1 Did the deceased ever smoke tobacco?	1. Yes	2.No	9. NK	SMOK
9.2.2 If yes how long had s/he been smoking?	1.Less than a year	2. 1-5 years	3. 6-10 years.	DSMOK
	4. 11-15 years	5. >15 years	999. NK	
9.2.3 How often did he/she smoke?	1.Chain-smoked	*2. Hourly*	*3.Daily*	*4. Weekly*	SMOKOF
	5. Fortnightly	6**.** Once in a while	999**.** NK	
9.2.4 How much tobacco did s/he smoke per day	1.Less that 5 sticks	2. Less than 1 packet	**3.** 2-5 packets	NSMOK
	4. More than 5 packets	5. Other (specify) ……	999. NK	

9.2.5 Which type of tobacco did the deceased consume?

Filtered cigarette	1. Yes	2.No	999. NK	FILC
Unfiltered cigarette	1. Yes	2.No	999. NK	UFIL
Pipe	1. Yes	2.No	999. NK	PIPE
Cigar	1. Yes	2.No	999. NK	CIGA
Others (specify) ……	1. Yes	2.No	999. NK	OTTA

9.2.6 What was the source of the tobacco s/he smoked?

Bar	1. Yes	2.No	999. NK	CBAR
Local retailer	1. Yes	2.No	999. NK	CLOC
Homemade pipe	1. Yes	2.No	999. NK	HPIP
Friends and or /relatives	1. Yes	2.No	999. NK	CFRI
Others (specify) ……	1. Yes	2.No	999. NK	COTH

9.3. DRUG ABUSE

9.3.1 Did the deceased ever use drugs?	1. Yes	2.No	999. NK	UDRG
9.3.2 If yes how long had s/he been using drugs?	1.Less than a year	2. 1-5 years	3.6-10 years.	DDRG
	4. 11-15 years	5. >15 years	999. NK	
9.3.3 How often did he/she get high?	1.Daily	2. Weekly	3.Fortnightly	DRGOF
	4. Monthly	5. Once in a while	999. NK	

.3.4. Which type of drugs did the deceased consume?

Heroine	1. Yes	2.No	999. NK	HER
Cocaine	1. Yes	2.No	999. NK	COC
Ecstasy	1. Yes	2.No	999. NK	ECS
Marijuana	1. Yes	2.No	999. NK	MAR
LST	1. Yes	2.No	999. NK	LST
Prescription drugs*	1. Yes	2.No	999. NK	PDG
Anabolic steroids	1. Yes	2.No	999. NK	ANA
Inhalants	1. Yes	2.No	999. NK	INH
Others (specify)** ……	1. Yes	2.No	999. NK	OTD

*Specify (e.g amphetamines, hallucinogens, diazepam, phethidine, etc)……

** Specify (eg glue, correction fluid, paint thinner, etc)…….

9.3.5 Was the deceased ever in trouble as a result of taking drugs?	1. Yes	2.No	999. NK	DRGTR

9.3.6 If yes what kind of trouble was s/he in?

Trouble with the law	1. Yes	2.No	999. NK	TLAWD
Violence (domestic rape etc?)	1. Yes	2.No	999. NK	VIOLD
Got ill (type of illness)	1. Yes	2.No	999. NK	ILLD
Neglect of responsibility (family break-ups, job loss etc	1. Yes	2.No	999. NK	NRESD
Other specify ……	1. Yes	2.No	999. NK	TOTHD

10.0: TREATMENT AND RECORDS

10.1 Treatment

10.1.1 Did s/he receive any drug during the illness?	1. Yes	2.No	999. NK	TREAT
10.1.2 Did s/he receive any antibiotics during the illness?	1. Yes	2.No	999. NK	ANTIB
10.1.3. Did s/he receive any anti-malarial drug during the illness?	1. Yes	2.No	999. NK	ANTIM

10.1.4 Which anti-malarial drug did s/he receive?	1.Choroquine	2.Fansidar	3.Quinine	
	4.Other	888. NA	999. NK	ANTIM_T

10.2 Health records

Source	**Summary of details**
Death Certificate	Cause of death:
Burial permit	Cause of death:
Post-mortem results	Cause of death:
MCH Card	
Hospital prescription forms	
Treatment cards	
Hospital discharge forms	Diagnosis:
Other hospital documents	
Laboratory/cytology results	
None	Tick here if there are no treatment records

11. Interviewer's comments and observations

_____

_____

_____

Certify correct on:							**By:**		**CCB**