ANALYSIS OF CAUSES AND RISK FACTORS ASSOCIATED WITH

MATERNAL DEATHS IN NAMIBIA

A THESIS SUBMITTED IN PARTIAL FULFILMENT

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ABSTRACT

Maternal mortality is a major health concern in Namibia as it is the case in most countries. The rate at which women are dying due to pregnancy related causes is high and the cause as well as risk factors are not well explored. The main objective of this research was to identify the causes and risk factors associated with maternal mortality in Namibia and thus the study described the socio-demographic characteristics and three delays that lead to maternal deaths in Namibia. The paper also aims to propose strategies for midwifery practice, in order to prevent maternal deaths in future.

Data on health facility based review of maternal records from 13 regions in the country during the period of 2008-2012 was used. This was then complemented by the 2011 Namibia Population and Housing census data. For the health facility data, a case control study design was applied, with a total number of 154 maternal deaths included in the study as cases and 770 women of reproductive ages who fell pregnant during the study period and survived as controls. A logistic regression model was used to assess the risk factors associated with maternal deaths. For the Census data, measures of maternal mortality, such as maternal mortality ratio, maternal mortality rate, lifetime risk of maternal death, and proportion of maternal deaths among women of reproductive age were estimated.

Based on the health facility data, of the 154 maternal deaths reviewed, 58.4% were from direct maternal deaths and 41.6% were from indirect maternal deaths. Haemorrhage (37.8%), eclampsia (24.4%) and puerperal sepsis (23.3%) were the

leading causes for direct maternal deaths. About 65% of the haemorrhage cases; 64% of the eclampsia cases and 53% of the puerperal sepsis occurred to women who lived in rural areas. The predominant recognizable indirect causes were HIV (45.3%); pneumonia (23.4%) and tuberculosis (17.2%). Maternal deaths are less likely to occur to women living together with their partner than those who are not living together (OR = 0.53). Most women experienced first (51.3%) and third delays (51.9%). Only few women experienced a second delay (12.9%). However it is important to note that some women experienced more than one delay and in some cases all delays were experienced.

Using the 2011 Census data, maternal mortality ratio was 547 deaths per 100 000 live births. The highest ratio of 1954 deaths per 100,000 live births is recorded for women in the age group of 45-49 years. Maternal Mortality Ratio is also observed to be high among the teenage mothers between the age group of 15-19 years with an estimate of 421 deaths per 100,000 live births as compared to 318 deaths per 100,000 live births estimated for women aged 20-24

This analysis reinforced previous findings pointing to the fact that haemorrhage and eclampsia are the leading causes of maternal mortality in Namibia and other developing countries. This indicates the need for better obstetric care, particularly for women over thirty years of age.

TABLE OF CONTENTS

ACKNOWLEDGEMENT

DEDICATION

I dedicate this work to my son Lineekela Paulo Ndevelo who was born 2 weeks prior to my registration of this course.

DECLARATION

I, Lihongeni Ndufewa Mulama, declare hereby that this study is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree in any other institution of higher education.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ANC	Ante-natal Care
ARV	Antiretroviral
AU	African Union
BEmOC	Basic Emergency Obstetric Care
CARMMA	Campaign on Accelerated Reduction of Maternal Mortality in Africa
CEmOC	Comprehensive Emergency Obstetric Care
CIA	Central Intelligence Agency
Ci	Confidence Intervals
DHS	Demographic and Health Survey
GNP	Gross National Product
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
ICD	International Statistical Classification of Diseases and Related Health Problems

ICD-10	International Statistical Classification of Diseases and Related Health Problems, 10th revision
LFR	Lifetime Risk
MMrate	Maternal Mortality Rate
MMR	Maternal Mortality Ratio
MDG	Millennium Development Goal
MoHSS	Ministry of Health and Social Services
NDHS	Namibia Demographic and Health Survey
NSA	Namibia Statistics Agency
ORs	Odds Ratios
PMDF	Proportion of Maternal Deaths to Females of Reproductive Age
PRC	Population Resource Centre
SBA's	Skilled Birth Attendants
UN	United Nations
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund
WHO	World Health Organization

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1. Background

Among the many roles that women play in society, their reproductive role, which ensures the continuation of the human species, is of great importance. Yet, in fulfilment of this much important role, majority of women die annually from complications of pregnancy and childbirth. Globally, there has been extensive improvement in maternal health, with a decline of worldwide maternal mortality ratio (MMR) by 45% between 1990 and 2013 from an estimated 523 000 to 289 000, yielding an MMR of 210 maternal deaths per 100,000 live births (World Health Organization [WHO], 2014). Nonetheless, maternal health remains a significant problem in many countries, and overall progress still remains far short of the Millennium Development Goal (MDG) number five (5) target of reducing maternal mortality ratio by 75% by 2015. The Millennium Development Goals report has recognized that the improvement of maternal health and the decrease of maternal mortality are two of their most important targets to improve health in the developing countries (United Nations, 2012). Maternal death is usually associated with both poor health environment, serious lack of health resources and inadequate information and lack of knowledge on recognizing danger signs (Abyeji, 1998).

Maternal mortality is defined as the 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 (WHO–ICD 10). Maternal mortality represents one of the widest health gaps between developed and developing nations and it is intriguing that developing countries contribute much to this death rate.

The best way of reliably measuring maternal mortality is through a civil registration system that registers all deaths and provides medical certification of cause of death (Hill et al., 2007). However, even where such systems exist, vigilance is necessary to ensure that all maternal deaths are correctly classified. Studies have shown maternal deaths to be under-reported (Bouvier et al. 1991, Atrash et al. 1995, & Turner et al, 2002). In countries lacking complete recording of adult deaths, especially in most low-income countries, alternative approaches to estimate maternal mortality are needed. Researchers have developed a range of alternative measurement strategies. United Nations Children's Fund (UNICEF), WHO, and the United Nations Population Fund (UNFPA) have previously developed global, regional, and country estimates of maternal mortality for the years 1990, 1995, and 2000 (WHO, 2007). One of the most frequently used estimates of maternal mortality is the maternal mortality ratio. It measures obstetric risk (i.e., the risk of dying once a woman is pregnant). It therefore omits the risk of being pregnant (i.e., fertility, in a population, which is measured by the maternal mortality rate or the lifetime risk) (Ronsmans & Graham, 2006). The international definition of the maternal mortality ratio (MMR) is the number of Direct and Indirect deaths per 100,000 live births (ICD-10).

Maternal Mortality Ratio = <u>Total Maternal Deaths</u> *100,000
Total Live Birth

In many countries of the world this is difficult to measure due to the lack of death certificate data as well as a lack of basic denominator data, since baseline vital statistics are also not available or unreliable.

Sub-Saharan Africa continues to have the highest burden of maternal deaths (62% of global maternal deaths) as well as the highest proportion of maternal deaths due to HIV/AIDS (WHO, 2014). The adult life time risk of death from maternal causes in Sub-Saharan Africa is estimated at 1 in 38 compared to 1 in 3700 among women in developed countries (WHO, 2014). Globally, there is increasing evidence that reduction of maternal deaths is achievable with the timely provision of quality Emergency Obstetric Care (EmOC). The challenge therefore is to focus on improving efficient and timely delivery of emergency obstetric care. Studies have shown that most life-threatening obstetric complications cannot be predicted or prevented but can be successfully treated if prompt access to quality Emergency Obstetric services and skilled attendance are available (United Nations [UN], 2007).

In addition to maternal deaths, millions more women suffer from near death complications and long-term disabilities as a result of pregnancy-related complications which also affect the lives of numerous babies. Contributory factors include lack of access to good quality maternal and neonatal health services and strong adherence to negative cultural beliefs and practices (AbouZahr & Wardlaw, 2001; WHO, 2005b).

Maternal mortality, a largely avoidable cause of death, is an important focus of international development efforts, and a target for Millennium Development Goal (MDG) 5. Under MDG 5, a number of countries, Namibia included, are committed to reducing maternal mortality ratio by three quarters between 1990 and 2015. The link between MDGs and maternal mortality is important in identifying drivers of trends of maternal mortality and inform appropriate policy responses. A recent article published in *The Lancet* in 2010 showed that maternal mortality is declining in Africa. This is in line with UN data which shows that many African countries in fact recorded large declines in maternal mortality during 1990-2008, for example, Equatorial Guinea, Eritrea, Egypt, Morocco, Cape Verde, Tunisia, Ethiopia, Algeria, Rwanda and Mauritius all recorded more than 50 per cent reduction, and are thus close to achieving MDG five, but no African country has yet achieved the goal (UN, 2012). Despite such remarkable progress, half of the maternal deaths in the world still take place in Sub-Saharan Africa. Notably some countries have seen a reversal of initial gains. A case in point is Namibia. Cases of maternal deaths in Namibia are increasing and this is of concern for women's health.

Maternal deaths may be direct or indirect. Direct maternal deaths refer to those deaths that result from obstetric complications of the pregnant state (pregnancy, labour and pueperium) from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above, while indirect deaths are those that result from previous existing disease or diseases that developed during pregnancy but, were aggravated by physiologic effects of pregnancy e.g. deaths due to anaemia, HIV/AIDS, heart disease, diabetes etc.

The Namibian government is committed to the improvement of maternal health, as a contribution to the sustainable development of the nation. To ensure the universal health of every woman, a holistic health management, provision, and service delivery approach with multi-sectoral involvement has been adopted (MoHSS, 2009). The public health sector has made tremendous strides in ensuring that women have access to health services, with close to 95% of pregnant women receive Ante-Natal Care (ANC) from medical professionals, and 82% are attended by skilled health workers at time of delivery. With impressive figures on women attending ANC and delivering with help of medical professionals, maternal mortality rate remains high in the country. Further, with very high health facility based deliveries (85%), it can be postulated that the majority of these deaths take place in health facilities.

The extent to which risk factors and causes that lead to cases of maternal deaths has remained largely unexplained, especially in Namibia. Hence, this study will provide a better understanding of risk factors critical at explaining variations in maternal mortality, thus crucial for informing policies and implementation of public health interventions aimed at reducing maternal mortality and improving women health.

1.2 Problem Statement

Maternal mortality is one of the most sensitive indicators of the health disparity between richer and poorer nations. The lifetime risk of dying due to maternal causes is about one (1) in six (6) in the poorest countries, compared with about one (1) in 30,000 in Northern Europe (Ronsmans & Graham, 2006). Almost every month a

woman dies due to pregnancy related complications in Namibia. These cases of maternal deaths are frequently reported in the media. Namibia's maternal mortality ratio has increased from 271 deaths in 2000 to 449 deaths per 100,000 live births in 2006 as reported by the 2006-07 Namibia Demographic and Health Survey (NDHS) report and the Central Intelligence Agency (CIA) world fact book has recorded a slight decline from 449 reported in 2006 to 200/l00, 000 live births in 2010, but still unacceptably high. Namibia's target is to reduce maternal mortality to 86 deaths per 100,000 by 2015. According to the 2nd Millennium Development Goals report of Namibia released in 2008; the target of reducing maternal mortality is reported unlikely to be achieved by 2015. The African Union (AU) followed through with the launch of the Campaign on Accelerated Reduction of Maternal Mortality in Africa (CARMMA). The campaign aims to save the lives of mothers and new-born and is active in about 20 African countries, including Namibia. In an effort to reduce maternal mortality, the Ministry of Health and Social Services has adopted a road map for accelerating the reduction of maternal and neonatal morbidity and mortality, which was launched in February 2010 (MoHSS, 2010b). The road map has a life span of five years, which covers the period of 2010-2014. Despite all these initiatives in place, maternal mortality continues to be a serious problem in Namibia as it is reducing at a slower pace than is expected. The MMR statistics of Namibia are illustrated in Figure 1. This scenario has raised concern among the nation, policy makers and programme implementers. Critical towards accelerating the reduction of maternal mortality is to identify causes and risk factors associated with this problem.

Figure 1: Maternal Mortality Ratio trend in Namibia per 100 000 live births by year
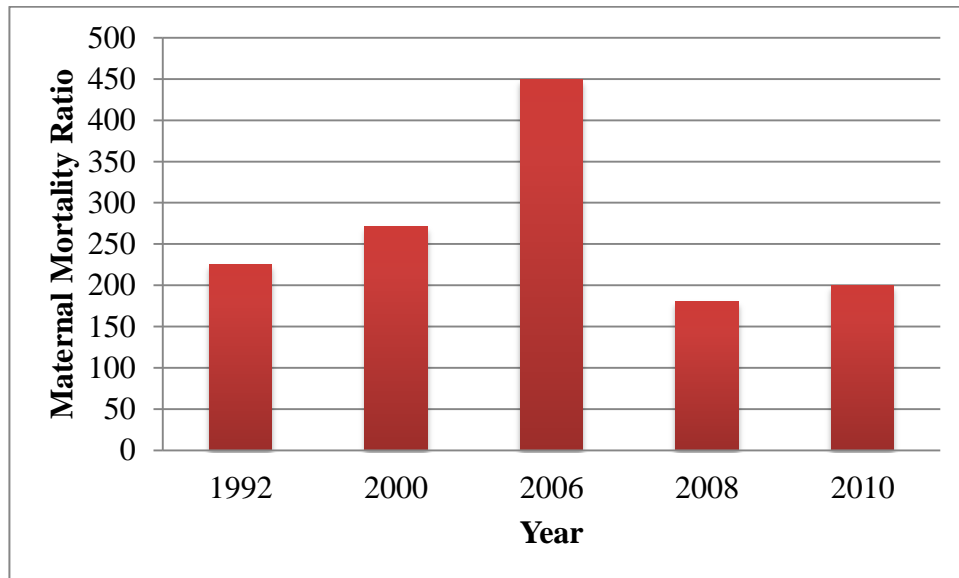
Source: NDHS and World Bank data

1.3 Research Objectives

The main objective of the study was to examine causes and factors associated with maternal deaths in Namibia. This objective was achieved by addressing the following research questions:

- What are the main causes of maternal deaths in Namibia?

- What are the risk factors associated with maternal deaths among Namibian women of reproductive age 15-49?

- Are there geographical differences of maternal deaths in Namibia?

1.4 Significance of the study

Issues related to maternal mortality have generated a lot of empirical and theoretical information. However, despite the amount of work published on the topic as well as policies and initiatives being adopted in an effort to reduce maternal deaths, it

continues to occur at high rates and solutions to the problem are still not clear. In Namibia the main source of maternal mortality estimates are Demographic and Health Surveys; however these only present the level of maternal mortality but not the causes and risk factors. This study is therefore unique as it attempts to combine information on maternal deaths recorded from facility based review conducted in 13 regions of the country during the 2008-2012 periods, complimented by the 2011 Namibia Population and Housing Census data. This will provide insights for evidence-based health policies and programmes aiming to reduce maternal deaths in Namibia.

1.5 Organisation of Chapters

This thesis document contains six (6) chapters of which the first chapter is giving the introductory part of the research which includes: background information, statement of the research problem, research questions, and the significance of this study. The second chapter on the other hand, is giving out the literature review, which is what other researchers and book authors have done on topics similar to the current study, as well as the guiding conceptual frameworks that guided the study. The third chapter consist of methodology in which elaboration on how the study was carried out is outlined, it contains the type of research design used for this study, the types of data sources used in the study, as well as an elaboration on the types of data analysis procedures or models and types of variables being used to obtain the results presented in this paper. The fourth chapter presents the results of the study. The fifth chapter presents the discussions based on the results that the study found and how similar or different are the findings from that of other researchers. The sixth and last chapter consists of conclusion and recommendations made based on the results that the study found.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

This chapter gives an overview of level of maternal deaths in developing and developed countries. It also highlights causes and risk factors associated with maternal deaths following the conceptual framework developed for other countries.

2.2. Maternal Mortality Situation in Developed Countries

Maternal mortality, of all health indicators, exhibits the greatest disparity between the developed and developing world. The maternal death occurring in developed countries indicates that, it could be avoided if proper health resources and services were available to women in developing nations (PRC, 2006). The tragedy and opportunity is that most of these deaths can be prevented with cost-effective health care services. Health care programs to improve maternal health must be supported by strong policies, adequate training of health care providers and logistical services that facilitate the provision of those programs. Once maternal and neonatal programs and policies are in place, all women and girls must be ensured equal access to the full range of services (Policy Project, 2003).

The example of a country doing well in managing maternal deaths is that of Japan. In 1950, Japan had a maternal mortality ratio of around 180 deaths per 100, 000 live births and this was drastically reduced to 50 deaths per 100,000 live births in 1970,

and by 2004/5 Japan was among the countries with the lowest maternal mortality in the world with its maternal mortality ratio of 6 deaths per 100,000 live births (Graham, 2008). This tremendous success was due to a host of factors such as; access to family planning, universal access to skilled care at delivery and timely access to emergency obstetric care for all women with complications.

With 99% of maternal deaths occurring in developing countries, it is too often assumed that maternal mortality is not a problem in wealthier countries. Yet, statistics released in September of 2010 by the United Nations place the United States 50th in the world for maternal mortality, with maternal mortality ratios higher than almost all European countries, as well as several countries in Asia and the Middle East, estimated at 21 deaths per 100,000 live births in 2010 (WHO, 2010).

While developed countries have made enormous progress in bringing down the huge death rates associated with pregnancy, women in developing countries continue to face very high risks of death and disability as a result of pregnancy. This depicts that, maternal mortality is a universal problem, thus no country is spared by it, but the variation between developing and developed countries is an indication that maternal mortality can be prevented/ controlled if its causes and risk factors are known and addressed.

2.3. Maternal Mortality Situation in Developing Countries

Global maternal mortality statistics reflect the widening gap between the developed and developing countries. Maternal mortality has been recognised as a public health

problem in developing countries, as evidenced by an increasing magnitude and significance of the problem (Boema, 1987). Pregnancy complications are a primary source of maternal and child morbidity and mortality. A large proportion of maternal and neonatal deaths occur during the first 48 hours after delivery. Thus, postnatal care is important, as it treats complications arising from the delivery and provides the mother with information on how to care for herself and her child. Therefore, it is recommended that all women receive a check-up within two days of delivery (NDHS 2006-07). Obstetric complications continue to represent the major cause among women of childbearing age, far ahead of tuberculosis, suicide, sexually transmitted diseases, or AIDS (WHO, 2005b).

Women and girls, if not dead, suffer from disabilities caused by complications during pregnancy and childbirth each year. Maternal deaths in developing countries are a major public health problem. Various programs have been proposed to reduce this human cost, involving a multitude of interventions to deal with the life-threatening conditions related to pregnancy and delivery at different stages (Bulatao & Ross, 2001).

Even though maternal mortality is still high in developing countries, efforts are put in place and these have helped countries to reduce maternal mortality, increase deliveries attended by skilled health workers and increasing access to contraceptives. In Rwanda, maternal mortality ratio has dropped from 750 in 2005 to 383 in 2010, during the same period; the country has increased deliveries attended by skilled health workers from 38% to 63.5 % (UNFPA, 2010)

2.4. Maternal Mortality Situation in Africa

Maternal health is still a serious concern for most of African countries. The continent's average maternal mortality ratio was 590 deaths per 100,000 live births in 2008 (UN, 2012). Of the 529 000 deaths due to pregnancy or childbirth complications that occur each year worldwide, 95% are in Africa and Asia alone. In the Sub-Sahara Africa where fertility is quite high, estimated at 5.1 births per woman in 2005–10 (UN, 2011), which is more than double the replacement level, the lifetime risk of dying from maternal causes is about 1 in 16 which contrasts sharply with a risk of 1 in 2,800 for women from the developed world (African Population and Research Center, 2002). In Niger, women have a 1 in 7 life time risk of dying from a pregnancy related complication, significantly higher, for example, in comparison to Ireland where it is 1 in 48,000 (WHO, 2008).

Maternal mortality figures vary widely by source and are highly contentious, estimates for Ghana suggest that roughly between 1,400 and 3,900 women and girls die each year due to pregnancy-related complications, with an additional 28,000 to 117,000 women and girls suffers from disabilities caused by complications during pregnancy and childbirth. Even though it is a matter of concern, some African countries have recorded a large decline in maternal mortality during 1990-2008, but none of the African countries has achieved MDG 5 yet.

According to the MDG report of 2012, most of these countries greatly improved the proportion of women giving birth with skilled attendant. They did this mainly through policy interventions that focused on improving access through means, such

as transport to referral health institutions, increased information about contraceptives and better supply of health attendants.

According to the 2013 estimates made by the World Health Organisation, UNICEF, UNFPA and the World Bank, the Sub-Sahara Africa has the highest maternal mortality rate as compared to other regions, as shown in figure 2.

Figure 2: 2013 estimates on MMR for the four regions
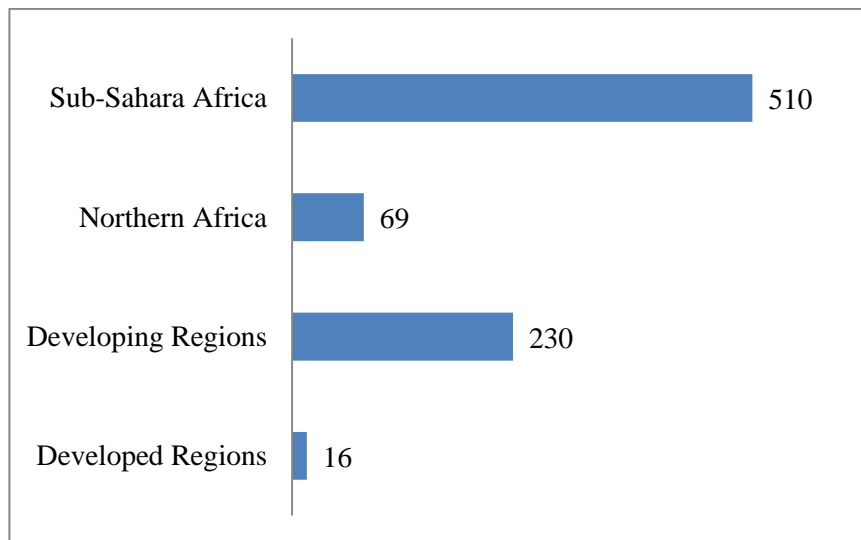
Data source: WHO, UNICEF, UNFPA and the World Bank (2013)

Maternal haemorrhage, obstructed labour, postpartum sepsis, eclampsia, unsafe abortion and anaemia are among the leading causes of deaths among pregnant women in developing countries. These complications of pregnancy contribute significantly to the high levels of maternal and neonatal mortality in Sub-Saharan Africa.

Regarding MMR trends, five countries (Botswana, Lesotho, Namibia, South Africa and Swaziland) in Southern Africa had increased MMR from 1990 to 2000, partly as attributed to HIV epidemic. This was confirmed by a study conducted by Gillian et

al. (2008) in Malawi, which recorded HIV/AIDS as a factor contributing to maternal deaths in that country, with the highest HIV prevalence rate of 23.0% for urban adult as compared to 12.4% in rural areas.

The Namibia's Millennium Development Goals third report produced in August 2010 reiterates the issues surrounding maternal health (Namibia, 2010). Although the coverage of antenatal care, delivery by skilled attendance, and contraceptive prevalence rates have all improved in the last decade, the increase in the maternal mortality rate − even if largely attributable to HIV − is worrisome and demands significant and timely investment. Lack of good antenatal care, delivery and postpartum care, maternal malnutrition and anemia, high parity and septic abortion were also reported by researchers as contributing significantly to the high rate of maternal mortality in many African countries (Namibia, 2010).

2.5. Maternal Mortality Situation in Namibia

While vital registration is still to improve in Namibia, the Population and Housing Censuses and Demographic and Health Surveys are the primary sources of data of mortality levels and trends in the country. Most cases of deaths that happen in the population are not registered and thus missed when one is doing mortality related studies. According to the Namibia Statistics Agency (2014), out of the 22,668 deaths reported during the 2001 census, 11.5 percent of these deaths were not registered.

Pregnancy-related deaths are among the top 5 causes of deaths in Namibia (NSA, 2014). During the 2001 Census, a total of 375 pregnancy related deaths were

recorded in Namibia, of these, 54.9 percent of deaths happened to women aged 25-39 years. The most recently available World Health Organization (WHO) estimates of the maternal mortality ratio (MMR) for Namibia, in 2010 is estimated at 200 maternal deaths per 100,000 live births, placing Namibia in the category of moderate MMR countries (defined as MMR between 100 - 200/100 000 live births). This represents a decline from estimates in recent years. According to WHO estimates, Namibia's MMR peaked in 2005 at 310 maternal deaths/100 000 live births. Data from the Namibian Demographic and Health Survey (NDHS) in 2006 – 2007 produced even higher estimates of 449 maternal deaths/100 000 live births, a significant increase from the prior 2000 DHS report of 271 deaths/100 000 live births (MoHSS, 2008). Since independence in 1990, Namibia has introduced various programmes to address the health needs of women and children. The Safe Motherhood Initiative was introduced in Namibia in 1991 and the Roadmap for the acceleration of the reduction in maternal and child deaths was introduced in 2006 (MoHSS, 2007; MoHSS, 2010b).

Namibia has a fertility rate of 3.9 children per woman, which is a decline from 6.1 births per women in 1991 and 4.1 children per woman in 2001. Though fertility rate at a national level is decreasing, in rural areas, the rate has remained constant since 2001 at 4.6, which is even higher than the national level. The majority of births were recorded among women aged 20-24 years. Alongside the high fertility rate in rural areas, the likelihood of dying from a pregnancy-related condition is far high than in urban areas.

With a high Fertility rate and MMR in a country, a national survey conducted in Namibia in 2004 in order to assess the availability of basic and emergency obstetric care, found that Namibia has only four facilities offering all eight signal functions that meet the WHO standard for Comprehensive Emergency Obstetric Care (CEmOC) facilities. There were no Basic Emergency Obstetric Care (BEmOC) facilities in Namibia and most obstetric emergency services are performed at CEmoC facilities (MoHSS, 2010b). In 2006 -07, more than 70% of births were assisted by Skilled Birth Attendants (SBA's), and more than 10% of babies were delivered by caesarean section. More than 20% of caesarean section deliveries were in urban areas, while in rural areas this number is only 7% (and this is where most babies are being born), this is mainly due to lack of CEmOC facilities and staff such as aesthetics (MoHSS, 2008). The NDHS of 2006/2007 indicates that 65% of Namibian mothers received a postnatal check-up within two days for her last live birth. Of these, most women had their check-up within four hours after birth. Coverage of ARV prophylaxis was less than 10%. Considering that 18.8% of pregnant women are HIV positive, the ARV coverage is rather low.

Namibia is one among a number of Sub-Saharan African countries in which the HIV epidemic has had an enormous impact on maternal health and maternal deaths. In 2010, WHO estimated that 59.4% of maternal deaths in Namibia were attributable to HIV/AIDS, and the 2014 National HIV Sentinel Survey concluded that 16.9% of pregnant women in Namibia were HIV-positive (MoHSS, 2014). This represents a significant contribution to the increased MMR of the last decade.

Studies done in Tanzania, Malawi and South Africa have also found HIV to be the leading indirect cause of maternal deaths (Kongnyuy et al., 2009; Urassa et al., 1995). As antiretroviral (ARV) drugs become increasingly available, maternal deaths due to HIV/AIDS is expected to significantly decline. Over the 1990 – 2010 period, however, the progress towards reduction of the national MMR was only 2% overall (average annual reduction of 0.1%), making Namibia one of 14 Sub-Saharan countries designated as having made insufficient progress towards MDG#5 and it is said to be unlikely to be met by the year 2015. Other important maternal health statistics include WHO's 2010 estimate of the lifetime risk of maternal death in Namibia (1:160) and the proportion of maternal deaths to females of reproductive age (PMDF) which is at (3%).

2.6. Causes of Maternal Deaths

Causes of maternal deaths are numerous and vary from one place to another depending on factors prevailing. The main direct causes of maternal death in developing countries include haemorrhage, sepsis, obstructed labour and hypertensive disorders (Khan et al., 2006). The risk of death from haemorrhage is one (1) in 1,000 deliveries in developing countries, compared with one (1) in 100,000 in developed countries, and accounts for one third of the maternal deaths in Africa (Zimmerman et al., 2012). A study in Canada found increased risk of eclampsia among women with existing heart disease and anaemia as the leading direct cause of maternal deaths (Liu et al., 2011). A retrospective study undertaken at a tertiary hospital in Nigeria in 2007 found that the most common risk factors for maternal mortality were, haemorrhage, anaemia, eclampsia and malaria (Yakasai &

Gaya, 2011). Risk factors for complications arising from infections include delivery under unhygienic conditions, poor nutrition, anaemia, caesarean section, membrane rupture, prolonged labour, retained products and haemorrhage (van Eijk et al., 2008). A research conducted by Ramos et al. (2007) in Argentina found that the most common causes of maternal death were abortion complications, haemorrhage, sepsis and hypertensive disorders.

In Malawi, according to Kongnyuy et al. (2009), the leading causes of maternal deaths in that country are postpartum haemorrhage, postpartum sepsis, and HIV/AIDS, accounting for direct and indirect maternal causes respectively. This was supported by a study carried out by Namibia's Ministry of Health and Social services (2010a) where the leading cause of maternal death was HIV/AIDS, however, most women died as a result of direct causes (56.7%). Other causes like ruptured uterus, complications of abortion, anaemia, and ante-partum haemorrhage were also present though they did not contribute to a larger proportion.

However, this was not the case in Ethiopia, where a study conducted by Herpassa and Dwivedi (2008) in Ambo hospital, found uterine rupture as the underlying cause of haemorrhage, while obstructive labour and unsafe abortions were the underlying causes of sepsis. Ruptured uterus served as the major cause and sepsis was the second most common cause of maternal deaths. These causes of maternal deaths were different with respect to region, rural-urban and age. Other studies conducted in Senegal, Guinea Bissau and Nigeria showed that the leading causes of maternal

deaths among women of reproductive age 21-23 were puerperal sepsis, haemorrhage, eclampsia and abortion complications.

Severe anaemia is believed to be an important cause of maternal death in developing countries, although much of the evidence is circumstantial (Lindsay, 1997). Mild anaemia in pregnancy may go unnoticed, but the potential adverse effects of pregnancy increase as haemoglobin levels fall. Very severe anaemia with haemoglobin levels of less than 4 g/dL can lead to heart failure and death from shock (Royston & Armstrong, 1989). It has also been suggested that anaemic mothers are less able to tolerate blood loss during childbirth, although this has never been empirically verified (Rush, 2000). Severe anaemia in pregnancy has been reported as the main cause of 8–23% of maternal deaths in some hospitals and 11–16% in community-based studies (Shulman et al., 1999; MacLoed & Rhode, 1998; Boerma & Mati, 1989).

2.7. Risk Factors of Maternal Mortality

This study recognised the complexity and interlinking nature of the many different factors which can prevent women and girls from being able to access high quality maternal care. The delay model by Thaddeus and Maine is a conceptual framework that has been used to assess factors contributing to maternal mortality in developing countries. This framework attributes mortality to certain determinants that contribute to the delay in deciding to seek care, the delay in reaching a health facility, and the delay in receiving quality care upon reaching a health facility. According to Maine

and Thaddeus (1994), from the onset of obstetric complication to the outcome, there are multiple factors that interfere with the chances of a woman getting rapid quality treatment, which are called delay factors. With the three delays, there are different underlying issues which influence the decision making and thus the reason for delays. The reasons for the first delay may be late recognition of the problem, fear of the hospital or the costs or lack of an available decision maker. The second delay is usually caused by difficulty in transport and the third delay is often due to difficulty in getting blood supplies, equipment and operation theatre (UNFPA, 2003). Low socio-economic status of women, illiteracy and residing in the rural areas may be the main factors responsible for delays in receiving care during delivery (UNFPA, 2003). The model has organised these three delays into three phases as outlined in Figure 3.

Figure 3: Three delay model of maternal mortality (Maine & Thaddeus, 1994).
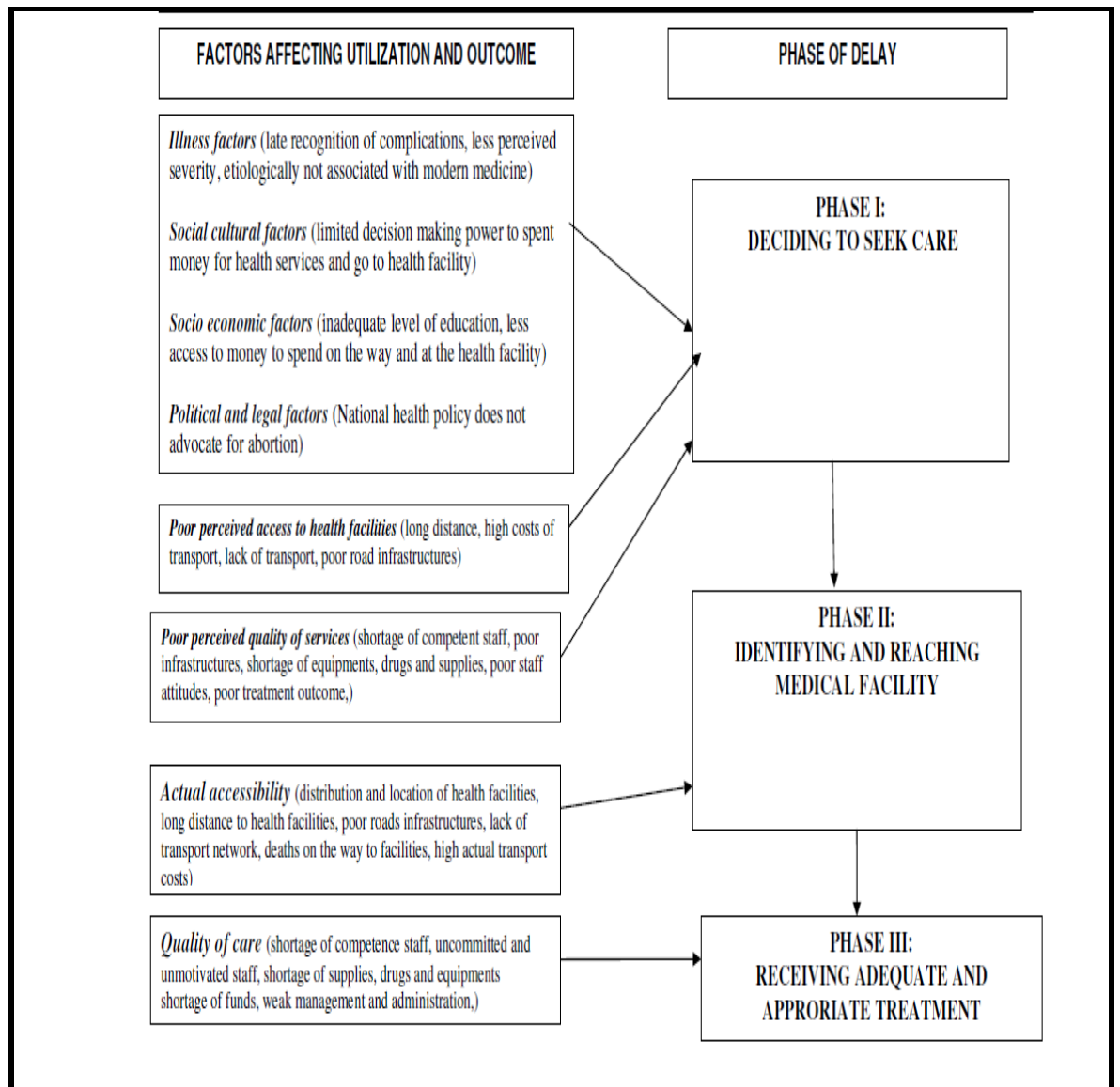
Many individual and socioeconomic factors have been associated with high maternal mortality. These include; lack of education, parity, previous obstetric history, employment, socioeconomic status, and types of care seeking behaviors during pregnancy. The burden of maternal mortality frequently falls on the rural poor who have many hurdles to overcome to access timely care: lack of transport infrastructure, distance to health facilities, misinformation on available services, lack

of basic services, perceived negative attitude of health providers, lack of means to pay for transport or the services at the health centers and sometimes due to reliance on traditional measures (Kongnyuy et al., 2009). Communication to the outside world is sometimes limited to those families that are living in far remote areas where telecommunication signals are not available, and this contributes to the delay of getting transport on time and most women will deliver in the presence of female relatives and in few cases with traditional birth attendants, and most of these women are only taken to health facilities when complications occur (Warren & Mekbib, 2009).

Delay due to illness factors is influenced by insufficient knowledge and awareness on obstetric danger signs. In Southern Tanzania, it was found that the proportion of women with skilled care at delivery increased with knowledge of danger signs (Mpembeni et al., 2007). The increase was significant and it ranged from 39% among women who didn't know any danger signs to 68% among those who knew four or more signs (P<0.05).

Perception of poor quality care in health facilities is another discouragement to seek delivery services. Poor attitudes of health staff, unavailability of skilled staff, poor health infrastructures and amenities that prevent privacy and confidentiality, lack of drugs, supplies and equipment are among issues that can create negative incentives from seeking care. In Nepal, a study conducted to show the influence of staff attitudes on utilization of professional midwifery care documented that improved

staff attitudes to clients contributed to increased utilization of services (Clapham et al., 2008).

The place where a woman delivered the baby as well as the distance to the health facility can also influence the risk of maternal deaths. A study done in Ethiopia by Samuel and Habtamu (2004) found out that the risk of maternal mortality was between 8-16 times high among women attending the hospital from outside the town where the hospital was situated compared to those who live in town. A study done in Argentina showed that place of delivery can divulge the disparity between the death of a woman outside and within health facility as it is an underlying factor for place of death (Ramos et al., 2007).

Educational level of a woman is found to be a powerful influence when it comes to women health; it is observed that women who went up to secondary school level delay their time to fall pregnant, they mostly too have few children, having access to health information and private doctors and these reduce their risk of dying due to maternal related causes compared to their counterparts with low level of education. This was supported by a study carried out in Ghana; which found out that, 61.4% of the deceased had up to primary and middle school education as compared to 8% of those with tertiary education (Alida, 2011). It is also presumed that women with higher education may have some awareness about the effect of illness and treatment; and they may have higher demand for contraceptives, prenatal care and a higher likelihood to have a partner with high education. A study in Tanzania found that low level of spouse's education was a risk factor for maternal mortality (Mpembeni et al.,

2007). Both Okonofau et al. (1992) and Chowdhury et al. (2007) found that increases in education reduce the risk of dying due to maternal mortality.

Lack of knowledge regarding the need for skilled attendants is a barrier to women seeking care, especially during birth emergencies. A survey conducted in Kenya in 2006 showed that 15% of pregnant women were not informed of the importance of hospital deliveries (Mutis et al., 2008). In Nigeria, a cross-sectional survey revealed that, the most common risk factors for maternal death were prim-gravidity (19%), and unbooked status (19%) (Ozumba & Nwongu-Ikojo, 2008).

Marital status was found to be a risk factor for maternal deaths as well, a study conducted in rural Tanzania by Evance (2010) found out that unmarried women were 150% more likely to experience maternal deaths compared to women who had ever been married, and the researcher have attributed this low risk of married women, to quick decisions made by their spouses in seeking for health services on time.

The number of times a woman had given birth; also tends to increase the risk of dying due to maternal cause. This was confirmed by a study conducted by Kalu and Hika in 2004 in Adama hospital in Ethiopia, were they found a positive relationship between maternal death and parity, especially in the presence of pathogenic factors. Women who had at least four live births experienced twice the risk of maternal death as compared to their counterparts of parity 1-3. This is expected since increased exposure to childbearing would invariably increase the risk of haemorrhage, obstructed labour and infections, and these factors elevate the risk of maternal death.

Short and long birth intervals are known to adversely affect infant and child mortality, and short birth intervals in particular can impede maternal nutrition repletion in low-income settings. The effect of the length of time between pregnancies and their outcomes on subsequent maternal and child morbidity and mortality warrant accurate and full understanding. There is limited consensus on the optimal length of a birth interval associated with lower risk of child death. The observed effects of birth spacing themselves can be decomposed and attributed to several key underlying behaviors and conditions, i.e., breastfeeding, sexual abstinence, contraceptive practice, maternal nutrition, physical exertion, and infections. Collectively these impact fetal growth, safe delivery and subsequent maternal and child mortality risk (Ahmed et al., 2012). In this same study, Ahmed et al. (2012) found that contraceptive use is efficient for the primary prevention of maternal mortality in developing countries by about 44%. The use of contraceptives reduces unwanted pregnancies, lower rates of abortion, decreases the rate of baby dumping and reduces the risk of premature deaths. Those are some of the benefits and roles of family planning in improving maternal health (MoHSS, 2009).

Risk factors differ from country to country, and depend on the types of data sources and variables used in the study. In Senegal, the factors related to the functioning of the health system were identified, where Garenne et al. (2008) found out that, the failure of the medical equipment had a very high odds ratio (OR=55.5), as well as the absence of qualified personnel at time of admission (OR=6.6). Similarly, late referral

(24 hours or more after onset of symptoms) appeared as a major risk factor (OR=16.9).

Poverty has also been associated with adverse maternal outcomes, not directly, but as a contributor to maternal ability to access and utilize care where complications occur (Fillipi et al. 2006., Harding et al. 2008). This is irrespective of sociocultural and demographic aspects of women, with the poor women using fewer services than the rich (Kone-Pefoyo & Rivard, 2006). According to a study from Nigeria, 80% of mothers who died in relation to pregnancy belonged to the lower socio-economic class (Obi et al., 2001). This was also the case as a study from Sub- Saharan Africa showed a strong negative association between maternal mortality and Gross National Product (GNP) per capita as well as health expenditure per capita (Buor & Bream, 2004).

2.8. Estimation of causes and risk factors associated with maternal mortality

In most developing countries, vital registration of medically-certified births and deaths is non-existent or incomplete, and validity or feasibility of other purely records-based approaches is questionable. A reproductive age mortality study (RAMOS) uses multiple sources such as records from hospital, police, public-health department and vital data registries to identify and investigate the cause of deaths for each woman of reproductive age in a defined population

The RAMOS approach is considered to be the most complete estimation of maternal mortality, but it can be complex, because information regarding the number of births must come from separate sources (Graham et al. 1989).

Many maternal mortality surveys, such as the sisterhood method typically measure pregnancy-related deaths as maternal deaths, since the cause of death is not elicited in such surveys. Maternal mortality estimates from the sisterhood method have been useful in situations in which there is no other reliable measurement of the level of maternal mortality and limited resources hinder other approaches for measuring maternal deaths. But, it has many limitations. It is for this reason; this study opted to explore case-control study to measure maternal mortality.

The use of other methods such as a longitudinal approach to investigate the causes of maternal mortality could be ideal, but that requires large and lengthy studies to give adequate statistical power, considering time limitation of this study, that approach was not feasible. An alternative which avoids this difficulty was the case-control design. The use of cases and controls permits estimation of odds ratios (but not of attributable risks).

Retrospective studies with case-control design were often used for these types of studies, and they had more than one dataset used in their studies. That was due to unavailability of comprehensive data. Studies carried out in Ethiopia, Kenya and Nigeria was hospital-based with more than one dataset complimenting each other to do statistical estimates. Doing a comprehensive assessment of maternal deaths in Argentina, Silvina et al (2007), used a paired case–control study design to evaluate risk factors associated with maternal deaths. Cases were women aged 10–49 years who had died from causes associated with pregnancy in public institutions during

2002; and they have also used additional cases from 2001 to obtain the required sample size.

It is evident from the literature that maternal mortality is a social problem, and its causes vary from place to place, there was no study done on the causes and risk factors contributing to the increasing rate of maternal mortality in Namibia. In order to develop, implement and evaluate policy, understanding of why women are dying from pregnancy complications is more important than waiting to establish the level of maternal mortality. It is with this reason that, this paper reports on the causes of maternal deaths in all districts and referral hospitals, assess risk factors and determine underlying contributory factors to maternal deaths in Namibia. The paper also aims to propose strategies for midwifery practice in order to prevent maternal deaths.

CHAPTER 3

METHODOLOGY

3.1. Research Design

This study used a case-control study design. A case-control study is a type of study that compares a group who experienced the outcome of interest, referred to as cases (in this study is women who died due to maternal cause), compared with those women who did not experience the outcome of interest (maternal death), here referred to as controls (women of reproductive age who gave birth during the study period and survived). This is a retrospective study to compare how frequently the exposure to a risk factor is present in each group to determine the relationship between the risk factor and maternal death. The study analyzed the causes and various risk factors of maternal deaths in Namibia using secondary data, obtained from facility based review data from the Ministry of Health and Social Services for the period of 2008-2012. The data is then complemented with the 2011 Namibia's Population and Housing Census data, where we obtained the controls, and was also used to estimate the levels of maternal mortality in Namibia. The study also synthesized the available operational and academic research findings through a review of published literature from both international and national sources.

3.2 Data Source

3.2.1 Data

The main data sources for this study are the Facility-based review of maternal deaths in Public hospitals in Namibia and the 2011 Population and Housing Census. For facility-based review data, all public health facilities providing maternity care services were expected to complete a process of maternal death review within seven days of maternal death, with the review carried out by the health workers involved at the institution where the death occurred. Each maternal death was entered on a confidential maternal death review form, which was given a unique number and maintained at the institution for review as well as reviewed by a Regional Maternal and Peri/Neonatal Death review committee within one month of the death. Data collectors reviewed all maternal deaths recorded in each of the facilities during the period under retrospective study (January 1, 2008 – June 30, 2012) and collected pertinent data from the confidential maternal death review form as well as other supporting clinical documentation (e.g. case notes, operating theatre registers, death records). Data collectors cross-checked the maternal death records with additional institutional death registers from the given time period. Death registers, outpatient and inpatient registers, death notification books and other hospital records such as, nurses and doctors' reports, post mortem records and operating theatre records pertaining to deaths of all women of child-bearing age were reviewed to determine the cause of deaths. Causes of maternal deaths were classified as direct or indirect and attempt was also made to determine levels of delay according to the three delay model in which the first delay is in deciding to seek professional care, second delay

is identifying and reaching an appropriate health facility and the third delay is receiving adequate and appropriate treatment at the facility.

Census data is considered to provide more reliable data about maternal mortality, especially at sub-national level to estimate the level of maternal mortality in the country. In an effort to supplement the facility-based data on maternal deaths, the researchers also used the Namibia Population and Housing Census data for 2011 to estimate some important demographic measures of maternal mortality i.e. Maternal Mortality Ratio/ Rate, proportion of deaths due to maternal causes as well as the lifetime risk of women dying due to maternal causes by age group, region as well as by the women's place of residence. The census data was collected at household level with the actual enumeration exercise undertaken over a period of three weeks from 28 August to 15 September 2011. The basic information on each household member (demographic characteristics of each person such as age and sex, relationship, etc,) was recorded. The information used in this study was obtained from the causes of deaths as recorded during the census period where a further question on classification was also asked to find out if the women died while she was pregnant, during child birth or within 2 months after child birth. During the 2011 Population Census, a total 375 deaths were classified as maternal-related deaths. Data cleaning was performed on the data set, to filter out cases that are out of the target population, at the end, a total of 332 maternal deaths were used in this study from the 2011 census data.

3.2.2. Target Population

The target populations for this study are women of child bearing age 15-49, who had died during the 2008-2012 study period. A total of 154 maternal deaths identified

from the audit were considered as cases. Controls were selected from women of child-bearing age who survived during the same study period. Controls were selected based on region, age and place of residence as matching variables. Controls were selected randomly by region depending on the number of cases per region. Each case had 5 controls (1:5). The total number of controls selected through this random procedure is 770 and this brought the total number of women in this study at 924. Table 1, presents the distribution of cases and controls by region used in the study.

Table 1: Distribution of cases and control by Region

Region	Number of maternal deaths (Cases)	Number of Allocated Controls
Caprivi	11	55
Kavango	17	85
Kunene	3	15
Ohangwena	20	100
Omusati	15	75
Oshana	13	65
Oshikoto	11	55
Otjozondjupa	7	35
Karas	6	30
Hardap	5	25
Omaheke	4	20
Erongo	8	40
Khomas	34	170
TOTAL	**154**	**770**

The risk factors for the case-control analysis were classified to include women's socio-economic indicators such as education, marital status, employment and biological factors such as age, gravidity and obstetric history. For those factors which were time-dependent such as age, marital status or pregnancy-related, the data used

for the cases and controls were those reported at the time of the fatal pregnancy and death.

3.3. Method of Analysis

The data was analysed using Statistical Package for Social Sciences (SPSS) software. Descriptive, bivariate and multivariate analyses were carried out to determine the association between variables of interest and maternal death. The Univariate analysis results is presented using frequency tables and graphs in summarizing risk factors and main causes of deaths. Using the data, the risk of maternal mortality was estimated by fitting the fixed effect logistic regression model and unadjusted odds ratio (OR) and confidence intervals (CI) were estimated. Significant variables in the regression model were identified using stepwise selection criterion at a 0.05 level of significance. Possible interactions were fitted and tested for significance. The goodness of fit of the fitted model was evaluated by the chi-squared test for the overall model. Three delays leading to deaths of women were also identified and analysed by region and place of residence.

The outcome variable of the study was maternal deaths- these were the deaths that occurred to women of reproductive age 15-49 years during pregnancy, delivery or up to forty two days after delivery. This was coded as binary 0 and 1 with women who experienced maternal deaths being coded as 1 (cases) and those who survived as 0 (controls). This outcome was explained by exposure variables such as: maternal age groups (years), education level, marital status, occupation and place of residence. Table 2 gives an overview of these explanatory variables.

Table 2: Description of explanatory variables used in the analysis

Variable	Description
Maternal Age Groups	(15-19) = 1 (20-24) = 2,(25-29) =3, (30-34) = 4, (35-39) =5, (40-44)= 6, (45-49) =7
Education Level	no formal schooling = 0, primary education = 1, Secondary and higher education =2
Marital Status	Not living together with partner = 0, Living together with partner = 1
Occupation	Unemployed = 0, Employed = 1
Place of Residence	Rural = 0, Urban = 1

To estimate the net effect of these variables on the risk of maternal mortality, the logistic regression model was employed. The outcome of interest in our model was whether a woman of reproductive age 15 − 49 who had fallen pregnant during the reference period died or survived. The log-odds of maternal death are expressed as a linear function of the predictor variables as follows:

$$ln\ (Pi\ /1\text{-}\ Pi) = \beta0 + \beta1Xi1 + \beta2Xi2+\ldots+ \beta kXik\ ,$$

Where, *Pi* is the chance of the *ith* woman dying due to maternal cause, 1 − *Pi* is the chance of the *ith* woman not dying due to maternal cause. The quantity *(Pi /1- Pi)* is the odds of the *ith* woman dying due to maternal cause, and *X1, X2, X3…* represent predictor variables. The *ß0, ß1, ß2, . . . ßk* are unknown regression parameters associated with the predictor variables, and are to be estimated using the data.

The census data was used to estimate the following measures of maternal mortality: maternal mortality ratio, maternal mortality rate, lifetime risk of maternal death, and proportion of maternal deaths among women of reproductive age and these were the formulas used for estimation.

Maternal mortality ratio (MMRatio): the ratio of the number of maternal deaths during the 2011 census period per 100,000 live births during the same time-period.

$$MMRatio = \frac{Number\ of\ maternal\ deaths}{Number\ of\ live\ births} * 100,000$$

The ratio measures the risk of death a woman faces with each pregnancy. This measure may overestimate obstetric risk by excluding from the denominator pregnancies that do not terminate in a live birth, but that may be responsible for a maternal death.

Maternal mortality rate (MMRate): the number of maternal deaths in a population divided by the number of women of reproductive age, per 1,000 women.

$$MMRate = \frac{Number\ of\ maternal\ deaths}{Number\ of\ women\ aged\ 15\text{-}49} * 1000$$

The rate measures the risks to women, whether or not they are pregnant. While the MMRate provides an indication of the risk of maternal death in the adult female population, it conceals the effect of differing levels of fertility in cross-country comparisons (WHO, 2013).

Proportion of maternal deaths among deaths of women of reproductive age (PM): the number of maternal deaths in 2011 divided by the total deaths among women aged 15–49 years.

$$PM = \frac{Number\ of\ maternal\ deaths}{Number\ of\ deaths\ among\ women\ 15\text{-}49}$$

The lifetime risk of maternal death (LTR) reflects the chances of a woman dying from maternal causes over the course of her 35-year reproductive life span. This

indicator takes into account the probability of a death due to maternal causes each time a woman becomes pregnant.

$$LTR = 35 * MMRate$$

Calculating the probability of a woman to die due to maternal cause during the 5 year period, which is the age group interval, this indicator was calculated as follows:

$$LTR = 5*MMRate \text{ for that age group}$$

Although the three indicators of maternal mortality are calculated, the analysis against the background variables will be based on maternal mortality ratio.

3.4. Research Ethics

A letter was written to the Permanent Secretary of Ministry of Health and Social Services to request permission to make use of the data, which was granted in June 2013. Data collected during the research period is treated with confidentiality and anonymity and only used for the purpose of this research.

CHAPTER 4

RESULTS

4.1. Introduction

Facility-based records may underestimate or overestimate the actual level of maternal mortality in the general population, depending on the characteristics of women admitted and the quality of available records. However, the estimates may, at least provide an idea of the magnitude of the problem in the country. It is on this basis that population surveys are often used to estimate maternal mortality. This chapter presents results of the study for both two data sets used.

4.2. Levels of maternal mortality

A total of 375 maternal deaths were recorded during the 2011 Population and Housing Census, of which 332 deaths were used in this study. The highest deaths were being recorded in Kavango and Ohangwena regions with 60 and 59 deaths, respectively. The least number of maternal deaths were recorded in Karas and Hardap regions with 2 and 6 deaths recorded, respectively. A total number of 60650 live births during the last 12 months prior to census were recorded.

The majority of maternal deaths recorded during the 2011 Census happened during deliveries with 35.5% of deaths occurred during birth, 34.3% of maternal deaths occurred within 2 months after child birth, while 27.4% of deaths occurred during pregnancy.

Table 3 presents the Maternal Mortality Ratio by age groups. The results show a common trend of high maternal mortality in the age groups 20–24, 25–29, and 30–34 in which 61% of the deaths reported occurred in those age categories. Namibia's maternal mortality ratio is estimated at 547 deaths per 100 000 live births, this Ratio increase by age of women. The highest ratio of 1954 deaths per 100,000 live births is recorded for women in the age group of 45-49 years. Maternal Mortality Ratio is also observed to be high among the teenage mothers between the age group of 15-19 years with an estimate of 421 deaths per 100,000 live births as compared to 318 deaths per 100,000 live births estimated for women aged 20-24.

Table 3: Distribution of Maternal Mortality Ratio by Age group in Namibia 2011

Age Grouped	Number Of Women	Number of women deaths during 2011	Number of deaths due to maternal cause	Number of live births in the last 12 months of 2011by maternal age group	MMRatio (per 100,000 live births)	MMRate (per 1,000 women)	Proportion of Deaths due to Maternal Causes	Lifetime Risk of Maternal Death (per 1,000 women)
15-19	120922	576	32	7593	421	0.26	0.06	1.3
20-24	108359	917	53	16655	318	0.49	0.06	2.4
25-29	89761	1232	68	14296	476	0.76	0.06	3.8
30-34	74995	1591	84	11017	762	1.12	0.05	5.6
35-39	63463	1487	54	7237	746	0.85	0.04	4.3
40-44	50529	1320	24	2982	805	0.47	0.02	2.4
45-49	42607	1140	17	870	1954	0.4	0.01	2.0
TOTAL	550636	8263	332	60650	547	0.6	0.04	21.1

Since the need of information at regional level is very important, the regional structure of maternal mortality ratio was assessed. Regional disparities can be observed in terms of maternal mortality ratios as shown in Figure 4. The highest maternal mortality ratio were recorded in Omaheke 1076/ 100 000 live births, Ohangwena 784/ 100 000 live births, Kavango 763/ 100 000 live births and Kunene 684/ 100 000 live births.   The lowest maternal mortality ratios were recorded in Karas 97/ 100 000 live births, Khomas 236/ 100 000 live births, Hardap 283/ 100 000 live births and Erongo 319/ 100 000 live births.

Figure 4: Distribution of Namibia's Maternal Mortality Ratio by Regions
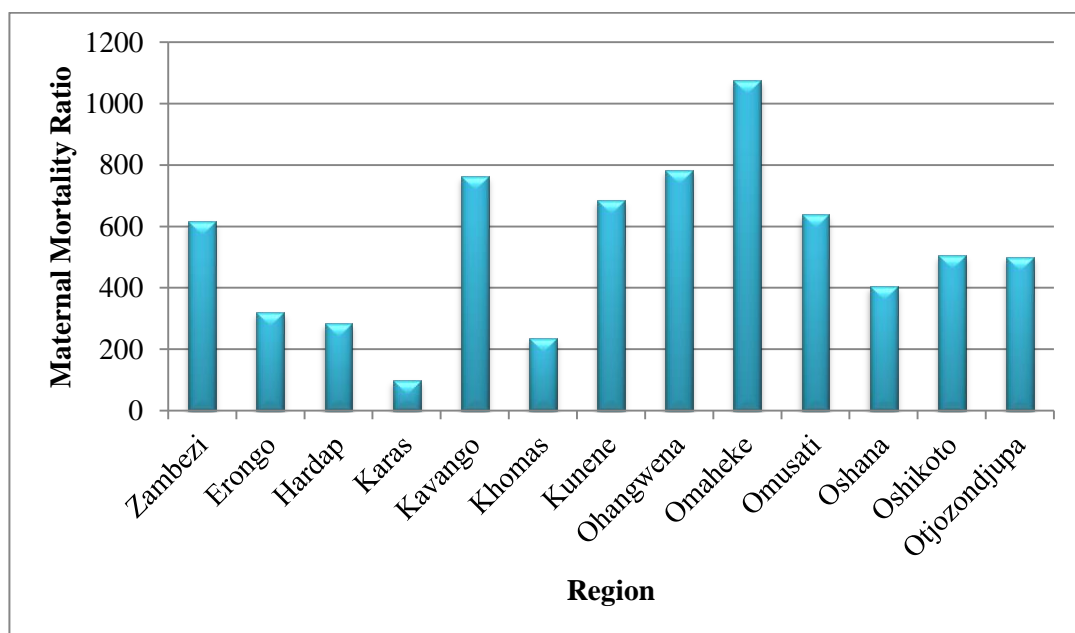
With respect to a woman's place of residence, the results indicated that of the 326 women who died due to maternal cause, 103 of them lived in urban areas, and this number has doubled to 223 deaths of those who live in rural areas. The estimate of maternal mortality ratio at the level of place of residence found out that, the ratio was high at rural areas, standing at 636 deaths/ 100 000 live births which is higher than

that at the national level, which is estimated to be at 547 deaths/ 100 000 live births. Maternal mortality ratio in urban areas was lower compared to those of women in rural areas, standing at 381 deaths / 100 000 live births.

4.3. Causes of maternal mortality

The proportion of maternal deaths increases with education level, whereby 40.3% of maternal deaths occurred to women with secondary or higher education. Of the 154 maternal deaths reviewed, 58.4% were from direct maternal deaths and 41.6% were from indirect maternal deaths. Out of 154 maternal deaths, 96 women delivered their babies, of which, 67 delivered naturally while 29 delivered through cesarean section. Among these deliveries 17.7% were delivered at home, while 83.3% of the deliveries happened at the health facilities.

Table 4 illustrates the clinical causes of direct and indirect maternal deaths in Namibia. Haemorrhage (37.8%), eclampsia (24.4%) and puerperal sepsis (23.3%) were the leading causes of direct maternal deaths. About 65% of the haemorrhage cases; 64% of the eclampsia cases and 53% of the puerperal sepsis occurred to women who lived in rural areas

Table 4: Frequency distribution of causes of maternal deaths

Clinical cause	N	%
Direct Maternal cause	**90**	**58.4**
Post-partum haemorrhage	26	28.9
Antepartum haemorrhage	8	8.9
Eclampsia	10	11.1
Pre-Eclampsia	12	13.3
Puerperal sepsis	21	23.3
Abortion	5	5.6
Obstructed labour	6	6.7
Indirect maternal cause	**64**	**41.6**
HIV	29	45.3
Tuberculosis	11	17.2
Pneumonia	15	23.4

The predominant recognizable indirect causes were HIV (45.3%); pneumonia (23.4%) and tuberculosis (17.2%). Women who live in rural areas were more likely to experience a maternal death due to pneumonia (60%) as compared to those in urban areas. Most women who died due to HIV were aged between 30-39 years (75.9%) while maternal deaths due to eclampsia were most common among the younger women (15-29 years).

4.4. Risk factors for maternal deaths

Table 5 shows the distribution, unadjusted ORs and their 95% CIs for selected "background" characteristics among 154 maternal deaths (cases) and 770 surviving women (controls). Woman's maternal age, her marital status and place of residence showed statistically increased risk. The maximum and minimum risk of maternal deaths was observed for women younger than 25 years (OR= 1.85; (CI=1.05, 3.28))

and those aged 40 and above (OR =0.09; (CI =0.03, 0.21)) respectively, as compared to women aged 25-39 years.

Table 5: Background factors, unadjusted odds ratio (OR) and 95% confidence intervals (CI) maternal cases

Background factors	Cases n=154	Controls n=770	OR	95% C.I	
Age					
15-24	34	54	1.85**	(1.05	3.28)
25-39 (ref)	111	411	1.00		
40+	9	305	0.09**	(0.03	0.21)
Marital status					
Not living together (ref)	82	347	1.00		
Living together	55	423	0.57**	(0.36	0.88)
Highest education					
No formal education (ref)	10	130	1.00		
Primary education	58	297	3.21**	(1.38	7.50)
Secondary or higher	62	335	2.35*	(1.01	5.47)
Place of residence					
Rural (ref)	91	418	1.00		
Urban	47	352	0.52**	(0.33	0.81)

 * $P < 0.05$
** $P < 0.01$

The results also show that maternal deaths are less likely to occur to women living together with their partner than those who are not living together (OR = 0.57). Women who were not living together with their partners had a significantly high risk of maternal mortality as compared to those living together with partners.

There is also evidence that women in urban areas are less likely to experience a maternal death than those in rural areas (OR =0.52).

With regard to education level of a woman, the results revealed a somewhat different pattern. Although education level has been shown to be positively associated with maternal mortality, there is evidence that women with some level of education become hesitant to be proactive in responding to pregnancy complications. In addition, the high prevalence of literacy among cases and controls results in minimal disparities on maternal deaths between those with some level of education and those with no formal education.

4.5. Contributing factors to maternal deaths

The reasons that women die in pregnancy and during childbirth are many layered. Behind the medical causes are logistic causes, failure in health care system, lack of transport etc., and behind these are social, cultural and political factors which together determine the status of women, their health, fertility and health-seeking behavior (Bedi, Kambo & Ihilion, 2001). Social and cultural factors determine whether or not women visit health care facilities, and these often lead to certain delays and elevate the risk of a woman. In this study, most women experienced first (51.3%) and third delays (51.9%). Only few women experienced a second delay (12.9%) as illustrated in Table 6. However, it is important to note that some women experienced more than one delay and in some cases all delays were experienced. Regional differentials in delays experienced were observed, with women from Oshana, Kavango and Khomas regions experiencing the highest of all three delays. It is important to note that women in Kavango region are more likely to experience a second delay compared to any other region and those in Khomas are more likely to

experience a third delay. Women from Kunene and Omaheke regions have reported the lowest level of all the delays.

Further analysis was also done, that showed that age was not significantly associated to a delay experienced. With respect to education level of a woman and her place of residence the results indicated that of the 79 women who experienced the first delay, 41% had primary education and 35.4% had secondary education. About 68% of women who experienced the first delay live in rural areas, and 75% and 61% of them experienced the second and third delays, respectively. For those who live in urban areas, their experience with all delays is far below compared to those in rural areas, with those in urban areas recording the highest of 27.8% women experienced the third delay.

About 46% of women who experienced a second delay delivered at home and 95% of those who experienced a third delay delivered at hospital. Furthermore, 30% of women who experienced a third delay delivered through caesarian section.

Table 6: Distribution of delay experienced by background characteristics of deceased

	First Delay (N=79)		p-value	Second Delay (N=20)		p-value	Third Delay (N=80)		p-value
Region			0.016			0.003			0.036
Caprivi	7	8.9		0	0		8	10	
Erongo	4	5.1		1	0.5		2	2.5	
Hardap	4	5.1		0	0		1	1.2	
Karas	2	2.5		0	0		2	2.5	
Kavango	11	13.9		8	40		13	16.2	
Khomas	10	12.7		3	15		17	21.2	
Kunene	1	1.3		0	0		1	1.2	
Ohangwena	9	11.4		2	10		3	3.8	
Omaheke	2	2.5		0	0		1	1.2	
Omusati	7	8.9		1	5		5	6.5	
Oshana	13	16.5		3	15		15	18.8	
Oshikoto	9	11.4		1	5		5	6.2	
Otjozondjupa	0	0		1	5		7	8.8	
Place of residence			0.095			0.046			0.727
Rural	54	68.4		15	75		49	61.3	
Urban	22	27.8		5	25		22	27.5	
Education level			0.031			0.015			0.003
No formal education	9	11.3		0	0		5	6.25	
Primary education	33	41.7		10	50		32	40	
Secondary education	28	35.4		8	40		27	33.8	
Higher education	0	0		0	0		4	5	

Some of the reasons cited among women who experienced the first delays were; deceased did not attend antenatal care, the deceased delivered at home and waited for the traditional birth attendant to remove the placenta, while others were trying to induce abortion using herbs. Another issue that is associated with maternal mortality is the lack of access to skilled medical care during childbirth and the distance of traveling to the nearest clinic to receive proper care. The nearest clinic may not provide decent care because of the lack of qualified staff and equipment in those

remote areas. The reasons cited for those who experience the second delay are the hospitals being kilometres away, bad roads with lack of transport and facility fare. For the third delay, some of the cited reasons were nurses being too slow to attend to a patient, failure to manage postpartum bleeding, delay for operation due to lack of adequate medical equipment and wrong diagnosis.

CHAPTER 5

DISCUSSIONS

The level of maternal mortality in Namibia has shown age disparities. The study found a high maternal mortality in the age groups 20–24, 25–29, and 30–34, when combined, they make up 61% of the deaths reported. These findings agreed with that of Ujah et al. (2005) during their seventeen- year review of maternal mortality in North-Central Nigeria, they found that the greatest risk of maternal death was among early teenagers and older women with maternal mortality ratio of 573 and 2325 among women age less 15-19 and 40-49, respectively. Blanc, Winfrey and Ross (2013) also found an increase in the risk of maternal mortality with age, they found that "the maternal mortality ratio starts low and rises steeply and non-linearly after age 30, the MMR curve becomes progressively steeper as age advances. The ratio starts just above 400, dips to 319 among women age 20–24, and then rises to 1351 in the oldest age group. The risk for women age 15–19 is approximately 28 percent higher than for women age 20–24".

The lifetime risks of dying due to maternal deaths between age groups is highest among women of 30-34 years with nearly 6 women per 1000 women in that age category are at the risk. Surprisingly, women aged 15-19 years were at low lifetime risk of dying due to maternal deaths with 1.3 per 1000 women in that age category. In terms of live births, women in the age group 20-24, 25-29 and 30-34 have contributed the highest number of live births in the last 12 months, with both

recorded over 10 000 live births. The least number of live births in the last 12 months was recorded in the age category 45-49 years with 870 live births.

Regional disparities can be associated with many different factors such as the distance to health facilities, cultural beliefs and types of services offered at such health facilities. These results are expected, due to the fact that rural areas in Namibia have the highest fertility rate compared to urban areas, and in most cases there is a long distance to the nearest health facility which is also not well equipped. Knowledge/skill of individuals seemed to be a major factor for remote areas, since most of these deaths happened in rural areas where people have least knowledge on antenatal care and sometimes have to travel long distances to reach to the nearest health facility and this may pose delivery-related risks.

On place of residence, the study observed that rural areas have a high maternal mortality ratio compared to urban areas. The distributions of maternal deaths by place of residence found in this study are similar to that of other researchers from other countries. A study done in Southern India by Bhatia (1997) found out that 867 maternal deaths happened in rural areas compared to 206 in urban areas, and 52.5% of these deaths happened to women aged 29 years and younger. In rural areas of Northern Nigeria, maternal mortality situation is referred to be one of the worst in the world (Doctor, Findley & Afenyudu, 2012) and largely these deaths are due to poor health systems, low utilization of skilled antenatal care, and preference for home deliveries (Doctor et al, 2011). In Viet Nam, a study conducted by WHO (2005a), found that, 80.7% of maternal deaths were in rural areas and 19.3% in urban areas.

These causes of deaths are consistent with those reported from studies of other developing countries, with haemorrhage being the leading cause, followed by eclampsia and puerperal sepsis. These findings agreed with those of Lindros and Lukkainen (2004) who found that haemorrhage, sepsis, toxaemia and complications from abortion account for 62% of maternal deaths in Nigeria. A study by Evance (2010) also found out that, the main causes of maternal. Deaths in Tanzania were haemorrhage (28%), eclampsia (19% and puerperal sepsis (8%). Rizvi et al (2004) in Ireland found that to reduce massive postpartum haemorrhage, we need to revise practice guideline, disseminate them to staff and finally conduct practical skills training. Overall, nearly 60% of maternal deaths in our study were due to direct causes.

The study confirmed that HIV is the leading indirect cause of maternal deaths in the region. Other studies in Tanzania, Malawi and South Africa also found HIV to be the leading cause of indirect cause of maternal deaths (Sebitloane &Mhalanga, 2008; & Kongnyuy et al, 2009).

Other than explaining the causes of maternal mortality, the study also estimated the effect of individual level covariates. Woman's maternal age, her marital status and place of residence, were found to be risk factors associated with maternal mortality. Mbizvo et al. (1993) similarly argued that women who are not living together with their partners had a significantly higher risk of maternal mortality as compared to those living as married. These findings also agreed with Evance (2010) who

observed that women who had ever been married were found to be 51% less likely to experience a maternal death compared to those women who had never been married.

Women in rural areas had a very high chance of dying due to maternal cause. This can be attributed to many factors such as; the distance to health facility, distance to public transport, that are major delays for rural women in comparison to their urban counter parts. The difference between urban and rural areas can be attributed to the distance that women in rural areas have to travel to the nearest health facility compared to those in urban areas and thus majority experiencing the second delay of identifying and reaching at medical facility. According to 2009/10 Namibia Household Income and Expenditure Survey (NHIES), 52 percent of urban households travel shorter distance, 1 kilometer or less compared to 14 percent of rural households, while some regions recorded more than 50 percent of household travelling for more than 6 kilometers to the nearest health facility. In addition, 99.6 percent of households in urban areas live within 5 kilometers from public transportation, compared to 66 percent of rural households.

Other researchers such as Ujah et al. (2005) noted a correlation between education level and maternal death, about 70% of all maternal deaths occurred in women who were illiterate, the higher a woman's education level, the less likely that she would die during child birth. This was also the case in Ethiopia, where Warren and Mekbib (2009) found that, out of the 17 verbal autopsies, most of the women (n=12) who died had not attended school at all. The results of this study revealed a rather a different pattern, as there were minimal differences between those with education

and those with no education. This result is unexpected, because women who complete secondary education are more likely to delay pregnancy, receive prenatal and post natal care and have their birth attended to by qualified medical personnel. Therefore, we suggest that other social dynamics play a more important role than education in our study.

Findings on causes and risk factors of maternal deaths in Namibia agree with most studies done in Africa and elsewhere. A study conducted in Nigeria by Olopade and Lawoyin, (2008) found that obstetric haemorrhage and sepsis together accounted for almost 47.6% of all maternal deaths in Nigeria during their study period. This is also the situation in Japan, according to Nagayak, et al. (2000) haemorrhage was the most common cause of maternal death.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1. Conclusion

The analysis shows that there are socio-economic disparities with respects to maternal mortality in Namibia. It is evident that women in Namibia do seek maternal health care services although not at an appropriate time. However, even those who manage to reach to the health facilities, they neither receive quality maternal health care services nor prompt maternal health care services and hence the majority of women died as a result of direct maternal death causes. We need to work towards preventative causes of maternal deaths during childbirth, for instance bleeding during labour is a case that can be dealt with and prevent death. Diseases like HIV, Tuberculosis and Pneumonia incidences are major indirect causes of maternal mortality. These points out the importance of providing support to pregnant women in communities in rural areas with high incidence of HIV and Tuberculosis.

The burden of maternal mortality can be reduced if we prevent the direct causes that are easily avoidable with good obstetric care. The high proportion of haemorrhage should be addressed especially postpartum haemorrhage which is unpredictable and more dangerous if a woman is anemic. This loss of blood can easily lead to death, therefore prompt and appropriate life saving measures need to be in place, which should include proper management of the third stage of labour, universal availability of safe blood for transfusion and proper medical facilities with skilled staffs to minimize third delays.

Most maternal deaths are avoidable, as the health-care solutions to prevent or manage complications are known. All women need is access to antenatal care in pregnancy, skilled care during childbirth, and care and support in the weeks after childbirth. It is particularly important that all births are attended by skilled health professionals, as timely management and treatment can make the difference between life and death.

The study had a number of limitations due to the data use. This study used secondary data which was collected from two different data sources. These data were collected at different time periods and were collected to serve different purposes other than the purpose of this study. Therefore, this led to the study using limited number of variables that were available from the two data sets.

6.2. Recommendations

The study identified a range of socio demographic, clinical and health system factors as possible contributors to maternal deaths in Namibia. Hence, it is recommended that, the care needs of HIV-positive pregnant women should be addressed to assure compliance with Highly Active Antiretroviral Therapy (HAART), safe and respectful childbirth practices for women living with HIV/AIDS. Reviewing and discussing cases is an important step to improve future care-giving. Effective maternal audits are associated with improved quality of care and reduction of severe adverse outcomes. Thus, clinical audits are rewarding for both patients and providers. To achieve substantial reductions in maternal mortality levels, work must be done on these specific risk factors. Regional variations in terms of delays are important, and thus call for the implementation of health care strategies according to

regional specific risk factors of maternal deaths. These interventions need to target the most vulnerable rural populations and poor people, which is essential if substantial progress is to be achieved by year 2030. Further research is needed in order to understand other possible contributors, such as those found in the community, and factors associated with quality of care.

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