ENVIRONMENTAL DETERMINANTS OF MATERNAL MORBIDITY AND MORTALITY IN BONDO DISTRICT, KENYA

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DECLARATION

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

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DEDICATION

This research work is dedicated to my last born child Carey Francis Ochieng. I survived complications of pregnancy and delivery, a result which inspired this research.

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ABBREVIATIONS AND ACRONYMS

AIDS	: Acquired Immune Deficiency Syndrome
CBD	: Community Based Distributors
C B H W	: Community Based Health Workers
CBS	: Central Bureau of Statistics
E O C	: Essential Obstetric Care
EMoC	: Emergency Obstetric Care.
HIV	: Human Immunodeficiency Virus
ICPD	: International Conference on Population and Development
IMR	: Infant Mortality Rate
IPPF	: International Planned Parenthood Federation
KDHS	: Kenya Demographic and Health Survey
KEPIM	: Kenya Participatory Impact Monitoring
KNH	: Kenyatta National Hospital
MCH	: Maternal and Child Health
MMR	: Maternal Mortality Rate
MOH	: Ministry of Health
RTI	: Reproductive Tract Infections
NPEP	: National Poverty Eradication Plan
PSRI	: Population Studies and Research Institute
STD	: Sexually Transmitted Disease
UK	: United Kingdom
UN	: United Nations
UNDP	: United Nations Development Programme
UNFPA	: United Nations Fund for Population Activities.

UNICEF : United Nations Children's Education Fund.

WHO : World Health Organization

DEFINITION OF TERMS AND CONCEPTS

Environment: Refers to the surrounding area of a given physical or geographical point or place within which human beings dwell.

Maternal Mortality (WHO, 1987): The death of a woman while pregnant or within 42 days of termination of pregnancy from any cause related to, or aggravated by, the pregnancy or its management but not from accidental or incidental causes.

Maternal Mortality Rate: The number of deaths due to puerperal causes per 10,000 or 100,000 live births. The number of births is employed as an approximation to the number of women exposed to the risk of dying from puerperal causes. This is a widely used cause specific mortality rate representing approximately the risk of dying as a result of complications of pregnancy, childbirth and the puerperium.

Reproductive morbidity: Refers to any morbidity or dysfunction of the reproductive tract, or any morbidity, which is as a consequence of reproductive behaviour including pregnancy, abortion, childbirth, or sexual behaviour morbidities, which may include those of a psychological nature (WHO, 1989)

Live Birth: The complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy, which, after such separation, breathes or shows any other evidence of life such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached. Each product of such a birth is considered live born (WHO, 1972).

ABSTRACT

The evident disparities in maternal morbidity and mortality between developed and developing countries are of concern. These stem from the fact that developed countries have achieved very low rates of 9 maternal deaths per 100,000 live births, while developing countries have very high rates of 900 maternal deaths per 100,000 live births. In the developing world, 533,000 women lose their lives as a result of complications of pregnancy and delivery, unlike the developed world where there are only 6,000 deaths. The persistence of high maternal mortality ratios in developing countries despite the Safe Motherhood Initiative and efforts by the Inter Agency Group has led to prioritisation of maternal mortality reduction one of the UN's Millennium Development Goals. In Kenya, the maternal mortality ratios between different regions have displayed similar disparities with some regions in Central and Rift Valley Provinces having very low rates while some regions in the Coast, Western and Nyanza Provinces have very high rates, hence the problem of the study. The choice of Bondo District was based on the fact that the District is in one of the regions with a high maternal mortality rate of 620 deaths per 100,000 live births and a high number of health problems. The main objectives of the study were to estimate the maternal morbidity and mortality rates for Bondo District; determine environmental factors that impact on maternal morbidity and mortality; ascertain the extent to which each of these factors impacts on these phenomena in the District; and to assess progress made towards lowering maternal mortality rate in the District. The literature review covered several issues perceived to impact on maternal morbidity and mortality. The perspectives were founded on population theories, such as the demographic transition theory. This was followed by a review of maternal morbidity and mortality studies conducted worldwide. The Mosley and Chen's conceptual model (1984) of factors affecting mortality was adapted for this study. The methodology addressed the study site, the study design, methods of data analysis and their limitations. The study was conducted in five divisions of the District. A random sample of 50 enumeration areas was drawn from a total of 686 enumeration areas in the District. From each of the enumeration areas, 20 households were systematically sampled in proportion to the size of each enumeration area. From each household, a female of reproductive age 15-49 was selected for interview. A total of 1,000 female respondents were thus selected. Descriptive statistics and logistic regression analysis were applied in data analysis, using the statistical package for social sciences (SPSS). Common morbidities were malaria, during pregnancy and fever in postpartum period, while the least illness suffered was sexually transmitted disease (STD). The maternal mortality rate for the District was estimated at 477 deaths per 100,000 live births. The logistic regression analysis showed that environmental factors such as demographic attributes of age, socio-economic attributes of occupation, income and health attributes of family planning increased risks of maternal morbidity. The study confirmed increased risk of haemorrhage during pregnancy among women aged 35-39, increased risks of postpartum haemorrhage in the age group 25-29 and 30-34, but reduced risks of haemorrhage in pregnancy among low income. Age was also found to be a risk in some maternal morbidity areas such as cough, anaemia, and fever. The study recommends mandatory delivery in health facilities and attendance of postpartum care. It also recommends empowerment of women economically and educationally as a means to better healthcare. The study emphasizes the need for further study on causes of postpartum haemorrhage in adolescents and the link between the injectible and Norplant methods of contraception and anaemia

CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

The magnitude of loss of life as a result of maternal mortality and the health problems women suffer as a result of pregnancy and childbirth especially in developing countries is of concern. More than half a million women die worldwide from complications of pregnancy and childbirth every year. Many of these deaths (99%) occur in the developing world. The discrepancy between the developing and developed countries for the maternal mortality ratios is higher than for any other public health indicator monitored by the World Health Organization. The relevant global statistics released jointly by UNFPA, WHO, UNICEF and WORLD BANK, in October 2005, exhibits a wide disparity between developed and developing regions as summarised in Table 1.1. For instance, developed regions account for only 960 maternal deaths, whereas developing regions account for a whopping 533,000 maternal deaths! The maternal mortality ratios are more telling: the developed regions have maternal mortality ratio of 9 maternal deaths per 100,000 live births, whereas the developing regions have maternal mortality ratios of 450 deaths per 100,000 live births. Sub Saharan Africa has the highest maternal mortality ratio of 900 maternal deaths per 100,000 live births.

In addition, more than 10 million women suffer debilitating illnesses and lifelong disabilities worldwide (World Health Report 2005) as a consequence of pregnancy and childbirth. Again, more than 90 percent of these women are in developing countries. About 75 % of maternal deaths occur during childbirth and post-partum period (UNICEF, 2008). Most of these deaths are due to five direct causes. These are

haemorrhage, sepsis, unsafe abortion, obstructed labour and hypertensive disease of pregnancy. The vast majority of maternal deaths are avoidable when women have access to vital healthcare before, during and after childbirth.

The maternal mortality ratio has been declining globally at an insignificant rate of less than 1%. The total number of women dying in pregnancy or child birth has also shown a modest decrease between 1990 and 2005. In 2005 a total of 536,000 women died of maternal causes compared to 576,000 in 1990 (UNFPA, UNICEF, WHO and WORLD BANK, 2005). In the developed countries, the maternal mortality ratios and absolute numbers remained static between 1990 and 2005 suggesting diminished levels of maternal mortality. According to UNICEF (2009), near universal access to skilled care during delivery and emergency obstetric care when necessary have contributed to these diminished levels. In the developed countries, skilled attendance at birth is 98 percent. In some developing regions excluding sub Saharan Africa, both the absolute numbers of maternal deaths and maternal mortality ratios declined between 1990 and 2005. South Eastern Asia has made a substantial improvement by reducing the maternal mortality ratio from 450 maternal deaths per 100,000 live births in 1990 to 300 per 100,000 in 2005 and the absolute numbers from 56,000 to 35,000. On the contrary, in sub Saharan Africa, maternal mortality ratios remained high over the same period. A moderate decline in maternal mortality ratio was made from 920 per 100,000 in 1990 to 900 per 100,000 live births in 2005. This insignificant progress is particularly worrying since the region exhibits the highest maternal mortality ratios as well as life time risk of death (Table 1.1).

Table 1.1: Estimates of MMR, Number of Maternal Deaths, Lifetime Risk, and Range of Uncertainty by United Nations MDG Regions, 2005

Region	MMR(maternal deaths per 100,000 live births)	Number of maternal deaths	Lifetime risk of maternal death:1 in:	Range of uncertainty on MMR estimates	
				Lower estimate	Upper estimate
WORLD TOTAL	400	536,000	92	220	650
Developed Regions	9	960	7,300	8	17
Countries of the Commonwealth States(CIS)	51	1,800	1,200	28	140
Developing Regions	450	533,000	75	240	730
Africa	820	276,000	26	410	1,400
North Africa	160	5,700	210	85	290
Sub-Saharan Africa	900	270,000	22	450	1,500
Asia	330	241,000	120	190	520
Eastern Asia	50	9,200	1,200	31	80
South Asia	490	188,000	61	290	750
South-Eastern Asia	300	35,000	130	160	550
Western Asia	160	8,300	170	62	340
Latin America and the Caribbean	130	15,000	290	81	230
Oceania	430	890	62	120	1,200

Source: UNFPA, WHO, UNICEF AND WORLD BANK, OCTOBER 2005.

The persistence of high maternal mortality especially in sub Saharan Africa, despite intervention programmes put in place through Safe Motherhood Initiative and the Inter-Agency Group, calls for urgency in the development of new approaches to tackling the issue. The toll resulting from maternal deaths triggered the pledge by United Nations in September 2000 to reduce maternal mortality by 75% by the year 2015 as its Fifth Millenium Development Goal.

Various modes of intervention and varied approaches currently in place, and designed to reduce incidents of maternal morbidity and mortality are: increased use of family

planning methods, increased prenatal care, delivery in a health facility, delivery by trained birth attendants. The most favoured strategies are Essential Obstetric Care (EOC) and Emergency Obstetric Care (EmOC). In other strategies, nutritional education and overall change of the standard of living of a population are advocated to reduce risk of infection and maternal mortality.

In Kenya, the National Reproductive Health Strategy 1997-2010 (Ministry of Health, 1997) was developed in response to the programme of action of UN, ICPD 1994. The goal of the Strategy was to provide a comprehensive and integrated system of reproductive health through government, civil society organizations and private sector facilities (MOH, 2007b). Prior to this, the 1994-1998 Development Plan underscored the achievement of "Health for All" by the year 2000. The Health for All Plan intended to consolidate maternal and child health and family planning services in order to reduce morbidity and fertility (Ministry of Finance and Planning, 1994-1998). Similarly, the National Poverty Eradication Plan (Ministry of Finance and Economic Planning, 2003) included improvement of the health of children and mothers, among the mains goals and targets. The aim was to lower morbidity from common causes as well as reduction of maternal mortality by 25% by the year 2003. This was to be achieved by increasing women's access to medical facilities, and deliveries by health personnel from 56% to 66%.

Towards this end, interventions put in place were centralisation of health care provision, which involved a change in the operational structure of the Ministry of Health, more equitable distribution of staff, improvement of facilities, supply of drugs to be demand-driven and exemption of charges for the poor. The need for monitoring

trends on maternal health has led to its inclusion in the Kenya Demographic and Health Surveys (KDHS).

Despite these comprehensive health policies, their implementation has faced numerous challenges. For instance, implementation of the National Reproductive Health Strategy 1997-2010 has been affected by lack of specific interventions targeting the resources to the poor (MOH, 2007a). In spite of all these efforts maternal mortality rates remain high in some parts of Kenya. According to the 2002 Bondo District Development Plan, the estimated maternal mortality ratio for Bondo District was 620 deaths per 100,000 live births (Ministry of Finance and Planning, 2004). This rate is significantly higher in comparison to the national estimate of 414 deaths per 100,000 live births (NCPD, 2003).

1.2 Statement of the Problem

The disparities in maternal morbidity and mortality rates between developed and developing countries have generated interest at international fora such as The World Summit for Children (UN, 1990), the International Conference on Population and Development (UN, 1994) and the 1996 International Conference on Women held in Beijing China. Hence, the prioritization of maternal mortality as a Public health issue (WHO, 2004). The regional statistics on maternal morbidity and mortality in sub-Saharan Africa shows great concern. For instance, Kenya records 414 maternal deaths per hundred thousand live births; Tanzania has 578 per 100,000 (Sameji, 2008) and Mozambique has an estimated maternal mortality ratio of 874 per 100,000 live births (Wright, 2008).

High maternal mortality rates in some regions of Kenya continue to persist despite intervention programmes since inception of International Safe Motherhood Initiative. A wide regional variation in maternal mortality has been reported in the maternal mortality baseline survey where rates for Nyeri in Central Province of Kenya is as low as 100 deaths per 100,000 live births, whereas Bondo District in Nyanza Province has a very high comparative rate of 620 deaths per 100,000 live births (Ministry of Finance and Panning 2004-2008). Review of literature on maternal mortality studies point to socio-economic and environmental conditions as main causes of disparities in maternal morbidity and mortality rates. It is, therefore, important to investigate the extent to which these factors determine maternal morbidity and mortality rates in Bondo District. The District was curved out of Siaya District in May 1998. The District's high maternal mortality rate is an impediment to the achievement of the national target of reducing the maternal mortality rate from the current 414 to 170 by 2010.

There was need to conduct this research study to establish the magnitude and the direction of the variables directly linked to maternal morbidity and mortality in Bondo District of Kenya, in order to identify and apply the most effective intervention strategies to bring maternal morbidity and mortality to an irreducible minimum in the District.

1.3 Research Questions

The study set out to answer the following research questions, which emerged from the background of the problem experienced in Bondo District:

1. What were the maternal morbidity and mortality rates for the District?

2. How does the environment impact on maternal morbidity and mortality?
3. Which aspects of the environment had the greatest impact on maternal morbidity and mortality?
4. What progress has been made in the District to lower these rates?

1.4 Objectives of the Study

The general objective of the study was to explore environmental factors and ascertain the extent to which these factors impact on maternal morbidity and mortality in Bondo District.

The specific objectives of the study were:

1. To estimate maternal morbidity and mortality rates in the District.
2. To determine environmental factors that impact on maternal morbidity and mortality and the extent of their impact.
3. To determine progress made in lowering maternal morbidity and mortality in the District.

1.5 Research hypotheses

The following research hypotheses were formulated to guide this study:

1. There was a positive relationship between environmental factors and maternal morbidity and mortality.
2. There was a positive relationship between socio-economic factors and maternal morbidity and mortality.

3. There was a negative relationship between health care factors and maternal morbidity and mortality.
4. There was a negative relationship between improved household factors and maternal morbidity and mortality.

1.6 Significance of the Study

Since the inception of the Safe Motherhood agenda, improvement of reproductive health has become a major international priority. This has generated demand for better information about the nature and magnitude of reproductive health problems in specific settings so that priorities can be set and resources applied in the most effective manner (Bhatia and Cleland, 2000). Planning for maternal and child health similarly requires adequate information on the magnitude of the problem as well as information on factors that sustain the observed rates. The problem of maternal morbidity and mortality in Kenya requires an understanding of contribution of the environment to these phenomena in order to formulate policies and strategies that can contribute significantly to addressing maternal morbidity and mortality issues. This is because the risk of maternal death cannot be isolated from environmental conditions in which the mothers live. Haemorrhage, sepsis, cerebral malaria and unsafe abortion are some of the most frequent causes of maternal deaths (Stekelenburg and Roosmalen, 2002). Some of these conditions are environmental and need to be tackled from this perspective.

Issues of maternal morbidity and mortality, therefore, call for an integrated approach that considers socio-cultural and physical environment at community level to lower

these rates. This research study was undertaken at the community level in Bondo District of Kenya to explore how the environment impacts on maternal morbidity and mortality and consequently recommend appropriate integrated strategy that could be applied. This study will compliment other strategies and programmes geared towards addressing maternal morbidity and mortality.

1.7 Justification of the study

Though studies on maternal mortality have been conducted in Kenya, the contribution of the environment on maternal morbidity and mortality has not been clearly documented, thus necessitating a study aimed at providing an in-depth understanding of the contribution of environment to these phenomena and help to identify appropriate policy measures that could be applied to address these issues. This study fulfilled this important gap.

Further to its usefulness, the study makes significant contribution to a pool of knowledge useful for reference material. The results of the study contribute to basic information required for policy formulation as well as assisting health planners with vital statistics from which to base intervention programmes. Environmentalists, demographers, health scientists, and scholars in general, will find inspiration from the methodology, results and recommendations. Subsequent research studies will emanate from the findings.

The choice of Bondo District for the study was based on high cases of morbidity and mortality caused by malaria, diarrhoeal diseases, bilharzia, typhoid, amoebiasis, and

HIV- related diseases according to the District Development Plan of 2004-2008. The estimated infant mortality rate of 110 per 1,000 live births and a maternal mortality rate estimate of 620 per 100,000 live births according to the Plan place the District among some of the Districts with high cases of mortality (Ministry of Finance and Planning, 2004). The research findings will contribute to careful considerations of factors unique to specific settings in determining resource allocation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This Chapter presents review of literature on maternal morbidity and mortality. A review of theories of population related to fertility and mortality and their relevance to this study was found necessary as a philosophical foundation of the issues under study. The Chapter also presents literature on theoretical explanations about factors associated with maternal mortality in general. In addition, a review of studies on maternal morbidity and mortality worldwide is presented. The Chapter also discusses the conceptual framework considered essential in this study. Finally the Chapter concludes with a summary of literature review.

2.2 Review of Theories on Population

It is important to point out from the onset that there is no particular theory on mortality and morbidity. This section, therefore, reviews theories on population and studies on related concepts. Population theories have their foundation in the ideas of the philosophers of ancient Greece (UN, 1973, Chapter, 3). Plato and Aristotle were concerned about ideal size of population and, therefore, discussed the question of "optimum" population with respect to the Greek city-states. Plato proposed measures to be taken to maintain the desired size. He proposed rewards to induce birth-rate, rebuke to the young and immigration as a last resort. In order to remedy over-population he proposed birth control and colonisation. Aristotle recommended child exposure and abortion as factors that could prevent excessive population. However,

these proposals could lead to early childbirth and high parity, all of which are risk factors in maternal mortality.

The ancient Romans, Hebrew writers and early mediaeval Christian writers favoured fertility and multiplication. Augustus Caesar created privileges for those married with children and discriminated against the unmarried. The aim was to raise birth-rate and marriage. Mediaeval Christian writers viewed population from a moral and ethical standpoint. They condemned polygamy, divorce, abortion, and infanticide and child exposure thus encouraging high fertility. And yet both high infertility and multiplication are risk factors in maternal mortality.

The benefits of high population were advanced by Ibn Khaldoun (UN, 1973, Chapter 3). This Arab author, living in the fourteenth century, held that densely settled population was conducive to higher levels of living since it permitted a greater division of labour, a more effective use of resources and both military and political security. These views are closely related to the Mercantilists, who favoured a large and growing population, and policies aimed at stimulating marriages, large families, improved public health, check on migration and promotion of immigration of skilled workers for purposes of wealth creation. These views could, invariably, lead to increased risks of maternal mortality.

The effect of social status on mortality and fertility was advanced by Marx (1848), who held the theory that differences in mortality and fertility among social and working classes are determined by social positions, levels of living, work conditions and other social factors. He noted that the number of births and deaths as well as absolute family

size were inversely proportional to wage levels and, hence, to the means of subsistence available to different categories of workers. This became the foundation of economic theories on fertility and mortality.

The focus on status of women emerges with views of post-Marxist socialists. According to Babels, population questions were primarily related to the status of women in capitalist conditions and in a socialist society. He held that population was likely to increase more slowly in a socialist society than in a bourgeois society, mainly because of the relatively superior position of women under socialism. Status of women has subsequently been linked to small family norm and low maternal mortality. Later, Lenin (UN, 1973, Chapter 3) advocated for birth control as a human right. He supported unconditioned abolition of all laws prohibiting abortion or dissemination of medical means for preventive measures.

Dumont (UN, 1973) formulated the principle of 'social capillary', believing that the weakening of the desire to procreate was caused by the progress of civilization and attributed the reduction in family size to the individual's ambition to improve his position in society. He argued that just as the water can rise only under the force of capillarity in thin tubes, an individual can rise in the social scale only by having fewer children. The individualism and the desire for personal improvement in advanced societies created a state of mind conducive to declining fertility.

2.3 The Demographic Transition Theory

Landry (UN, 1973, Chapter 3) was the first to postulate the demographic transition theory which identified three main regimes; the primitive, the intermediate, and the modern. The primitive regime is characterized by uncontrolled fertility, and economic factors influence mortality which in turn regulates population growth. In the intermediate regime, economic factors will affect fertility through postponement or foregoing of marriage which results in the decline in birth rates. In the modern regime, there is a conscious family limitation as a result of a change in the aspirations of man concerning his conditions.

Notestein ((UN, 1973, Chapter 3) developed a comprehensive theory on mortality transition. According to this theory, agrarian society is characterized by a high degree of self-sufficiency. In such a society, there are typically high death and high birth rates, with death rates fluctuating as a consequence of variations in crop production and varying incidences of epidemics, poor diets, primitive sanitation and absence of effective preventive and curative medical practices. However, modernization has the effect of reducing death rates through improvements in communication, productivity, sanitation, developments of vaccines and other preventive medicines.

Birth and death rates pursue a more or less parallel downward course with the decline of the birth rate lagging behind. Finally, as further decline of death rate becomes harder to attain, the birth rate again approaches equality with the death rate and a more gradual rate of growth is established with low risks of mortality and small families as the typical pattern. Mortality rates then become relatively stable from year to year and birth

rates respond to voluntary decisions rather than deeply embedded customs (Coale and Hoover, UN, 1973, Chapter 3).

Critics of this theory, such as Lebenstein ((UN, 1973, Chapter 3)), point out that mortality response to modernisation may vary according to levels of income, until a certain level beyond which it has little effect on mortality. Lebenstein argues that mortality is negatively related to income because higher wages, better food, shelter, and medical care associated with an increase in income will lower mortality. Closely related are views by Nelson ((UN, 1973, Chapter 3) who argued that income, investment and population growth affect one another to the extent that changes in population growth can only result from mortality, which is determined by the level of per capita income. Mortality response to modernisation is demonstrated by the experience of western countries. For instance, during the 18th century, France had a maternal mortality rate of 1,000 per 100,000 live births. This was before the discovery of antibiotics and perfection of such techniques as caesarean sections and blood transfusion. The current level of maternal mortality has reduced to a minimum of around 9 deaths per 100,000 live births in response to modernisation. Hagen and Jorgenson argue that the experiences of developing countries differ from those of industrialised societies. Mortality can be changed by improved public health and changes in medical science (Jorgenson and Hagen: UN, 1973). It is only by state intervention that mortality transition may take off. For instance, in sub Saharan Africa, the widespread poverty, particularly in rural areas or in urban slums with lack of sanitation, pure water, food, education and health services, coupled with poor governance is aggravating high levels of mortality and morbidity thus delaying mortality transition. In order to break this vicious cycle, appropriate interventions must

be put in place. Intervention in the physical and social environment by provision of sanitation, pure water, immunisation, sufficient food, education and healthcare among others will lead to acceleration of mortality decline (Engelstrom, 1976). Some studies confirm reduction in deaths in response to improvement in socio-economic conditions. Bhatia et al. (1997) confirmed maternal mortality decline in response to improvement in transport and communications, liberalisation of abortion laws, eradication of malaria, extension of health services into the interior, and the launch of Safe Motherhood Initiative in India. The experience of Kerala, Sri Lanka and Cuba also attest to the impact of health policies and provision of education in effecting changes in mortality (Gendercide Watch, 2005). In Cuba, through policy priorities evident from the early days of the revolution, maternal mortality has reduced to first world levels (Gendercide Watch, 2005).

Finally, there is a close association between mortality and fertility decline. The path of these relationships is often debatable. The general argument is that in response to improvement in health, mortality declines as survival improves. Consequently couples decide to have fewer but high quality children they can care for. Maternal mortality in regimes of low fertility would be expected to be low as mothers are exposed to fewer risks of pregnancy.

No general consensus exists on the path to mortality transition. Palloni (1990) for example, identified various characteristics of mortality transitions. He argues that in the process of mortality transition, there is not a unique path but a multiplicity of transits between them. No one society reproduces the experience of another even under the onslaught of diffusion processes involving medical technology, knowledge, ideological

structures, standards of living, household conditions and individual behaviour. The course of transition from high to low mortality in developing countries is treacherous, fraught with obstacles that are not superseded by utilisation of low-cost medical technology or partial interventions.

Some scholars argue that demographic transition is not a theory but a description of historical events, while others contend that it is a theory that provides a satisfactory framework and means for wider empirical generalisations. The demographic transition theory has for long influenced programmes aimed at reduction of mortality levels. This study was guided by this theory.

2.4 The Environmental Factors and Maternal Morbidity and Mortality

The relationship between environmental factors and maternal mortality and morbidity are both direct and indirect. The prevalence or absence of certain diseases may be related to such factors as altitude, availability of open water, humidity and rainfall (Ojany, 1974). The effect of malaria, anaemia and viral hepatitis on maternal mortality cannot be underestimated. Similarly, sanitation and logistics have a bearing on maternal morbidity and mortality.

Transmission of vector borne diseases is greatly influenced by environmental and climatic factors (WHO, 1997). Ecological investigations have defined climate ranges, which sustain vector life cycles sufficient for parasite development and transmission to human hosts (Hay et al., 1998). Climate is an important co-factor in malaria epidemiology. Many carriers of asymptomatic malaria and mosquitoes may produce

little or no indigenous infection unless a suitable temperature coincides with carrier importation (Snow et al., 1998). As altitude increases, temperature declines so does the risk of infection and there is a typical threshold below which transmission ceases (Lindsay and Martens, 1998). A temperature range of between 18^0c and about 30^0c and a relative humidity of the range 60-80 % are ideal for continuous malaria transmission (Chwatt, 1985).

On the other hand, rainfall increases humidity and this enhances mosquito survival and provides sites for laying eggs and so an increase in mosquito numbers (Craig et al., 1999). Many women contract malaria because of living in close proximity to stagnant water.

Adaptation strategies to environmental change such as irrigation can increase the risk of malaria transmission. Similarly, extreme weather events such as flooding will intensify transmission of malaria as well (Githeko et al., 2000). In areas where rainfall is limited but temperature is high, mosquito populations increase rapidly at the onset of rain due to long development cycles (Craig et al., 1999). Where temperature is limiting during colder season, such as in highlands, then mosquito populations increase slowly at the onset of rain due to long development cycles (Craig et al., 1999). Parasite and vector development are slow and favourable conditions need to last longer to provide a window of transmission. In warmer climates, adult female mosquitoes digest food faster and feed more frequently thus increasing transmission intensity (Githeko et al., 2000).

The incidence of malaria worldwide is estimated to be in the order of 300-500 million clinical cases while mortality due to malaria is estimated to be 1-2 million deaths each year with the majority of deaths in Africa occurring among children under 5 years and pregnant mothers (WHO, 2000). Coastal and Lake Victoria regions of Kenya are classified among the hyper-holo-endemic. The altitude favours stable malaria transmission throughout the year (Snow et al, 1998). In the 1940s - 1960s, spraying the inside surface of houses with a residual insecticide such as dichloro diphenyl trichroethane (DDT) was the main means by which the incidence of malaria was reduced in regions where malaria was endemic. The decline in the use of DDT has led to the use of residual pyrethroids to treat bed nets as a means of controlling malaria vectors (Curtis and Mnzava, 1999).

Malaria destroys red blood cells, and is known to lower the hemoglobin level by about 1.5 grams per cubic centimetre, thus contributing to anaemia in pregnancy (Abour and Royston, 1991). It can cause inability to tolerate blood loss during delivery and especially during caesarean section. It has been documented that resistance to malaria built up during childhood begins to break down in pregnant women from 14 weeks of pregnancy (Abour and Royston, 1991). Risks of cerebral malaria are increased in pregnancy and can lead to death (Winikoff, 1988). Malaria also reduces resistance to infections in pregnancy and can cause spontaneous abortions.

The problem of malaria has become even serious due to the increasing prevalence of drug resistant forms of malaria with the potential for serious morbidity and the need to use more toxic drugs for treatment. Some studies have documented the response of maternal mortality to eradication of malaria (Fortney and Karungari, 1995; Bhatia, et

al.1997). Interventions to prevent infection include environmental management and vector-control measures such as the use of treated mosquito nets.

Anaemia, on the other hand, results from iron imbalance attributable to frequent pregnancy, blood loss during menstruation and inadequate diet (Islam et al., 2004). Its consequences include decrease in physical work capacity, low economic productivity, heart failure, shock, lack of resistance to disease, haemorrhage and maternal deaths (Baker, et.al, 1996). Anaemic women become susceptible to puerperal infection and are anaesthetic and operational risks. The risk is greater for young women aged 20 or teenagers having a second birth. Viral hepatitis is another environmental problem associated with poverty and unsanitary living conditions.

Water scarcity and lack of quality drinking water pose health problems in developing countries. Water bodies are subject to pollution from industrial, domestic and agricultural sources (Ochieng, 2000). The warming up of surface water as a result of thermal discharge from industries, power plants and sewage treatment plants reduces the dissolved oxygen saturation, thus resulting in multiplication of pathogenic bacteria and fungi. Waterborne bacterial contamination has the most devastating impact on women who lack basic food and access to doctors and medicine. Ground water may be polluted by domestic and agricultural activities. Domestic pollution may occur through wastes and solid waste damps such as garbage into ground water.

Furthermore, the leakage of septic tanks and cesspools especially in densely populated areas provide an additional input of toxicants into ground water acquifers. Agricultural activities can contribute to trace metals in water resources. Due to poor discharge and

control processes, metals find their way into natural water systems. Other agricultural activities such as spray irrigation, slurry disposal, use of pesticides and the storage of potential water pollutants may also lead to the discharge of appreciable amounts of metals into the ground water acquifers. Poor water quality is also linked to the problem of water borne diseases. Unsafe drinking water will lead to spread of diseases such as cholera, diarrhoea, and amoebiasis (Ministry of Finance and Planning, 2004). Unsafe water includes unprotected wells, rainwater, and water from lakes, rivers and ponds. In rural areas, households rely on rainwater more during the wet season, and resort to using water from rivers, lakes and ponds during the dry season (Ministry of Finance and Planning, 2000). Improper methods of waste disposal result in spread of infectious diseases (Ministry of Finance and Planning, 2003b). Caffrey (1979) documents diarrhoea as a principal cause of maternal death.

Indoor air pollution has been linked to ill health in developing countries. Approximately half the world's population and up to 90% of rural households in developing countries rely on unprocessed biomass fuels in the form of wood, dung and crop residues. These are typically burnt indoors in open fires or poorly functioning stoves. As a result, there are high levels of air pollution to which women and their young children are exposed (Bruce et al., 2002). Indoor air pollution causes diseases such as acute respiratory infection, chronic obstructive lung diseases such as asthma, chronic bronchitis, lung cancer, stillbirths and other problems at birth (Bruce et al., 2002).

Low nutritional status of women may limit the efficiency of a woman's reproductive system. Basic causes of low nutritional status are low income, low levels of education

and poor access to health services. Poor families lack the economic, environmental or social resources to purchase or produce enough food (UNICEF/ GoK, 1998). Land degradation, water salinity due to over-irrigation and soil erosion can all undermine families' ability to grow enough food. Malnutrition intensifies the severity of many infections especially in pregnancy. Teenage pregnancy threatens the health and nutritional status of the mother and the foetus with both competing to meet their growth needs. The risk of maternal death is three times higher for teenage mothers than for women 20-29 years (Baker et al. 1996).

2.5 Healthcare Factors and Maternal Morbidity and Mortality

Health intervention is the first initiative perceived to bring down levels of maternal mortality. The advocates include the International Safe Motherhood Initiative, UNICEF, and WHO among others. Several intervention strategies are applied to bring down maternal mortality. These include family planning services, safe and legal abortion, trained medical attendants at birth and Emergency Obstetric Care (Shiffman, 2000). Increased prenatal care, delivery in hospital and delivery by trained birth attendants are emphasised because through these any potential risks of pregnancy and childbirth are able to be detected and dealt with promptly.

Family planning approach seeks to prevent unwanted pregnancies and to influence the timing and frequencies of pregnancies. This is also desired to ensure that births take place in the safest reproductive age groups. Family planning is instrumental in reducing occurrence of pregnancies at high-risk ages such as among very young women and among very old women. Nutritional education and overall change of the standard of

living of a population are essential in reduction of risks of infection and maternal mortality. Substantial poverty reduction is vital for overall improvement of standard of living. Protection of female reproductive health is, therefore, thought to improve health and general living conditions globally.

On the other hand, antenatal care is encouraged in order to diagnose and treat any health problems appropriately. Early danger signs can be detected by physicians. The abdominal scan can detect multiple pregnancy, position and presentation of the foetus and the adequacy of the outlet compared to the foetal size and skull. The measurement of the size of the cervix can be used to predict the likelihood of obstructed labour. All these are of benefit to early detection of complications of delivery and therefore result in making prior arrangements for safer methods of delivery. In addition, essential services such as tetanus toxoid, folic acid tablets and nutritional education are provided during antenatal visits (Magadi, et al., 2000 b). Studies document poor pregnancy outcome among women who had no antenatal care Magadi (1999). Such women were about three times more likely to die outside a health facility compared to those who had received some antenatal care.

On factors related to antenatal care, Magadi et. al. (2000 b) found that socio-economic factors, urban residence, higher education, and proximity to a health facility increase frequency of antenatal visits. The desirability of pregnancy appears to be correlated with both the frequency of antenatal visits and the timing of the first antenatal visits. On the contrary, pregnancies that were unwanted were associated with late start of antenatal care and less frequent visits compared to pregnancies that were wanted. It was also found that long distance to the nearest antenatal facility was an obstacle to

receiving adequate antenatal care. Travel costs are an inhibition to the use of maternity services that are located far away even if they were cheaper in terms of charges. In addition, poverty is an impediment to the use of antenatal care facilities. There is an association between low household socio-economic status and late start of antenatal visits.

Lack of access to well equipped health care services and skilled obstetrician is perceived to be a major factor that determines risk of maternal death (UNICEF, 2003). Direct medical causes of maternal deaths such as haemorrhage, puerperal sepsis, obstructed labour, and abortion should be promptly handled in a health facility by a qualified obstetrician in order to save lives of mothers who would otherwise perish. It is with this conviction that health policies are geared to ensuring that mothers deliver their babies in health facilities under proper medical attention and hygienic conditions. This is based on the premise that in emergency cases, for example, surgical intervention and access to transfusion and other obstetric emergency services become handy and an obstetrician handles these cases better. It is generally agreed that acceleration of maternal mortality decline is possible if appropriate health interventions are undertaken.

The importance of provision of essential facilities for management of complications of pregnancy and deliveries has led to the concept of Essential Obstetric Care (EOC). In this approach, there must be trained professionals who are able to provide women, wherever they live, with medical and surgical procedures that are likely to save their lives in case of obstetric complications (Smith, 2003). EOC is a strategy geared to towards provision of facilities for surgery, intravenous oxytocin, anaesthesia, medical

treatment for shock, sepsis, anaemia, hypertensive diseases of pregnancy, blood transfusions, manual procedure, monitoring of labour, management of problem pregnancies, manual vacuum aspiration and special care of neonates (Smith, 2003). It is an intervention strategy with the highest positive impact on maternal health.

Though the benefits of delivery in a health facility are clear, some studies have documented some factors that determine delivery care. Magadi et. al. (2000a) found that deliveries in a health facility are significantly higher for births to women resident in urban areas, higher educational attainment and household status. In addition, age of women, birth order, increased birth interval, and age at first birth were other significant factors. Deliveries for desired pregnancies were more likely to take place in a health facility than unplanned or unwanted pregnancies. On the other hand, availability of some community-based health services, such as the presence of traditional birth attendants or mobile clinics, was associated with a reduced chance of delivering in a health facility. The study found that accessibility of place of delivery increased the probability of delivering in a health facility, but this tends to reduce with increasing distance and time taken to the nearest health facility with delivery care.

Abortion, on the other hand, contributes to a large percentage of maternal deaths and accounts for a high proportion of sepsis (Fawcus et. al., 1996; Khan et. al., 1986). Consequently, it is desirable that women should have access to quality services for the management of complications arising from abortion. Post-abortion counselling, education and family planning services should be offered promptly to avoid repeat abortions. The absence of legal abortion exposes women to dangerous procedures that may necessitate admission to a health unit for treatment of uterine bleeding or infection

(Huntington and Pelon, 1999). This is because women with unwanted pregnancies resort to unsafe induced abortion. Studies document contribution of abortion to maternal mortality. In a study in rural Bangladesh, Kwast et. al. (1986) found that abortion made a substantial number of maternal deaths. Alaudin (1986), on the other hand, found that abortion related deaths contributed to nearly 10 deaths per 10,000 live births. Major causes of maternal deaths were found to be obstructed labour and sepsis caused by improperly performed abortions. Those at risk were mothers below age 20 and above 30 years and those mothers with parity of more than four. In another study on abortion related maternal mortality in the Russian Federation, Zhirova et. al.(2004), found that abortion-related deaths were high in Russia: some older and married women died from complications of induced abortion. In some cases crude methods were used to induce abortion. The study confirms that the most common cause of death was sepsis from abortions performed outside the hospital. These were followed by haemorrhage and embolism. The study found that factors contributing to post abortion maternal mortality included misdiagnosis of complications, incorrect treatment, incorrect abortion procedure, and second trimester operations that took too long to perform. Other contributing factors were delay in seeking help and receiving attention at the hospital. Associated diseases and institutional organisation were also found to contribute to some of these deaths. The study also found that most deaths were realised from second trimester abortions.

In Kenya, the health consequences of unsafe abortion have been documented in the hospital-based studies (Mutura, 1990; Makokha, 1980). In these studies, abortion accounts for 35% of maternal mortality and at least 50% of hospital gynecological admissions. These studies excluded women who sought abortion from private

providers and those with no access to health services. The concern over the grim situation of women who undergo abortion has given rise to post abortion initiative whose aims are to provide emergency treatment for complications of spontaneous or induced abortion as well as provision of post-abortion and family planning, counselling services, emergency abortion treatment services and comprehensive reproductive health care. Family planning is recommended to prevent maternal deaths resulting from poorly performed abortions and post partum sepsis (Mtimavalye et al., 1980; Khan et. al., 1986). This is because it is an intervention strategy that reduces incidence of unwanted pregnancies and frequency of pregnancies.

Birth interval is equally important for the survival of mothers. An interval of at least two years is recommended to allow the body time to recover from the extra demands of pregnancy and lactation. A shorter birth interval takes a heavy toll on women who are overworked, undernourished and in poor health (Mhango et al., 1986; Chandramohan et. al. 1998).Women with inter-pregnancy interval of 5 months or less, compared with those of intervals of 18 to 23 months after previous birth, have been found to have high risks for maternal deaths, third trimester bleeding, premature rupture of membranes, puerperal endometritis and anaemia (Agudelo and Belizan, 2000). Women with inter-pregnancy intervals longer than 59 months, compared with those with intervals between 18 to 23 months were found to have significantly increased risks of pre-eclampsia (ibid).

Frequent births deplete energy among poor women. Their bodies, therefore, do not have time to recover from the stress of pregnancy, birth and breastfeeding. These

women do not replenish vital nutrients and this makes them vulnerable to maternal depletion syndrome culminating in a weakened body that is unable to cope with the next pregnancy. The consequence is a high maternal death due to bleeding, ruptured uterus and abnormal presentation caused by laxed uterus (Oryem, 1997).

The success of health interventions in reduction of maternal deaths however depends on the woman, her family, the maternity unit or institutional personnel, the national policy on maternal health and whether this is given any priority in the usually overstretched national budget (Mtimavalye, 1980). It is necessary to provide adequate antenatal care facilities, adequate staffing and equipment of maternity units alongside a good referral system, and properly trained personnel to handle obstetric services. The study by Mhango et. al. (1986) in Lusaka, Zambia, recommends use of antibiotics, blood transfusion capacity, intravenous fluids, improved nutrition and delivery by trained birth attendants and prevention of unwanted pregnancies, among others.

On the other hand, substandard care, delay in seeking care, non-availability of drugs or intravenous fluids, organisational failures, and clinical case management contribute to some maternal deaths (Stekelenburg and Roosmalen, 2002). Other institutional problems are late referrals, over-crowding due to lack of beds, failure to examine, delayed therapy, irregular treatment, poor nursing care, lack of proper investigation with regard to etiological causes of the infection which result in inappropriate choice of drugs and non-response of the micro-organisms to therapy (Makokha, 1980).

Patient characteristics are equally important in success of healthcare. Late arrival for treatment, low immune resistance, failure to recognise emergencies and decisions taken

too late contribute significantly to some of the deaths. For example, Makokha (1980) found that some patients whose pregnancies had been interfered with arrived in toxic shock and most of the pregnancies were in mid-trimester. In other cases, patients that died of sepsis were referred from other hospitals so late while others had delivered at home but referred to hospital when critically ill.

Despite these limitations, some studies document the impact of health interventions in reduction of maternal mortality. An intervention study in Gambia aimed to establish the impact of intervention on pregnancy outcome by Greenwood et. al. (1990) resulted in increased number of hospital deliveries and a decline in both maternal and neonatal deaths. The traditional birth attendants were instrumental in identifying complications of pregnancy, which needed to be delivered in a hospital. The study by Maine et. al. (1996) in Matlab similarly attests to the importance of interventions in bringing down maternal mortality. The results showed that treatment of complications by the midwives at the Matlab Clinic and the number of direct obstetric deaths in the intervention area declined from 20 deaths in the three years before the maternity care programme was implemented to six deaths in the three years after the programme began. An important factor in the decline seems to have been identification of serious cases, that is those that might have resulted in death and to refer them to Chandpur for caesarean section, blood transfusion and Dilation and Curettage (D and C).

2.6 Socio-Economic Factors and Maternal Morbidity and Mortality

Rising standards of living have been perceived to lead to mortality decline. Higher income results in improved health, most likely through increased public and private

spending on goods that directly or indirectly improve health. Improved per capita income should be an important component of any country's health strategy.

Wealth may be the critical determinant of maternal mortality for a number of reasons. Wealthier families may have better nourished mothers because households with higher incomes can purchase more nutritive food. Better-nourished mothers in turn may remain healthy throughout pregnancy and be less likely than poorer women to suffer delivery complications. Sufficient iron intake will reduce the prevalence of anaemia which is a risk factor for hemorrhaging at birth. Wealthier nations, on the other hand, have more resources available for public health systems, a situation that improves the capacity to address maternal health issues. Both wealthier nations and families can devote more resources to the education of women, increasing the likelihood that women will seek appropriate medical care during pregnancy and at delivery and that they will understand and practise behaviour conducive to good health throughout their lives. The status of women is higher both in wealthy families and in richer nations and their lives are given greater value, so that they are accorded greater concern in pregnancy and during childbirth. Finally, wealth is associated with low fertility, that is, wealthier women experience fewer pregnancies than others and, therefore, have a lower lifetime risk of dying from causes related to maternity.

Marital status, on the other hand, affects mortality through economic wellbeing and psychological stability from supportive family. The occupation of the husband is an indicator of social class. Husband's unemployment may have an adverse effect on the outcome of the wife's pregnancy. Some studies show that areas with high

unemployment rates have high mortality rates. Maternal health behaviour and attitudes may in some cases be related to the husband's economic ability.

Rural and urban differentials in maternal mortality rates are largely attributed to differences in socio-economic status of the women resident in these areas. Improved socio-economic conditions have been shown to lead to a decline in maternal mortality (Chandramohan et al., 1998; Bhat, et. al.1995).

2.7 The Status of Women and Maternal Morbidity and Mortality.

Improving the status of women has been perceived to be the key to maternal mortality transition with benefits that supercede improvement of general standard of living or making available appropriate health services. This perspective echoes the post-Marxist socialists. According to this view, a fundamental cause of maternal mortality may be the low value placed on the lives of women. The belief that the status of women may be a critical determinant of maternal mortality levels is based on several observations. When the status of women is high, the health of women is more likely to be a concern of national leaders, who may devote greater policy attention and resources to the issue. Second, the lives of mothers will be valued by other community members including their husbands, who will more likely help them seek institutional delivery or take action during a pregnancy or delivery if complications arise. Where their lives are valued, women are more likely to have access to education.

Education of women has implications for maternal health. Since the 1980s, the central theme of population policy has been the empowerment of women (Ross, 1997).The

mechanism through which the empowerment of women operates to effect a change in maternal morbidity and mortality is described below.

Education is associated with fewer pregnancies hence lower fertility. Ross (ibid) argues that emancipated women regard pregnancy from the perspective of "heavy physiological and personal cost;" and therefore opt for smaller families. Once women are freed from their traditional obligations they are able to consider pursuing a career outside family life. The provision of education and economic opportunities for women leads to postponement of marriage and child bearing, thus bringing down maternal deaths and improvement of women's reproductive status. It is argued that education changes the way that women regard themselves. Investment in girls' education yields global development returns in the form of reduced population pressure via delayed marriage (Furedi, 1997). Education is also associated with improved nutrition and good health (McCarthey and Maine 1992). Mothers with good education may also be able to avoid some of the potential risks associated with short birth intervals (Caldwell, 1986).

Considerable evidence also exists on the education-conditioned use of health services for example use of maternal and child health care services. Educated women are more likely to seek antenatal care and be more willing to choose trained medical personnel to assist them during delivery, rather than traditional birth attendants. The educated women are more likely to get and disseminate more comprehensive information regarding the signs and symptoms of diseases than their uneducated counterparts. Education has an influence on attitudes toward the family, pregnancy and health care. It breaks traditional family planning practices leading to less fatalistic attitudes about

health. Educated women develop the ability to make decisions and understand the importance of hygiene.

Some studies suggest, however, that the impact of education on the health of women is contingent on the level of economic development, social structure and cultural milieu (Furedi, 1997). Income, employment status, and nutritional state, ability to own resources, among others, affect the health of mothers and contribute to maternal mortality. Some studies have documented the burden of poor maternal healthcare (Ngoka and Mati 1980).

2.8 Demographic Factors in Maternal Morbidity and Mortality

The influence of age, parity and birth intervals on maternal mortality is well documented. The association between age of mother and maternal mortality is mainly of a physiological nature and to some extent, an environmental problem. The young women have not matured physically to sustain the physical demands of pregnancy and childbirth. The situation is further aggravated by poverty that will lead to malnutrition and contribute to anaemia in pregnancy. Teenagers may not go for antenatal clinic or they may go for it late (Mati and Aggarwal, 1980). In teenage mothers, structured changes of the gynaecologic canal may give rise to prolonged labour and delivery, obstructed labour and breach presentations leading to obstetric fistulas (Wall, 1998; Mutura, 1990). Complications such as breach presentations; toxaemia, anaemia, and premature rapture of the membranes are found to be common among young mothers having their first babies. Obstructed labour has been a major cause of morbidity and death among women (Wall, 1998).

The older women, on the other hand, are caught up in poor economic and environmental conditions and have a weakened body system resulting from several pregnancies and pressure of physical labour and therefore less capable of withstanding the pressures associated with pregnancy and childbirth. Many older women therefore succumb to ante partum and intra partum complications. These women have higher rates of gestational diabetes, pregnancy induced hypertension, gestational bleeding, abruptio placentae and placentae praevia (Berkowitz, 1990). Other common complications found among older women are intra partum complications such as hypertension, uterine bleeding and foetal distress. The older women also experience post partum complications leading to caesarean sections and post partum morbidity. They also experience increased incidences of eclampsia and pre-eclampsia. Uterine prolapse is also a malady associated with age and parity. On the basis of these observations, elimination of childbearing after age 35 is recommended to significantly reduce maternal morbidity and mortality.

Ojo et. al. (1981) document that grand multiparous (older women of higher parity), had higher rates of toxaemia, anaemia, premature rapture of the membranes and breach presentations. Stone et. al. (1994) documents the impact of multi parity on severe eclampsia. Voorhoeve et. al. (1978) and Magadi 1999 document the impact of age and parity on adverse pregnancy outcome.

On parity, frequent births and shorter birth intervals may induce some physical hazards for mothers (Ascadi and Ascadi, 1986). Other studies document increased incidences of death among women with more than four births (Alaudin, 1986); Khan et al, 1986;

and Mhango et al. 1986). Other studies suggest that a woman aged 25 and above with four or more children will face higher risks of death than one of the same age with one birth. The contention here is that such a woman does not allow herself adequate time to recover from the previous pregnancy. With a weakened body system and in the event of malnutrition, chances of a higher mortality are unavoidable. As parity rises, so is the incidence of anaemia, toxaemia, haemorrhage and malpresentation and blood pressure (Ascadi and Ascadi, 1986). In a retrospective study of maternal mortality in Nouna, a rural area of Burkina Faso in 1992, Garenne et al. (1997) found high risk of death in first births and high parity births. Khan et al. (1986) found maternal mortality was positively related to age and parity with mortality risk rising very sharply beyond age 35 and beyond parity four among women aged 25-34.

Frequently occurring pregnancies are more likely to deplete iron stores thus leading to anaemia (Fisher, 1969). The common cause of death among women aged 35 and above is eclampsia. Indeed literature points to increased incidences of eclampsia and pre-eclampsia in older women. An elevated level of maternal mortality in young women aged 25 – 34 but of higher parities may be attributed to too many pregnancies perhaps coming too close. The large number of frequently occurring pregnancies in low socio - economic groups is most likely to be associated with a high incidence of low iron reserves and subsequent anaemia. Closely linked to this is birth interval. Evidence suggests that closely spaced pregnancies lead to a weakened body and so subject the mother to a higher than average mortality.

Physical size has been linked to some complications of pregnancy and childbirth. The risk of obstructed labour is closely related to physical size. The condition is far more

common with short stature and in first births, possibly related to the lag in maturation of the pelvic outlet compared with the stature of young mothers. The risk of obstructed labour is especially more severe in women who are shorter than 1.5m when they deliver babies whose birth weights are much higher than 3.0 kg or 3.5 kg than when the foetus is 2.5 kg or lower. The problem is exacerbated in young and primiparous mothers and pregnant teenagers who have not yet reached adult stature because full growth of the pelvic dimensions occurs after growth in height is largely completed. Wright et. al (2008) in a study on maternal mortality in Maputo Mozambique between October 2002 and December 2004, found a maternal mortality rate of 874 per 100,000 live births. Haemorrhage, HIV related conditions, bacterial infections and malaria were major causes of death. The study recommended that effective measures be instituted to treat HIV, malaria and infections with pyogenic bacteria, alongside improvement in health services for obstetric complications to reduce maternal death in Mozambique and perhaps sub Saharan Africa.

2.9 Maternal Morbidity

Reproductive morbidity refers to any morbidity or dysfunction of the reproductive tract, or any morbidity which is as a consequence of reproductive behaviour including pregnancy, abortion, childbirth, sexual behaviour morbidities and those of a psychological nature (WHO, 1989). Reproductive morbidity can be classified into three categories, namely: direct obstetric morbidity, indirect obstetric morbidity, and psychological obstetric morbidity. There are also contraceptive morbidities which result from methods other than abortion to limit fertility whether traditional or modern. Kaufman et al. (1999) noted that reproductive tract infections are a major cause of

reproductive morbidity in developing countries. These can result from sexually transmitted diseases. They can also arise endogenously, or may result from poor asepsis gynecological procedures or examinations. Untreated infections can lead to a number of serious health problems including pelvic inflammatory disease, ectopic pregnancy, infertility, foetal loss, cervical cancer, health problems of the newborn, and increased risk of HIV transmission.

It is estimated that for every woman who dies, about sixteen women suffer damage to their health, which may last the rest of their lives (UNICEF, 2003). Some forms of maternal morbidity cause untold misery to individual women and their families (UN, 1979). Maternal morbidity may occur during the puerperium (6 weeks after birth or abortion). Some disorders may result from complications of pregnancy while others may not be specific to pregnancy although their outcome may be affected by pregnancy. Disorders such as puerperal hypertension, peripartal cardiac failure, acute prolapse of the cervix, psychiatric illness in puerperium, obstetric fistulas, neurological dysfunction, and vaginal stenosis and steehans syndrome are some of the disorders that emanate from pregnancy and childbirth. Others are general weaknesses, anaemia, intolerance to cold weather and premature aging, infertility and chronic inflammatory diseases (Wall, 1998; Bhatia, 1995).

Some of the worst consequences of complications of pregnancy and childbirth are obstetric fistulas and damage to the uterus (Wall, 1998). Obstetric fistulas are abnormal openings between two body organs usually between the bladder and the vagina. This will lead to inability to control bowel or bladder movement. This state is usually an embarrassment to the victims. Damage to the uterus leads to infertility. Other

outcomes has not been well documented, Ocholla (1991) has explained some socio-cultural factors in the African environment which have implications on fertility and mortality. He identifies these as the belief system, the desire for children, fear, religion, marriage patterns and the desire for male children in particular (Wall, 1998).

The influence of religious beliefs and practices is documented by (May and Mc Lellan, 1973). Some religions forbid women from going to hospital for treatment and delivery. Failing to go to hospital for treatment in case of an illness, or failing to deliver in hospital will lead to a risk of maternal death or could contribute to maternal death directly in case of an obstetric emergency. In some religions, eating of certain types of food forbidden in the Bible is prohibited. Such practices deprive pregnant women essential protein sources from fish, meat and eggs. These practices contribute to various morbid conditions such as malnutrition and anaemia among pregnant women and thus become distant determinants of maternal mortality.

Food taboos in traditional societies impact negatively on maternal health thus leading to increased risk of maternal deaths. In some communities in Tanzania pregnant and lactating women are prohibited from eating eggs, pork, chicken, catfish and intestines of animals, twin bananas, pumpkins and others. All these food taboos coupled with food shortages create very serious problems such as increase in incidences of anaemia. All these result in maternal morbidity and mortality (May and Mc Lellan, 1973).

Socio-cultural factors also operate through care given to expectant mothers during pregnancy and delivery and impact negatively on maternal health. The widespread belief among some communities that decreased food intake during pregnancy is safer

for the mother (and possibly the child) because a smaller foetus will make for an easier delivery, denies women essential nutrients for safe delivery. Unhygienic and improper birth practices, especially among rural women also contribute to the fate of the mothers and their children leading to high incidences of tetanus neonatorum and puerperal sepsis (Chen; 1974). Early marriage, desire for many children, multiple pregnancies, many terminated by miscarriage and rejection or even suicide lead to deaths of many women (Jelliffe and Jelliffe, 1981).

Another harmful traditional practice is preference for home delivery. This exposes women to the risk of infection and death through unhygienic birth practices by traditional birth attendants. Home delivery practice is influenced by traditional values (Magadi et. al., 2000a).

The study by Mills and Bertrand (2005) demonstrates that traditional beliefs and practices associated with pregnancy and labour were no longer in practice. They found that the participants in the discussions were equally aware of the negative effects of some of these beliefs and practices, knowledgeable about signs and symptoms of complications of pregnancy and labour, and the need to refer patients when such complications arose at delivery to a health facility or to a doctor. It was also clear from the discussions that poverty is at times a hindrance to acquisition of means of transport to a health facility in case of emergencies.

2.11 Review of Methods used to Measure Maternal Mortality

Many methods of estimating maternal mortality have been developed and applied in various studies. Some of these methods are direct while others are indirect. Direct methods of measuring maternal mortality include vital registration. This refers to continuous registration of vital events as they occur. It includes registration of births, deaths and migrations. This is the most accurate method of estimating maternal mortality in countries that have instituted such systems. It can only be affected by underreporting or misclassification of maternal death (WHO, 1999).

However, in view of the fact that not many developing countries have vital registration systems, indirect methods have been developed. One of these methods is the indirect sisterhood method of estimation. This method was developed by Graham et. al. (1989) to be applied in areas lacking vital registration. The sisterhood method involves asking a representative sample of adults about the survival status of their sisters born to the respondent's mother who reached adulthood, and for sisters who died, about the time of death relative to pregnancy and childbirth. Four vital questions are posed to obtain an estimate of the lifetime risk of maternal death and the proportion of adult female deaths due to maternal causes. These questions are used to obtain information on: (1) the total number of sisters who have reached adulthood or marriage and born of the respondent's mother. (2) The number of those sisters who are currently living, (3) the number of those sisters who are deceased; and (4) of those deceased, the number who died during pregnancy, childbirth, or postpartum period. Thus, by classifying any death that occurs during pregnancy, childbirth, or postpartum period as maternal, the indirect sisterhood approach identifies pregnancy related deaths (Stanton et. al., 2000).

The sisterhood method uses the proportion of adult sisters dying due to maternal causes to derive an estimate based on a set of underlying modeling assumptions, of the lifetime risk of maternal mortality from which the maternal mortality ratio can be readily derived. The proportion of sisters who died of maternal causes is converted into the lifetime probability of dying of maternal cause between ages 15-50. Secondly, the probability of dying of maternal mortality causes is converted into the maternal mortality rate by applying a standard value for the total fertility. Aggregate data are used to calculate the proportion of sisters dying due to non-maternal causes. Adjusted factors are used to convert these proportions into estimates of maternal mortality.

The main advantage of sisterhood method is that it cuts the sample size drastically. The main disadvantage, however, is that it relies on the recall of long past events. The sister preference over brothers as informants is based on the assumption that the death of a sister is a traumatic experience for the surviving sister and so she may not forget. There are also technical problems that limit the usefulness of the sisterhood method for programming purposes, particularly for assessing trends in maternal mortality. That the method uses respondents aged 15-49, produces an estimate of maternal mortality ratio that relates on average 10-12 years prior to the date of the survey. The method also has another disadvantage of being sensitive to the level of fertility. It requires countries where fertility and mortality as well as migration have been stationary in the recent past (Bhat et. al., 1995).

There are also several non-sampling errors that can affect sisterhood data, cultural factors such as meaning of sister, and problems where respondents have lost touch with

sisters who have migrated, or problems related to lack of knowledge on why the sisters died (UNFPA, 1998). Concerning the sample size needed for calculation of maternal mortality ratio (MMR), Graham et. al. (1989) did not come up with a method of calculation but seem to suggest that for an estimate of broad level maternal mortality, a sample of between 3000-6000 adults will be required. Ebrahim (1991), on the other hand, says that a sample of 2500-3000 adults is desirable to obtain reliable estimates (Hanley et. al., 1996). Calculations for the sample size arrived at by Hanley and others suggest that a sample size with a 20% margin of error is 3200. The sample size required is too large and time consuming.

In a study designed to test the accuracy of the sisterhood method of estimating maternal mortality, Shahidullah (1995) found out that the accuracy of indirect sisterhood method depends on the accuracy of reporting of the number of sisters each respondent had who died as a result of pregnancy and childbirth. The sisterhood report, however, was found to have a negative bias because it is based on retrospective reports of relatively rare events spread over a long period of time.

A direct approach in the measurement of maternal mortality is the sibling-history method (Stanton et. al., 2000). The direct estimation relies on the same underlying principle of proxy reporting as the indirect method, that is, sibling data are collected both as a means of expanding the sample size and of gathering information about deceased siblings who cannot be interviewed themselves (Stanton, et. al., 2000). The data requirements for the direct method are more demanding than for the indirect approach. In the direct approach, a respondent is asked to provide the birth history of her mother, including the current age of all her siblings and the age at death for all

deceased siblings. These data allow births, exposure time and deaths to be placed in calendar time and therefore, permit the calculation of sex and age specific death rates for reference periods defined by the analyst (Stanton et. al., 2000). The direct method requires fewer assumptions than the indirect method. The only assumption required by the direct method is that the respondents provide accurate information on current age of siblings, age at death and years since death of all dead siblings (Stanton et. al., 2000).

The statistic generated by the direct method is the maternal mortality rate. The maternal mortality ratio is obtained by dividing the maternal mortality rate by the general fertility rate. The direct method has several advantages: it allows for the calculation of rates and ratios for the reference period and for the monitoring of trends; it permits maternal mortality to be analysed by parity; and allows for data-quality to be checked for completeness and plausibility that are not possible with the indirect approach. The disadvantages of the direct approach are the extra time requirement to administer the questionnaire and additional training and supervision in the field. It also adds additional complexity to the data (Stanton et. al., 2000).

A third method for estimation of maternal mortality is the reproductive age mortality ratios (RAMOS). This method involves the identification and investigation of causes of death of women in reproductive ages. The deaths should be identified according to records or source of information available, that is vital registration, hospital and health centre records, autopsy services, community leaders, cemeteries, mass media, etc (Valonguero, 2001). Any source of information available may also be used for identification of cases. This method is perceived to yield fairly accurate estimates of maternal mortality ratios though the method is time consuming. It also requires

elaborate mechanisms and adequate personnel to reach every possible informant. Verification of cause of death is equally important and this is done by obstetricians. The method is commonly applied in epidemiological studies. It has been successfully applied by Fawcus et. al. (1996) in Zimbabwe.

Regression model has been used to estimate maternal mortality by relating the sex differentials in mortality for people of reproductive age to the age schedule of fertility. This method relies on vital registration data or census data for application. Bhat, et al. (1995) have applied a regression model to study maternal mortality in India. The technique was applied to the sample registration system for the period 1982-86. The results indicated a maternal mortality rate of 580 deaths per 100,000 live births for India. There were 638 deaths in rural areas, and 389 deaths in urban areas. Estimates derived for the major states suggest relatively high maternal mortality since 1900s. The decline in the birth rate is estimated to have accounted for nearly one fourth of the decrease in the maternal death rate and 5 percent of the fall in the maternal mortality ratio in the 10-year period of between 1972 - 76 and 1982 - 1986. The study found regional variations in maternal mortality in Indian states, from a high of more than 1,000 deaths per 100,000 live births in Assam to a low of 250 per 100,000 in Punjab and Kerala. Utter Pradesh, Bihar, Orissa and Jafasthan generally showed higher levels of maternal mortality. The urban states of India generally had a maternal mortality only 60 percent of that observed in rural areas.

2.12 Review of Progress in Maternal Morbidity and Mortality Reduction

In view of problems arising from both the direct and indirect methods of estimating maternal mortality, UNICEF, WHO and UNFPA (1997) developed process indicators for gauging progress in maternal mortality. A good process indicator is one that is correlated with the outcome of interest in maternal mortality and is simpler to measure on a regular basis (UNICEF, 2003). It has, however, been observed that there is no consensus yet about the most relevant indicators that will inform accurately on the level and changes in maternal mortality. Besides, the proposed process indicators have not been field-tested, evaluated and used for programmatic purposes (Maine et. al., 1997).

A number of process indicators have been proposed for monitoring progress toward reduction of maternal mortality, but the indicator with which there is the most experience in ease of data collection and analysis is the percentage of all births attended by skilled health practitioner (doctor, nurse or midwife (UNICEF, WHO and UNFPA, 1997). This indicator is highly correlated with maternal mortality and readily measurable using survey techniques and it meets key scientific soundness and accessibility. Moreover data are widely available (UNICEF, 2003). In recognition of the potential of the skilled attendant indicator to serve as proxy for measuring progress in maternal mortality, a report of the special session of the United Nations Assembly recommended in July 1999 that: "In order to monitor progress towards the achievement of the Conference's goals for mortality, countries should use the proportion of births assisted by skilled attendants as benchmark indicator (UNICEF, 2003)"

2.13 Summary of Literature Review

The literature reviewed in the foregoing sections has shown that factors that increase risk of maternal morbidity and mortality are complications of pregnancy and childbirth. These are breach presentations, eclampsia, obstructed labour, haemorrhage, anaemia and sepsis (Abour and Royston, 1991; Islam et. al. 2004). The risk of death is increased with lack of access to well equipped health care services. Non- availability of essential drugs, intravenous fluids and blood transfusion makes it difficult to save mothers who develop complications of delivery (Stekelenburg and Roosmalen, 2002). Further, sub-standard care and delays in seeking treatment are some of the factors that escalate the problem.

Various approaches have been used in the study of maternal mortality, including verbal autopsies successfully used by Chandramohan et. al. (1998). This method can be applied in areas lacking vital registration. The direct and indirect methods have been used by Garenne and Friedberg (1997), where results revealed that estimate of maternal mortality by use of the direct method led to a lower rate than the indirect sisterhood method. The accuracy of the sisterhood method was tested by Shahidulah (1995) where results revealed misclassification of death when sisterhood method is used. None of the studies reviewed had used process indicators in assessment of progress in maternal mortality decline. This study, therefore, applied process indicators to assess progress made towards lowering the level of maternal mortality and morbidity in Bondo district.

Hospital studies have been conducted with varied objectives and so are community studies conducted in different areas with application of various methodologies.

Multiple source reporting system was used in Zimbabwe and also in Machakos to identify community based factors in maternal morbidity and mortality. Many intervention strategies have been put in place to help bring down maternal morbidity and mortality. Some commonly applied strategies are family planning to avert unwanted pregnancies, antenatal care to detect risks of complications, delivery in a health facility, with emergency obstetric care to guard against emergency obstetric complications, delivery by a qualified obstetrician and overall improvement in the standard of living. The sudden onset of complications of pregnancy and delivery, points to the need for provision of Essential Obstetric Care and Emergency Obstetric Care at health centres and hospitals to save lives of mothers who develop such complications.

From the literature reviewed, it emerges clearly that anaemia, haemorrhage and abortion are recurrent causes of maternal mortality. The contribution of environmental causes such as malaria has received little consideration. Similarly, what happens prior to delivery complications has not yet been given significant attention in studies reviewed. This study, therefore, attempted to meet this shortfall by demonstrating how the environment impacts on maternal morbidity and mortality.

2.14 The Conceptual Framework

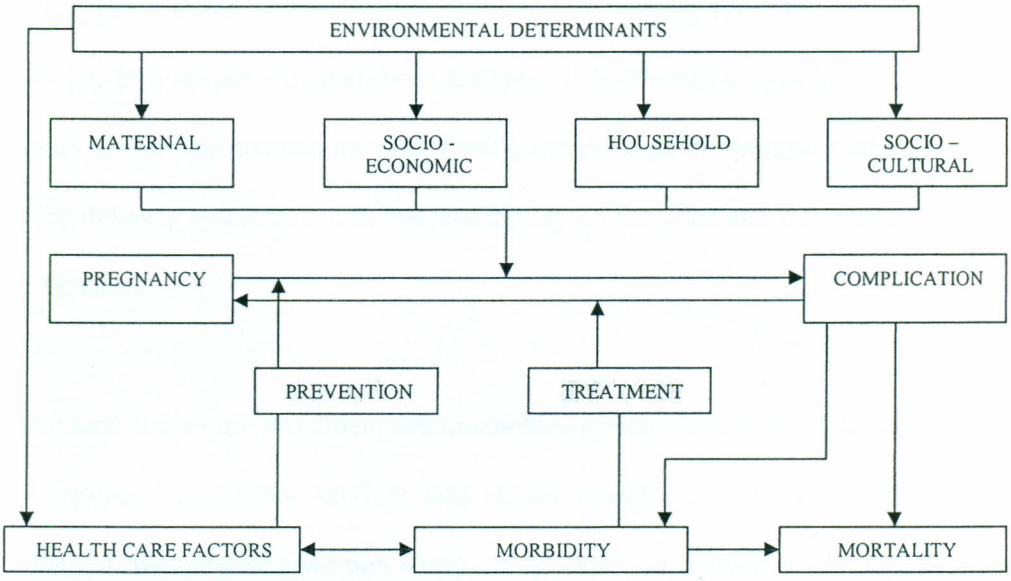
An attempt to develop a comprehensive theoretical framework that can be used in the study of maternal mortality has been made by Winikoff (1988), McCarthey and Maine (1992), and a model by Mosley and Chen (1984) to study infant mortality.

In the model developed by McCarthey and Maine, demographic and environmental factors are excluded and therefore hardly appropriate for this study. In the model developed by Winikoff, description of circumstances of mothers and girls is central making it difficult to operationalise.

Mosley and Chen's model recognises the fact that all social and economic determinants of child mortality operate through a number of proximate determinants to influence mortality. These co-authors recognise the fact that improvement in survival probabilities in any community would result from changes in social, economic, biological and environmental factors. In this model, therefore, they identify a group of five proximate determinants that directly lead to morbidity and mortality. These include: maternal factors- age, parity, and birth interval: environmental contamination- air, food/water, fingers/skin/soil/inanimate objects/ vectors; nutrient deficiency- calories, protein, micronutrient (vitamins and minerals); Injury- accidental, intentional, and personal illness control; personal preventive measures, and medical treatment.

Mosley and Chen's model, however, does not capture physical and social environmental factors relevant to this study, thus necessitating modification to incorporate issues relevant to the study on environmental determinants of maternal morbidity and mortality.

Figure 2.1: A Conceptual Framework on Environmental Determinants of Maternal Morbidity and Mortality



SOURCE: Adapted From Mosley and Chen (1984)-Population and Development Review, Supplement to vol. 10 pp. 26-48.

Drawing on the literature review, the following explanation shows how environmental factors interact to result in maternal morbidity and mortality. Immediate causes of maternal morbidity and mortality are complications of pregnancy and childbirth. The type of medical attention given to a woman during pregnancy, delivery, and the post-partum period compounds these factors. Women at risk are those who develop sudden complications and are not accorded essential obstetric care and appropriate post partum care. These emanate from social and economic disparities existing before and after conception that affect women's health and ability to seek medical care. The physical environment will determine prevalence of diseases such as malaria, hepatitis, and water borne diseases, among others. These diseases are a risk to expectant mothers.

The socio-cultural environment will determine fertility behaviour through age at marriage, age at first birth, and number of children ever born. The socio-economic environment, on the other hand, will determine the type of dwelling, source of drinking water, type of toilet facility, lighting and type of cooking fuel. The socio-economic wellbeing of a household determines the type of healthcare sought in pregnancy and delivery as well as postpartum care. Lastly, the political environment will determine service delivery system, such as the availability of facilities and personnel for health care services.

Health care factors are proximate determinants of maternal mortality. Lack of access to well equipped healthcare services and skilled obstetrician, as earlier discussed in section 2.5, will expose a woman with a complication of delivery to the risk of death. Similarly, maternal morbidities in pregnancy and post-partum period require that a victim present him/herself to a health facility for treatment and management of the condition. In other words, services provided by a qualified obstetrician in health facilities that offer Comprehensive Obstetric Care are instrumental in averting deaths from maternal morbidities and complications of delivery.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the study site, the data and methods used in carrying out the study, methods that were used to measure the concepts and relationships suggested in the research problem, and to test hypothesised relationships. It is divided into several sections that describe the study site, the data sources; the sample design, sampling procedure, and methods of data analysis, their characteristics and their limitations.

3.2 Description of the Study Site

The study was conducted in Bondo District of Kenya. The District is one of the twelve districts in Nyanza Province. It was curved out of Siaya District in May 1998. At the time of this study, the District was made up of five divisions; namely, Rarieda, Madiany, Nyang'oma, Maranda and Usigu. There were 19 locations in Bondo; North Sakwa, West Sakwa, South –West Sakwa, South Sakwa, Central Sakwa, East, West North, South and Central Yimbo, East, West, South Asembo, Central Asembo, East Uyoma, South Uyoma, West Uyoma and Central Uyoma. The District headquarters is based in Bondo town. This District is bordered by the Republic of Uganda to the West, Busia District to the North-West, Kisumu to the South East and South Nyanza to the South. Lake Victoria borders the District to the West (Ministry of Finance and Planning, 2004). Figure 3.1 shows these details.

The total area of the District is 1972 Km^2, of which 972 Km^2 is covered by land while the rest is covered by water, which is part of Lake Victoria. The population size of Bondo District was 238,780 according to the 1999 Census. Total number of females was 125,197 while the males numbered 113,583. The mean density was 242 persons per Km^2 at the time. The highest density was in Rarieda Division with 319 persons per km^2 while the lowest was in Nyang'oma Division with 186 persons per Km^2. High-density divisions are located in high potential areas while low-density areas are located in low potential zones. Bondo town had a population of 29,002 (Ministry of Finance and Planning, 1999).

Figure 3.1: Bondo District Map

Table 3.1 shows water sources in the District according to the 1999 Census. The lake, ponds and dams are the main water sources. Piped water is mainly supplied from Lake Victoria and river Yala which flows through the district.

Table 3.1: Source of Water in Bondo District, 1999.

	Pond	Dam	Lake	River	Spring	Well	Borehole	Piped
No	16790	1302	23758	6188	844	1328	3448	2419
%	29	23	41.9	10.95	1.49	23	6.09	4.21

Source: Ministry of Finance and Planning, 1999.

According to the District medical records, Bondo District faces grave health problems. Most diseases are environmental, such as malaria, diseases of the respiratory system, skin diseases, intestinal worms and diarrhoeal infections. Because of the presence of stagnant surface water, mosquitoes find easy breeding grounds. The District has one of the highest malaria prevalence rates in Kenya since it lies in the malaria holo endemic zone with stable transmission throughout the year. The infant mortality rate was 211 deaths per 1000 live births (Ministry of Finance and Planning, 2004).

In relation to female education, Table 3.2 shows the number of females in each age group by completed years of schooling. A large number of respondents had not gone beyond primary level of education according to 1999 Census statistics. The age group 15-24 formed the bulk of female population. By 2007, the gross attendance ratio for girls in secondary schools in the District was 21%, while the ratio for boys was 49.7%.

The literacy level in the District was 82% (Ministry of Planning and National Development, 2007).

Table 3.2: Female Population by Completed Years of Schooling

AGE	NO ED	PRI	1-4	5-8	FORM 1-4	5-6	UNI	N/S	TOTAL
15-19	262	244	1818	8941	1770	8	9	837	13889
20-24	259	159	672	7286	2474	12	41	250	11153
25-29	312	90	656	4786	1811	18	51	138	7862
30-34	537	89	785	3570	1344	54	46	151	6576
35-39	822	68	1088	2750	939	26	25	125	5843
40-44	1252	63	1129	1847	517	18	10	81	4917
45-49	1535	64	1031	1316	263	7	12	93	4385

Source: Source: Ministry of Finance and Planning, 1999.

On food availability, the District is self sufficient in fish and meat products, although these are out of reach of most people. There is a deficit in food production leading to incidents of malnutrition in the District (MOH, 2007). Most women in the District are either small scale farmers or housewives who derive their primary livelihood from subsistence agriculture.

The annual rainfall in the District is in the range of 800 – 1000 mm, with a mean of 910 mm. Humidity is relatively high, with a mean evapo-transpiration rate of 1,800mm per annum and a mean temperature of 22.5° C (Ministry of Finance and Planning, 2004). The District has an altitude of 1,140m above sea level.

3.3 Data Sources

Primary data sources were used in this study. These were obtained from two sets of questionnaires. The first consisted of a questionnaire administered to a sample of 1000 female respondents aged 15-49. These respondents were asked, among others, about the demographic, socio-economic, socio-cultural, health care and household amenities, all of which form background information important in maternal morbidity and mortality studies. This information was useful in exploring environmental factors that impact on maternal morbidity and mortality. The women were also asked about reproductive information pertaining to the last birth. This vital information was used to obtain data on pregnancy, delivery and post-partum complications all of which were used as risk factors for maternal morbidity and mortality. The second data set consisted of health facility survey questionnaire used to obtain information from Government records at the District Hospital, health centres and dispensaries. A major component of the questionnaire was a survey of maternal healthcare services available for pregnant mothers and for delivery. The questionnaire was administered to the District Medical Officer of Health, and to heads of health centres and dispensaries. Information obtained from this questionnaire was useful in evaluation of maternal mortality situation in accordance with process indicators (UNICEF, WHO, UNFPA, 1997).

3.4 Sample Design and Sampling Procedure

The sample for this study consisted of 1000 households. The households were randomly selected by use of a table of random numbers. The sample size was determined by application of the sample size calculation formula, which considers the variables of sample size, number of women of reproductive age and level of precision.

$$n = \frac{N}{1 + N(e)^2} = \frac{54\,525}{1 + 54\,525\,(0.05)^2} = 397$$

Where,

n = Sample size

N = No of women of reproductive age in Bondo District

E = Level of precision

Source: Yamane (1967)

However, because a population study requires large sample size to obtain reliable estimates, consideration for this factor led to the increase of the sample to 1000. To obtain the required sample size of 1000 households, the sampling design involved two stages. In the first stage, the total number of Census enumeration areas was obtained from the 1999 Census records at the Central Bureau of Statistics. There were 686 enumeration areas from which a random sample of 50 areas was selected using a table of random numbers. This was to give each enumeration area an equal chance of selection. The first enumeration area was determined statistically and the rest selected systematically at constant intervals until 50 areas were selected across the five divisions in the District. Area sampling was ideal for population identified within some geographic area with well defined boundaries. Two sampled enumeration areas fell on the islands of Mageta and Oyamo/ Ndeda which are difficult to access. These areas were excluded and two randomly selected areas from Usigu Division were used as substitutes to the original sampled areas. Maps for the selected enumeration areas were obtained from the District Statistical Officer.

The second stage consisted of a random selection of households. The local village elder provided information on the total number of households in each enumeration area. A sampling interval (n) was calculated by dividing the number of households in the area by twenty. Twenty was the total number of interviews conducted in each enumeration area. The first household was determined by random number generation and each n^{th} household was selected until the entire enumeration area was covered. Twenty households were thus selected from each of the 50 sampled enumeration areas making a total of 1000 households sampled. This large sample is desirable in mortality studies (Hanley et. al., 1996). From each household, only one female of reproductive age 15-49 was selected for interview. In the end a total of 999 women responded, giving a response rate of 99%.

Prior to the survey, training of research assistants was conducted at the District Commissioner's Boardroom for one day. This training was pertinent to the success of data collection, though the research assistants were experienced, having been drawn from the Kenya National Bureau of Statistics (KNBS). The data collection phase took three days and was organised to cover the two divisions of Madiany and Rarieda on the first day. On the second day, interviews were conducted in Maranda division in which Bondo town falls. On the last day, interviews were conducted in Usigu and Nyang'oma divisions.

Four teams were set up to conduct the interviews. The entire research team consisted of four supervisors, 25 research assistants from Kenya National Bureau of Statistics, four drivers and the Principal Researcher. Each team had a supervisor, six interviewers and a driver. One team, however, had seven interviewers. The research work was

coordinated by the District Statistical Officer. The interviews were conducted in a private setting with no one else present except the interviewer and, where applicable, a translator. The supervisors conducted spot checks in the field to ensure quality data collection and strict adherence to instructions. At the end of the day, the supervisors collected completed questionnaires from each research assistant. The completed questionnaires were carefully checked to ensure that all sections were completed and correctly filled. Data cleaning was done to ensure consistency.

3.5 Rationale for Selection of Variables

Consistent with literature review in Chapter Two, individual and contextual variables have been found to impact on maternal morbidity and mortality. These are key variables in mortality studies and are considered environmental because they are part of the external circumstances of these women. The following variables were therefore selected for this study:

a) **Maternal Variables:** These were age of woman, age at first birth and parity.

b) **Socio-economic Variables:** Level of education, employment status, income, husbands level of education and husband's occupation.

c) **Healthcare Variables:** Practice of family planning, antenatal clinic attendance, person seen for antenatal clinic, place of delivery and delivery attendant.

d) **Household Variables:** Toilet facility, fuel used for cooking, floor material, wall material and source of water.

The theoretical discussion of how the designated variables are related and interact with each other as predictor variables of maternal morbidity and mortality has been summarized in the literature review.

There were two dependent variables in this study. These were maternal morbidity and maternal mortality. The independent variables were maternal factors, socio-economic and healthcare, socio-cultural and household factors. Healthcare factors were included in the independent variables because they are immediate causes of death. These variables have been reviewed in literature and have been consistently found to impact on maternal morbidity and mortality.

3.6 Methods of Data Analysis

The methods of data analysis used in this study are described in this section. The general application of these methods, their assumptions, and their limitations are described.

3.7 Descriptive Methods

Frequency tables were used to display characteristics of the sample population. The percentage distribution of cases in each category also helped in collapsing empty cells for purposes of logistic regression analysis. Descriptive methods lend themselves to easy interpretation (Cooper and Schindler, 2005).

3.8 Logistic Regression

Logistic Regression is a linear regression, which uses the logarithm of the relative proportion of cases to non-cases as the dependent variable. This is a special class of log-linear models used to examine the relations between dichotomous dependent variables and independent variables. The method is useful in assessment of the degree to which the dependent variable is determined by a set of independent variables, and which independent variable is most strongly related to the dependent variable.

The regression co-efficient for each of the independent variable provides an estimate of the 'odds ratio', exp (B), which is the ratio between the chance that an event will occur when a given factor is present to a chance it will occur when the factor is absent. The odds- ratio is therefore used to measure the effect of the explanatory variables on the dependent variables. The value ranges from negative to positive infinity. A value of 1(one) represents the reference category. Any odds of a value less than 1, represents a negative effect of the variable while any odds with a value greater than 1 represents a positive effect of the variable or variable category on the independent variable. For example, an odds-ratio of 4.95 for the risk factor " place of delivery" with respect to maternal death would mean that if all other factors are constant, a woman who has not delivered in a health facility is about five times more likely to realise a maternal death than a woman who has delivered in a health facility. Similarly an odds-ratio of less than 1 means the risk is reduced rather than increased if the factor is present. The odds-ratio is, therefore, used to measure the effect of the explanatory variables on the study variable. The logistic regression also served as a framework for statistical testing (Cooper and Schindler, 2005).

Several considerations dictated the choice of logistic regression analysis for this study. The application of logistic regression analysis was found necessary because the dependent variables are dichotomous. That is, a woman will either experience or not experience a complication of pregnancy, or of delivery, or a post-partum complication. Secondly, logistic regression is ideal for prediction of an outcome of an event as well as in pointing the direction of the outcome. This was instrumental in determining risk factors for maternal morbidity. Third, some variables were measured on different scales. Some were aggregate others ordinal and while others were nominal. The combination of both individual and contextual variables necessitated the use of regression analysis as an ideal method of analysis applicable to these types of variables. The combined effect of such variables on an outcome such as a pregnancy or delivery complication is picked up in a logistic regression analysis. In addition, when some variables under study are categorical, this factor calls for care in the interpretation of results. This is because the presence of multicolinearity (where two or more variables are highly correlated) affects the regression co-efficients by raising the standard error of the estimates (Cooper and Schindler, 2005).

3.9 Limitations of Logistic Regression Analyses

One major assumption underlying the application of logistic regression analysis is the sample size. This is because the test statistic used in the selection of the model depends on and is affected by the sample size. The sample size should be large to allow a reasonable number of cases in each cell especially when it comes to categorical variables. In dealing with categorical variables it may be necessary to collapse some categories to avoid a situation of empty cells or cells with under five values. Collapsing

variables may be convenient in cases of financial constraints and time. The main problem with collapsing categories is that important information unique to a particular category or categories is usually lost and the conclusion drawn about the relationship may be inconsistent with those in the underlying population. Alternatively categorical variables may utilise one of the categories as the reference usually the category with the highest frequency is taken as the reference category and hence the k-1 dummy variable in the model. The treatment of dummy variables in this manner requires proper specification and careful interpretation of the B's in the dummy variables.

Another problem of multiple logistic regression is that of multicolinearity which is defined as the inter-correlation of the independent variables. The problem arises when independent variables overlap. The presence of multicolinearity affects the regression coefficients by raising the standard error of the estimate (Cooper and Schindler, 2005). The individual influence of each variable and its effect on the dependent variable becomes unreliable. If multicolinearity is suspected, then examination of the simple correlation among estimated co-efficient can be done from the variance co-variance matrix or simple correlation tests. If serious multicolinearity is present it becomes difficult to test hypothesis about individual co-efficient and therefore it is necessary to resort to joint hypothesis tests that is F-tests on sets of co-efficients.

Finally, the log-linear approach, assumes that all the observed frequencies for cells of the cross-classification are greater than zero. Otherwise estimation is impossible. To overcome this problem, it has been suggested that each sample zero be replaced by 1/R where R is the total number of cells in the table or alternatively adding ½ to each elementary cell before analyzing the model with zero cells. In this study, only

categories with values greater than five were entered in the model for analysis. The sample was large, drawn randomly and independently from the population. This was achieved by careful calculation of sample size requirement and through random selection of enumeration areas and households for the study. There were possibilities of enumeration and coverage errors anticipated though an attempt was made to minimise such errors by careful selection and training of interviewers and by use of supervisors to check the work of the interviewers.

For the purposes of logistic regression analysis, all reported cases of pregnancy, delivery or post-partum complication were coded as one, and as zero if no complication was suffered. Stepwise regression was applied for selection of significant variables at 0.05 significant level.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This Chapter presents the results and discussion of data analysis. The Chapter is divided into six sections. Section 4.1 presents the introduction and section 4.2 provides a description of background characteristics of the sample population. These characteristics were derived from responses to each question in the questionnaire by female respondents aged 15-49. Section 4.3 presents the estimate of maternal mortality rate in Bondo District. Section 4.4 of the Chapter addresses the second objective of the study, namely to determine environmental related risk factors for maternal morbidity and mortality in the District. Classification of variables entered in the regression model is outlined in section 4.5. Progress made to lower maternal mortality in the District is outlined in section 4.6. The summary of findings is in section 4.7.

4.2 The Sample Characteristics

This section presents a description of the characteristics of the sample population. These characteristics are essential in understanding the issues related to maternal morbidity and mortality in the District. The findings presented in this section formed a basis for logistic regression analysis. The results were based on a total 999 females who responded to the questionnaires.

Figure 4.1: Percentage Distributions of Respondents by Age Group

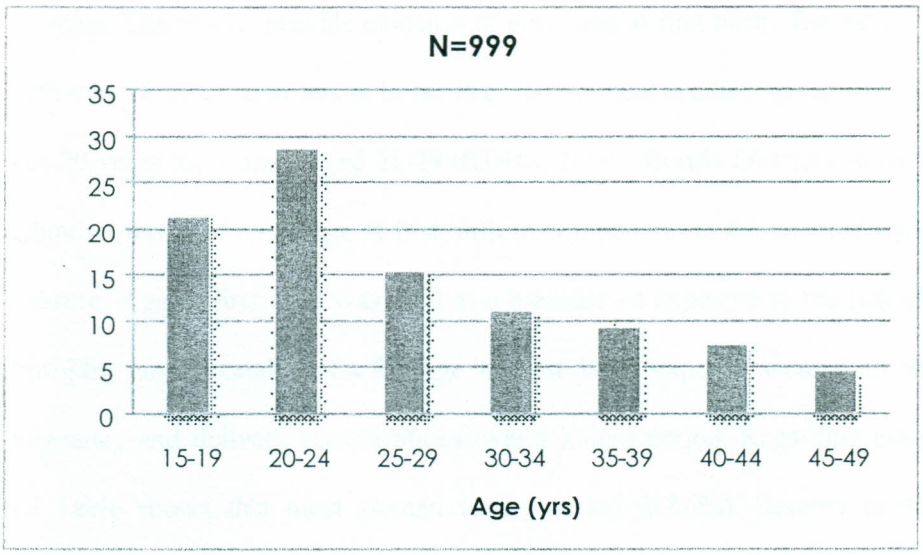


Figure 4.1 presents the bar chart for the age groups. The results show that the sample population largely consisted of women aged 15-19 (21.5%) and women aged 20-24 (29.7%). These two age groups constitute the peak of fertility. In view of the fact that age of the mother is known to be a critical determinant of maternal mortality, the age distribution in the community may point to potential risks of maternal morbidity and mortality. The risks associated with reproduction are likely to be higher among women aged 15-19.

Table 4.1 displays demographic characteristics of the sample population. These were investigated for their possible influence on maternal morbidity and mortality. The Table displays the number of women in the sample who had ever given birth. In total 78.8% had ever given birth. This group represents the proportion exposed to the risk of maternal morbidity and mortality and consequently the focus of the study.

The table also shows that 61.6% of the women interviewed had given birth at ages 15-19 years. The results provide evidence of early age at first birth. The mean age at first birth was 18 years, and this is lower than the national median age at first birth which was 20 years for women aged 25-29 (KDHS, 2003). Bondo District can be said to lag behind in terms of rising age at first birth in comparison to the national figure for this measure. Age at first birth was used as a measure of exposure to the risk of maternal morbidity and mortality. Earlier age at first birth exposes women to the risk of pregnancy and delivery complications over a longer period. Regarding marital status, the Table shows that most women were married (67.6%). Seventy percent of the women in the sample were married before first birth. Marital status represents exposure to the risk of pregnancy.

Table 4.1: Demographic Characteristics

AGE GROUP	NUMBER	PERCENT
15-19	215	21.7
20-24	297	29.8
25-29	156	15.7
30-34	113	11.4
35-39	95	9.6
40-44	76	7.7
45-49	47	4.7
TOTAL	999	100
Marital Status	**Number**	**Percentage**
Married/ living together	676	67.6
Single	153	15.3
Widowed	100	10.0
Divorced/ not together	8	0.8
Never married	62	6.2
Total	999	100
Given birth	**Number**	**Percentage**
Yes	788	78.9
No	211	21.1
Total	999	100
Age at first Birth	**Number**	**Percentage**
Below 15	15	1.9
15-19	491	61.6
20-24	259	32.5
25-29	31	3.9
30-34	1	0.1
Total	797	100
Married at first birth	**Number**	**Percentage**
Yes	552	70.1
No	236	29.9
Total	788	100
Parity	**Number**	**Percentage**
0	194	19.4
1	169	16.9
2	176	17.6
3	118	11.8
4	113	11.3
5	76	7.6
6	60	6.0
7	89	8.9
Not stated	4	0.4
Total	999	100

Table 4.1, also shows that, a majority of women in the sample had between 1 and 4 children. The total number of children ever born declines with increasing age. The results also showed that 19% of the women had not given birth at all. Parity has implications for maternal morbidity and mortality as reviewed in the literature.

The Table also shows that women in the sample married at a very early age. Some of the women were married as early as age 12. Age at marriage determines the onset of the socially acceptable time for childbearing. Therefore, women who marry early will, on average, have a longer exposure to the risk of pregnancy, and thus leading to higher parity. A longer exposure to pregnancy predisposes women to the risk of maternal deaths via complications associated with pregnancy and delivery. Figure 4.2 demonstrates age at marriage clearly in a bar chart.

Figure 4.2: Age at Marriage

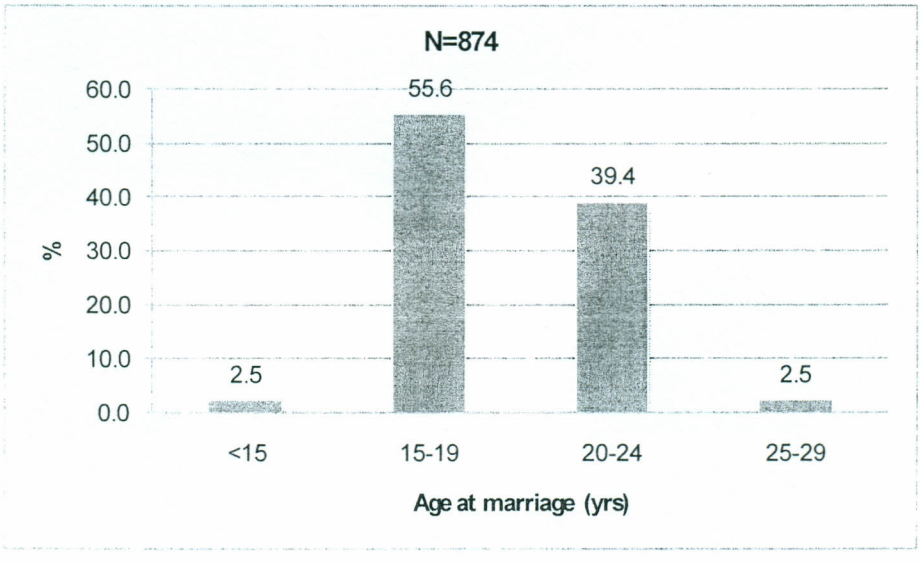


Table 4.2 displays socio-economic characteristics. Sixty eight percent of these women had primary education. Only 5.2% had secondary education. The same

pattern of education of women was evident in the census of the year 1999 (Ministry of finance and Planning, 1999). Primary education represents exposure to little knowledge hardly adequate to enhance desired healthcare. This may lead to lack of family planning and antenatal care. The Table also shows that, 30% of the women were engaged in subsistence farming. Farming was therefore the main occupation of most women in the sample population. In addition, the Table shows that 86% of the women did not state their employer, probably suggesting lack of permanent employment and a confirmation of involvement in small scale business activities. Table 4.2 also shows that on the average, the women in the sample earned an income of Kenya shillings (Kshs) 1500-3000, with a very small proportion earning Kshs 15001-18000. This shows that most of the women in the study were in the lower income group, hence the dissatisfaction with income earned.

Table 4.2: Socio-economic Characteristics

Level of Education	**Number**	**Percentage**
No education	60	6.0
Primary	679	68
Secondary	235	23.5
College	25	2.5
Total	999	100
Occupation of woman	**Number**	**Percentage**
Farming	299	29.9
Fish trade	46	4.6
Shopkeeper, kiosk, Hawking	239	23.9
Hotel business	5	0.5
Hairdresser	8	0.8
Student	109	10.9
Tailoring	26	2.6
Labourer	8	0.8
Housewife	58	5.8
Salaried employee	38	3.8
Nothing	45	4.5
Not stated	116	11.7
Total	999	100
Employer	**Number**	**Percentage**
Self	87	8.8
Government	20	2.0
Individual/church	11	1.1
Unemployed/church	20	2.0
Not Stated	860	86.0
Total	998	100
Income	**Number**	**Percentage**
None	145	14.5
1500-3000	343	34.3
3001-5000	72	7.2
5001-8000	23	2.3
8001-10000	8	0.8
10001-15000	16	1.6
15001-18000	4	0.4
Other	93	9.3
Not Stated	295	29.5
Total	999	100
Opinion on income	**Number**	**Percentage**
Very dissatisfied	135	21.7
Dissatisfied	352	56.7
Satisfied	81	13.0
Fairly satisfied	50	8.1
Very satisfied	53	8.6
Total	621	62.2%
Non Response	378	37.8

Table 4.3a presents results of the women's occupation: Farming and small scale business activities were the main economic activities of women in the sample population. Table 4.3b shows that most of the husbands were either farmers or fishermen. Very few were in formal employment. Occupation was measured on a five-point scale to determine the extent of engagement.

Table 4.3a: Field of Occupation

Field	Always	Mostly	Occasionally	At times	Never	Total
Selling	273(27.3%)	34(3.4%)	29(2.9%)	54(5.4%)	433(43.3%)	823(100 %)
Farming land	306(30.6%)	57(5.7%)	62(6.2%)	158(15.8%)	241(24.1%)	824(100%)
Teaching	29(2.9%)	5(0.5%)	1(0.1%)	2(0.2%)	767(76.7%)	804(100%)
Medical	2(0.2%)	-	-	1(0.1%)	799(79.9%)	802(100%)
Financial	1(0.1%)	-	-	3(0.3%)	796(79.6%)	800(100%)
Agricultural	6(0.6%0	3(0.3%)	19(1.9%)	17(1.7%)	755(75.5%)	800(100%)
Tailoring	20(2.0%)	2(0.2%)	10(1.0%)	4(0.4%)	766(76.6%)	802(100%)
Transport	2(0.2%)	2(0.2%)	-	2(0.2%)	794(79.4%)	800(100%)
Handicraft	11(1.1%)	2(0.2%)	10(1.0%)	17(1.7%)	759(75.9%)	799(100%)
Other	10(1.0%)	3(0.3%)l	1(0.1%)	4(0.4%)	498(49.8%)	516(100%)

Table 4.3b: Husbands Field of Occupation

Type of work	Always	Mostly	Occasionally	At times	Never	Total
Selling	72(7.2%	14(1.4%)	34(3.4%)	33(3.3%)	501(50.2%)	654(100%)
Farming	175(17.5%)	29(2.9	65(6.5%)	108(10.8%)	284(28.4%)	661(100%)
Teaching	37(3.7%)	10(1.0)	2(0.2%)	1(0.1%)	607(60.7%)	655(100%)
Medical field	7(0.7%)	_	_	2(0.2%)	644(64.4%)	653(100%)
Financial Institution	10(1.0%)	6(0.6%)	_		637(63.7%)	653(100%)
Agric sector	16(1.6%)	7(0.7%)	9(0.9%)	21(2.1%)	601(60.1%)	635(100.%)
Fishing	113(11.3%)	9(0.9%)	7(0.7%)	10(1.0%)	519(51.9%)	658(100%)
Mining	2(0.2%)	1(0.1%)	1(0.1%)	1(0.1%)	647(64.7%)	658(100%)
Building	37(3.7%)	9(0.9%)	16(1.6&)	14(1.4%)	578(57.8%)	654(100%)
Carpentry	33(3.3%)	7(0.7%)	11(1.1%)	7(0.7%)	600(60.0%)	658(100%)
Tailoring	7(0.7%)		1(0.1%)	3(0.3%)	644(64.4%)	655(100%)
Any other	42(4.2%)	8(0.8%)	9(0.9%)	6(0.6%)	429(42.9%)	494(100%)

Figure 4.3 is a bar chart showing the percentages of those who had attended antenatal care and those who had not. Ninety six percent (96%) of the women who had given birth prior to the survey attended antenatal care. This percentage is higher than the national average of 88 % according to the NCPD, 2003. Only four percent (4%) of the women failed to attend antenatal care. A variety of reasons were given to explain this failure. Notable among these were distance to the nearest health clinic, poor service, fear, embarrassment and poor condition of roads, among others.

Figure 4.3: Antenatal Care Attendance and Non-attendance

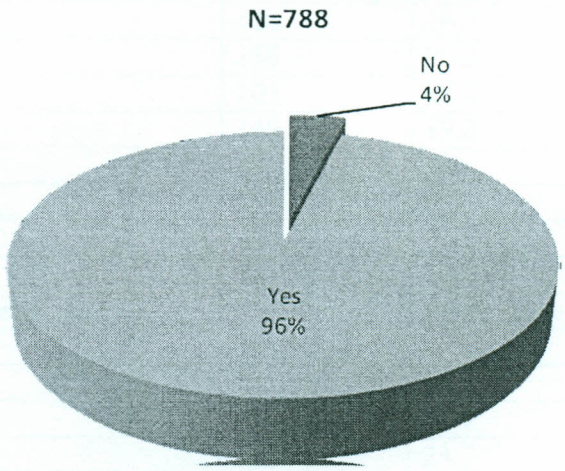


Table 4.4 displays further information on antenatal care. The information shows that 12.3 % of the respondents saw a doctor for antenatal care. This percentage falls below the national average of 14.7% (NCPD, 2003). The percentage (83.9%) that saw a nurse or midwife is higher than the average of 71.8% for Nyanza (NCPD, 2003), showing that only a small percentage of the women were able to be attended to by a doctor. The role of traditional birth attendants in provision of antenatal care is diminishing as shown from the small percentage that receives antenatal care from such sources.

Table 4.4: Further Information on Antenatal Care

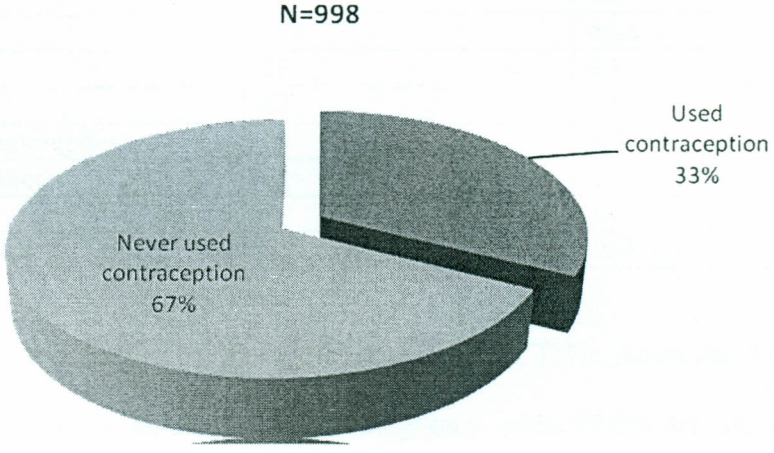
Reason for no antenatal Care	**Number**	**Percentage**
Facility is far	9	32.1
No need	8	28.6
Other	11	39.3
Total	28	100
Care provider	**Number**	**Percentage**
Doctor	91	12.3
Nurse/Midwife	619	83.9
TBA (Trained)	23	3.2
TBA(Untrained)	4	0.5
Other	1	0.1
Total	738	100
First visit in months preg	**Number**	**Percentage**
1	7	0.9
2	68	9.1
3	120	16.0
4	150	20.0
5	209	27.8
6	149	19.8
7	39	5.2
8	7	0.9
9	2	0.3
Total	751	100
Number of visits	**Number**	**Percentage**
1	35	4.7
2	181	24.2
3	134	17.9
4	178	23.7
5	136	18.1
6	57	7.6
7	19	2.5
8	7	0.9
9	3	0.4
Total	750	100

On timing and number of antenatal visits, results in Table 4.4 show that a majority of the women attended antenatal care only two to five times, and that only a small percentage of mothers attended antenatal clinic more than six times. In other words, the attendance falls short of the recommended 14 antenatal visits. Health personnel recommend that antenatal visits begin in the first trimester when monthly visits must

follow. After 28 weeks, a fortnightly schedule is followed until the ninth month when weekly visits are observed until delivery. The results, therefore, appear to imply that the women may not be aware of the need for regular antenatal visits and the rationale for beginning antenatal clinic attendance early in pregnancy.

Figure 4.4 is a bar chart showing the percentages of the respondents who used contraceptives and those who never used the contraceptives. The women who ever used contraceptives were 32.5%, while 67.5% did not use any method. The percentage of women that ever used contraceptives in Bondo is far below the national figure of 68% (KDHS, 2003). However, this percentage is above 27.5% for Nyanza Province in 2003.

Figure 4.4: Contraceptive Use and Non-Use in Bondo District



The Bongaarts' model (1978) of proximate determinants of fertility recognizes the importance of contraceptive use as a major determinant of fertility. The implication of low contraceptive use for maternal morbidity and mortality is rather serious. First, this exposes non- contraceptors, who are a majority, to the risk of pregnancy and as a result,

to the risk of death. Secondly, low contraception may result in many births, thus exposing the women much longer to the risks of maternal death. Thirdly, non-use of contraception may lead to unwanted pregnancies and child birth, compounding the risks of maternal death in the community.

Table 4.5 shows results of type of contraception used. Twenty percent of the women in the sample used pills and 48.6% used the injection. In summary, of the 998 respondents, 325 (32.5%) had used a variety of family planning methods, of which the injection was the most common. That the injection was a popular method of family planning was clear from the District Health Reports (Ministry of Health, Bondo, 2007).

Table 4.5: Type of Contraceptive Used

Contraceptive	Number	Percentage
Pill	66	20.3
IUD	19	5.8
Injection	158	48.6
Condom	28	8.6
Norplant	22	6.8
Rhythm/counting days	16	4.9
Natural method	12	3.7
Others	4	1.2
Total response	325	100

Table 4.6 presents results of diet in last pregnancy. The Table shows that 51.0% of the respondents took special diet during last pregnancy, while 49.0% did not. The quality of nutritional intake in pregnancy matters for the health of both the mother and the foetus.

Table 4.6: Diet in Pregnancy

Took Special diet	**Number**	**Percentage**
Yes	399	51.0
No	383	49.0
Total	782	100
Reason for no diet	**Number**	**Percentage**
Not necessary	42	46.7
No money diet	42	46.7
Due to illness	2	2.2
Not aware of need for diet	4	4.4
Total	90	100
Type of food	**Number**	**Percentage**
Bananas, avocados	55	5.5
Eggs, fish, chicken	38	3.8
Meat from dead cattle	19	1.9
Sugar, sweet foods	16	1.6
Others	17	1.7
None	854	85.5
Total	999	100.0
Reason	**Number**	**Percentage**
Baby grows too big	906	90.8
Bleed at Delivery	39	3.9
May lead to miscarriage	16	1.6
Baby may be abnormal	24	2.4
No reason	5	0.5
Not stated	8	0.8
Total	998	100.0

Extra nutrients and energy are needed to meet the needs of the growing foetus as well as the changes in the mother's body to accommodate the foetus. This calls for extreme care to meet nutrient need. In the sample population, almost half the number of women had no special diet. The main reasons given for this were ignorance and lack of financial resources.

Eighty five percent (85%) of the women indicated that they were not prohibited from taking any diet. Only fifteen percent (15%) indicated that they were prohibited from taking some types of food during pregnancy. These foods included bananas,

avocadoes, eggs, fish and chicken. A few respondents indicated milk, groundnuts, sugar, sweet foods, Irish potatoes and alcohol. These responses portray lack of dietary restrictions during pregnancy. On the reasons for dietary restrictions, 90.8% of respondents indicated that this was to prevent the baby from growing too big, 3.9% indicated prevention of bleeding at birth, 2.4% indicated abnormality at birth and 1.6% cited miscarriage.

Table 4.7: Diet Taken in Pregnancy

Servings	0	1	2	3	4	5	Total
Milk,	4(0.6%	475(67.4	154(21.8%	40(5.7%)	9(1.3%)	23(3.3%)	705(100%)%)
Vegetable	-	106(14.0%	375(49.7%	132(17.5%	76(10.1%	66(8.7%)	755(100%),
Fruits	-	247((33.0)	173(23.1%	161(21.5%	68(9.1%)	99(13.2%	748(100%)
Bread/	-	223(30.4%	239(32.6%	140(19.1%	57(7.8%)	75(10.2%	734(100%)
Proteins	-	309(42.3%	284(38.9%	82(11.2%)	29(4.0%)	26(3.6%)	730(100%)

Table 4.7 presents results of the number of times the women in the sample population consumed particular types of food. The results show that 0.6% women did not take milk or yoghurt, 67.4% took milk or yoghurt once daily and this means a majority fell short of the recommended ratios, only twenty eight percent took the recommended 2-3 servings per day. With regard to vegetables, only 17.5% took three times in a day as recommended. On fruits, 33% women took fruits once thus failing to take required number of servings. The rest of the women surpassed the number of servings needed.

In the carbohydrate sources, of bread, ugali (traditional meal), cassava category, 30.4% took once daily, 32.6% twice, 19.1% took three times daily, 7.8% took four times, and 10.2% took five times. In the protein sources of beef, chicken, fish eggs, dry beans, 42.3% women said they took once daily, 38.9% twice daily. In other words, the majority did not achieve the recommended number of servings. Failure to take

adequate energy giving foods is likely to contribute to energy deficiency among the women.

Table 4.8: Illnesses Suffered in Pregnancy

Illness	Always	Mostly	Occasionally	At Times	Never	Total (100%)
Malaria	128(29.4%)	32(7.3%)	83(19.0%)	83(19.0%)	110(25.2%)	436(100%)
Cough	16(3.7%)	18(4.1%)	56(12.9%)	39(9.0%)	305(70.3%)	434(100%)
STD	2(0.5%)		7(1.6%)	3(0.7%)	423(97.2%)	435(100%)
Anaemia	16(3.7%)	7(1.6%)	21(4.8%)	19(4.4%)	372(85.5%)	435(100%)
Lower Abd Pain	64(14.7%)	16(3.7%)	72(16.6%)	47(10.8%)	236(54.3%)	435(100%)
Haemorrhage	6(1.4%)	7(1.6%)	18(4.2%)	16(3.7%)	384(89.6%)	431(100%)
Vomiting	66(15.3%)	20(4.7%)	42(9.8%)	89(20.7%)	213(49.5%)	430(100.0%)
Fits/Convulsions	16(3.7%)	11(2.5%)	18(4.2%)	17(3.9%)	370(85.6%)	432(100%)

The type of illness and the frequency with which the women suffered in the course of their last pregnancy is displayed in Table 4.8. Malaria was the most suffered illness. It affected twenty nine percent of the women and seventy four percent of these women during their last pregnancy. Other diseases suffered by these women were cough, fever, STD, anaemia, haemorrhage, lower abdominal pain, vomiting, fits and convulsions. The least suffered illness was sexually transmitted disease.

Table 4.9 presents results of healthcare sought for illness in the last pregnancy.

The results show that 85% of the women who had an illness saw someone for treatment, the rest did not. Of the women who did not see someone for treatment, 59% thought it was a normal illness, 10% had no money, while 18.6% treated themselves. From the women who saw someone for treatment, 52% saw a nurse or midwife, while 41% saw a doctor. The traditional healer and traditional birth attendant were seen by a small percentage of the women. The type of health facility nearer mothers matters in case of an emergency. Thirty seven percent of the women

were nearer a hospital, while thirty one percent were nearer a health centre. While twenty seven percent said the nearest health facility was a dispensary.

Table 4.9: Type of Treatment

Saw Someone for Treatment	**Number**	**Percentage**
Yes	377	85.5
No	59	13.5
Total	436	100
Reason for no treatment	**Number**	**Percentage**
Felt it was normal	35	59.3
Had no money	8	10.2
Health facility far	3	5.1
Self treatment, fear, ignorance	13	12.0
Total	59	100
Person Seen for Treatment	**Number**	**Percentage**
Doctor	189	40.6
Nurse/Midwife	246	52.9
TBA/Trained	10	2.2
TBA Untrained	7	1.5
Traditional Healer	5	1.1
Not stated	8	1.7
Total	465	100
Nearest Health Facility	**Number**	**Percentage**
Hospital	375	38.4
Health Centre	272	27.8
Dispensary	310	31.7
Private Clinic	12	1.2
Other	8	0.8
Total	977	100
Transport	**Number**	**Percentage**
Car	28	2.9
Public Transport	117	12.0
Bicycle	168	17.2
Animal	7	0.7
Walking	657	67.2
Total	977	100

With regard to mode of transport to nearest health facility, the results show that walking was the main means to the nearest health facility. Sixty five percent of the

women walked to the nearest health facility, while a small percent used either public or public transport.

Table 4.10 displays results of the mean time taken to the nearest health facility: This shows the average number of minutes it took the respondents to travel to the nearest health facility by various modes of transport. The results show that, except for animal transport which on average takes 82 minutes, other modes of transport take 40 minutes. The use of animals for transport in Bondo District is a rare occurrence except in remote parts not accessed through public transport. Such locations of the District would be far from health facilities and hence the longer it takes to reach a facility in comparison to the shorter time it takes to walk.

Table 4.10: The Mean Time Taken in Minutes to the Nearest Health Facility

Mode of Transport	Mean time (minutes)
Car	39.64
Public Transport	41.45
Bicycle	41.32
Animal	82.14
Walking	45.70

The results in Table 4.11 display type of delivery care received by women in the sample population. Place of delivery is important for the safety of the mother and the child (See Figure 4.5). Most maternal deaths occur during labour, delivery or soon after (Smith, 2003). The percentage of home deliveries in the study population was 50.1 %. Although this was lower than 62.6% of home deliveries recorded for Nyanza province in 2003 (NCPD, 2003), it was higher in comparison to Central Province where 31.9% delivered at home (KDHS, 2003). It is expected that all deliveries (100%) should take place in a health facility if maternal deaths have to be brought to a minimum (UNICEF,

WHO, UNFPA; 1997). Figure 4.6 shows that 41% of deliveries were assisted by a nurse/ midwife, while a significant percentage received delivery assistance from an untrained traditional birth attendant. Although this kind of delivery assistance continues to play a vital role in assisting women who deliver at home, the major problem lies in their inability to handle difficult deliveries or sudden complications.

Table 4.11: Delivery Care

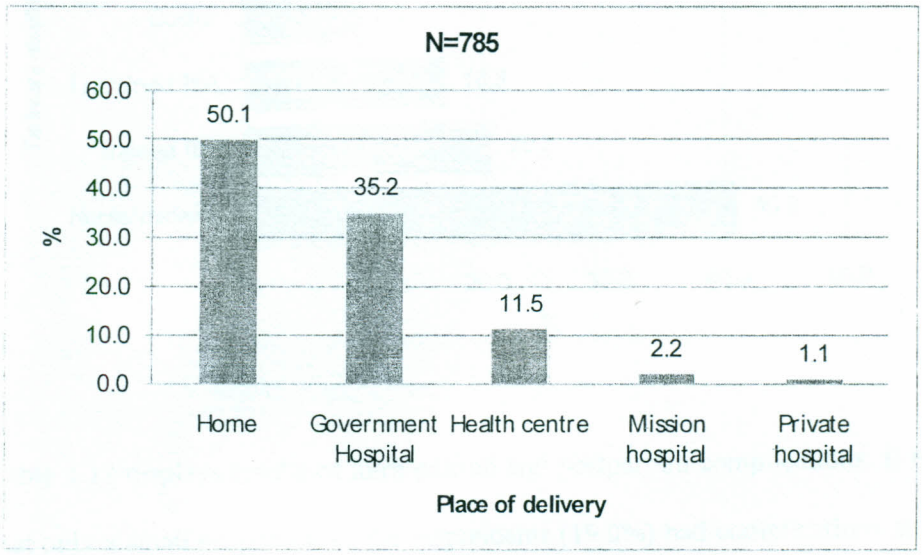
Place of Delivery	**Number**	**Percentage**
Home	393	50.1
Government Hospital	276	35.1
Health centre	90	11.5
Mission hospital	17	2.1
Private hospital	9	1.1
Total	785	100
Assistance at delivery	**Number**	**Percentage**
Doctor	78	9.9
Nurse/midwife	327	41.5
TBA (trained)	162	20.6
Untrained TBA	133	16.9
Relative/friend	57	7.2
Other	31	3.9
Total	788	100
Mode	**Number**	**Percent**
Normal	750	96.0
Caesarean	31	4.0
Total	781	100
Reason for caesarean	**Number**	**Percent**
Big baby/small canal	14	63.6
Others	8	36.4
Total	22	100

In emergencies, an obstetrician becomes handy since they are equipped with skills to handle emergencies and delivery complications. In the sample population, only 10% were delivered by a doctor. It is expected that expectant mothers should receive

delivery assistance from a skilled birth attendant, irrespective of whether the pregnancy is perceived to be without complications.

Figure presents a bar chart showing the place of delivery.

Figure 4.5: Place of Delivery



Concerning mode of delivery, 96% of the women had normal births (Table 4.11). Only a small percentage had caesarean sections. Of the women who had caesarean sections, the main reason was because the baby was too big. The rest of the women gave a range of reasons for caesarean sections. A significant percentage however did not give reasons for their caesarean section.

Figure 4.6 shows the type of delivery assistance.

Figure 4.6: Delivery Assistance

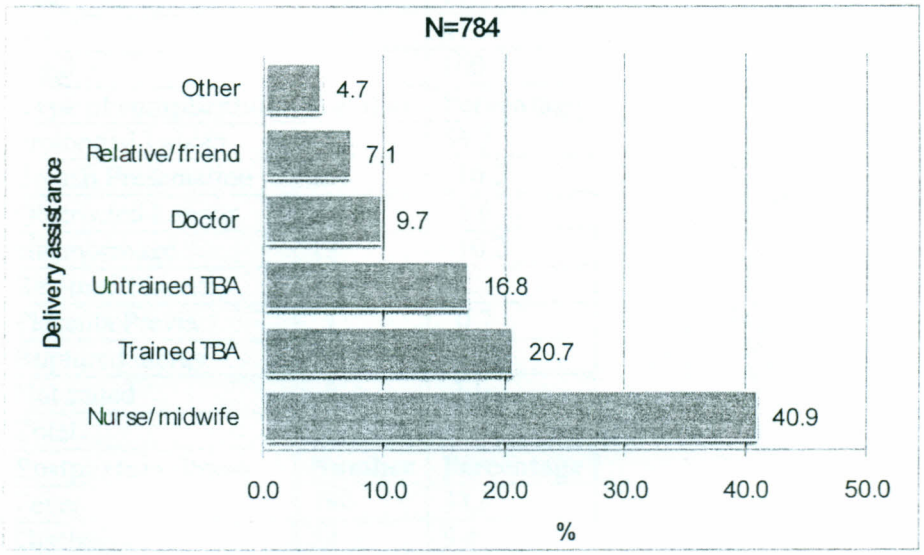


Table 4.12 displays results of intra-partum and postpartum complications. It is evident that only a small proportion of the respondents (19.0%) had complications at delivery, whereas the majority (81.0%) did not experience any complications. Of the women who had complications, 52.3% had prolonged labour. This was the major delivery complication realised in the study population. Other forms of delivery complications were haemorrhage, breach presentation and retained placenta. Ruptured uterus and placenta previa were negligible.

On postpartum illness, the results showed that fever and pain below umbilicus were the main illnesses the afflicted the women in the sample. This affected 33.6% and 26.75 of the women. These problems may be linked to some infection hence the fever and pain below umbilicus. Heavy bleeding (Postpartum haemorrhage) affected almost twelve percent of the women.

Table 4.12: Complications at Delivery and Postpartum Period.

Complication	**Number**	**Percentage**
Yes	138	19.0
No	587	81.0
Total	725	100
Type of complication	**Number**	**Percentage**
Prolonged Labour	69	54.3
Breach Presentation	13	10.2
Obstructed Labour	7	5.6
Haemorrhage	13	10.2
Retained Placenta	14	11.2
Placenta Previa	1	0.7
Ruptured uterus	1	0.7
Not stated	9	7.1
Total	127	100
Postpartum illness	**Number**	**Percentage**
Fever	190	33.6
Discharge	53	9.4
Bleeding Heavy	67	11.8
Pain below umbilicus	151	26.7
Depressed anxious	29	5.1
Other	76	13.4
Total	566	100

Table 4.13 shows results of quality of healthcare offered at the nearest health facility. Thirty nine percent of the women indicated that health services at the nearest facility were good. However, thirty three percent said the healthcare services were poor. These responses were relative and subject to further analysis to identify the health facilities perceived to offer either good or poor service.

Regarding problems at the health facilities, the women identified inadequate staff, lack of facilities, lack of drugs and dirty facilities. Others complained of harsh and arrogant nurses. However, distance did not appear to be a problem.

Table 4.13: Quality of Health Services at Nearest Health Facility

Opinion on quality of service	**Number**	**Percentage**
Good	159	39.2
Satisfactory	30	7.4
Average	64	15.8
Bad	136	33.5
Expensive	9	2.2
Lack of Staff	2	0.5
Okay	5	1.2
Rude Uncooperative Nurses	1	0.2
Total	406	100
Problems at health facility	**Number**	**Percentage**
Inadequate personnel	41	14.9
Lack of facilities	41	14.9
Dirt in hospital	32	11.6
Few wards and beds	12	4.3
Harsh/arrogant nurses	55	19.9
No drugs	83	30.1
Long distance	4	1.4
High Charges	8	2.9
Total	276	100

Table 4.14 displays results of source of water that the households used. The variable was measured on a five point scale to determine the regularity and frequency of use of a particular source of water. Multiple responses were allowed. Only 3.7% of households always used water piped into the house. A higher percentage of 16.6% always used a public tap. Another 6.8% used water from a well. Only 5.8% used pumped well water. A high proportion of 56.7% of the women used lake, river or pond. These sources of water are easily contaminated by animals and humans, which may expose the women to the risk of waterborne disesases. According to the 1999 Census, the main source of water in the District was Lake Victoria, although 6.6% used rain water.

Table 4.14: Distribution of Respondents by Source of Water

Source	Always	Mostly	Occasionally	At times	Never	Total
Piped in house	35(3.7%)	20(2.1%)	12(1.3%)	2(0,2%)	12(1.2%)%	876(100%)
Public tap	162(16.6%)	67(6.9%)	70(7.3%)	42(4.4%)	70(7.3%)	624(100%)
Well water	64(6.8%)	24(2.6%)	26(2.8%)	36(3.8%)	26(2.8%)	788(100%)
Well with pump	54(5.8%)	26(2.8%)	24(2.6%)	21(2.2%)	24(2.6%)	810(100%)
Lake/River/Pond	559(56.7)%	63(6.4%)	58(5.9%)	139(14.1%)	58(5.8%)	167(100%)
Rain water	65(6.6%)	44(4.5%)	252(25.6%)	455(46.3%)	252(25.6%)	167(100%)
Other	7(1.2%)	2(0.4%)	6(1.1%)	9(1.6%)	6(1.1%)	545(100%)

Table 4.15 displays results of household characteristics. According to these results, 59.8% of the women used pit latrines which can be a source of infection especially if they are not kept clean with proper hygienic practices.

Table 4.15: Household Characteristics

Type of toilet	**Number**	**Percentage**
Flush	11	1.1
Shared flush	33	3.3
Pit latrine	596	59.8
Ventilated	42	4.2
No facility/bush	314	31.5
Floor material	**Number**	**Percentage**
Natural/dung	611	61.1
Rudimentary	5	0.5
Parquet/polished	12	1.2
Ceramic	8	0.8
Cement	362	36.2
Type of Roof	**Number**	**Percentage**
Grass Thatched	355	35.5
Corrugated	630	63.14
Tiles	11	1.1

Only 4.2% of the respondents used ventilated pit latrines, which are an improvement with the vents acting as a release mechanism for foul smell and a trap for flies. A large proportion of 31.5% of the women still used the bush as toilet. Only 1.1% of the women used flash toilets which are the most hygienic form of waste disposal.

On type of floor material, the results show that 61.1% of women lived in houses with natural floor/dung, 36.2% lived in houses with cemented floors, 1.2% in parquet/polished floors, 0.8% lived in houses with ceramic tiled floors, 0.5% in houses with rudimentary floors, and 0.1% in "other" types of floors. Concerning type of roof, 63.14%, lived in houses with corrugated iron roofs, 35.5% lived in grass thatched houses and only 1.1% lived in houses with tiled roofs.

Table 4.16 shows results of pests and vectors found in the houses of the respondents. Mosquitoes and houseflies were common in most households. These vectors are the agents of transmission of malaria and diarrhoeal diseases respectively. Bedbugs were found in 5.9% of the houses. Rodents were found in 22.7% of the houses, cockroaches were in 37.9% of the houses. Other pathogenic pests were found in 3.0% of the houses.

Table 4.16: Pests and Vectors in Houses

Pest Type	Always	Mostly	Occasionally	At times	Never	Total
Mosquitoes	720(72.3%)	137(13.8%)	37(3.7%)	98(9.8%)	4(0.4%)	996(100%
Bedbugs	58(5.9%)	47(4.8%)	69(7.0%)	110(11.2%%)	699(71.1%	983(100%
Rodents	227(22.7%	64(6.5%)	146(14.8%)	197(19.9%)	354(35.8%	988(100%
Houseflies	712(71.8%%	100(10.1%)	25(2.5%)	65(6.5%)	89(9.0%)	991(100%
Cockroaches	374(37.9%%	160(16.2%)	86(8.7%)	192(19.5%)	174(17.6%	986(100%
Ticks	59(6.1%)	26(2.7%)	96(10.0%)	33(3.4%)	749(77.8%	963(100%

Table 4.17 displays results of methods of pest and vector control. Treated mosquito nets were used by 63.1% of the women, while untreated nets were used by 17.5%. It is evident that the common methods applied in control of pathogenic pests were mosquito nets, both treated and untreated. The least applied methods were spraying of stagnant water, application of fungicides, burning of cow dung and use of repellants.

Table 4.17: Methods of Pest and Vector Control:

Method	Always	Mostly	Occasionally	At times	Never	Total
Pesticides	24(2.4%)	7(0.7%)	63(6.4%)	60(6.1%)	835(84.4%)	989(100.%)
Fungicides	3(0.3%)	4(0.4%)	9(0.9)	21(2.1%)	949(94.9%)	986(100%)
Insecticides	98(9.8%)	51(5.1%)	75(7.5%)	203(20.3%)	564(56.9%)	991(100%)
Rodenticides	61(6.2%)	34(3.4%)	75(7.5%)	130(13.0%)	686(69.6%)	986(100%)
Treated nets	627(63.1%)	80(8.0%)	14(1.4%)	72(7.2%)	201(20.2%)	994(100%)
Untreated nets	173(17.5%)	38(3.8%)	33(3.3%)	78(7.9%)	668(67.5%)	990(100%)
Attracting	29(2.9%)	18(1.8%)	64(6.5%)	43(4.3%)	834(84.4%)	988(100%)
Repellants	13(1.3%)	11(1.1%)	42(4.2%)	43(4.3%)	881(88.1%)	990(100%)
Draining	68(6.9%)	12(1.2%)	37(3.7%)	53(5.3%)	818(82.0%)	998(100%)
Spraying	8(0.8%)	1(1 .4%)	16(1.6%)	14(1.4%)	946(96%)	985(100%)
Herbicides	7(0.7%)	9(0.9%)	20(2.0%)	1(0.1%)	842(87.1%)	819(100%)
Burning of	7(0.7%)	9(0.9%)	31(3.1%)	34(3.4%)	909(91.8%)	990(100%)

Table 4.18 displays results of household amenities. Possession of household amenities is a measure of standard of living and economic wellbeing. The results show that most households (79.4%) had a radio, a significant proportion of 24.9% had telephone set and only 1.6% had a refrigerator.

Table 4.18: Household Amenities

Amenity	Yes	No	Total
Electricity	46(4.6%)	953(95.3%)	999(100%)
Solar	17(1.7%)	982(98.3%)	999(100%)
Radio	793(79.4%)	206(20.6%)	999(100%)
Television	107(10.7%)	890(89.1%)	997(100%)
Telephone/ mobile	249(24.9%)	748(74.9%)	997(100%)
Refrigerator	16(1.6%)	981(98.4%)	997(100%)

Table 4.19 shows results of type of fuel the households used for cooking. Sixty percent of households used firewood for cooking. Firewood and charcoal were the common methods for cooking, while the least used methods were electricity, gas and biogas.

Table 4.19: Type of Fuel for Cooking

Type of fuel	Always	Mostly	Occasionally	At times	Never	Total
Electricity	3(0.3%)	-	1(0.1%)	1(0.1%)	980(99.5%)	985(100%)
Gas	4(0.4%)	1(0.1%)	10(1.0%)	9(0.9%)	961(97.6%)	985(100%)
Biogas	3(0.3%)	-	13(1.3%)	4(0.4%)	963(98.0%)	983(100%)
Kerosene	79(7.9%)	64(6.4%)	115(11.5%)	137(13.7%)	59(5.9%)	986(100%)
Charcoal	269(27.2%)	40(4.0%)	169(17.1%)	302(30.5%)	209(20.9%)	989(100%)
Firewood/Straw	603(60.3%)	94(9.4%)	29(2.9%)	90 (9.0%)	176(17.6%)	992(100%)
Dung	19(2.0%)	3(0.3%)	31(3.2%)	27(2.8%)	893(91.8%)	893(100%)
Any other	-	-	1(0.1%)	-	595(59.5%)	596(100%)

The results in Table 4.19 show the distribution of respondents by religion. A majority of the respondents, that is 61.3%, were Protestants, 33.4% were Catholics and "Other Religions" constituted only 5.3%.

The Table also shows that most of the respondents, that is 89.8%, indicated that their religions allowed blood transfusion. Only 7.5% indicated that their religion did not allow blood transfusion. HIV was cited as the main reason advanced against transfusion. Culture was however not seen as an impediment to transfusion, nor was it viewed as a risk to pregnancy and childbirth.

Table 4.20: Socio-Cultural Characteristics

Religion	**Number**	**Percentage**
Catholic	334	33.4
Protestant	613	61.3
Muslim	1	0.1
No religion	4	0.4
Other	47	4.7
Total	999	100
Transfusion	**Number**	**Percentage**
Yes	897	89.8
No	75	7.5
Not stated	27	2.7
Total	999	100
Reason against transfusion	**Number**	**Percentage**
Transfusion Causes HIV	15	41.60
Religious Inhibitions	14	38.89
Transfusion is demonic	2	5.56
Pray for healing	2	5.56
Fear of disease or contamination	3	8.39
Total	36	100
Restrictions on pregnant women	**Number**	**Percentage**
Yes	128	12.8
No	816	81.7
Not Stated	55	5.5
Total	999	100
Cultural prohibition	**Number**	**Percentage**
No construction for pregnant woman	17	13.3
No heavy duties	38	29.7
No going for funeral	6	4.7
Avoid fights and quarrels	8	6.2
Not to enter mother in-laws hut	5	3.9
Others	9	7.0
Not stated	45	35.2
Total	128	100

Tables 4.21a and 4.21b show the opinions of respondents on how to promote maternal health. The Table shows that most respondents (48.3%) felt that educating women, abandonment of cultural practices (26.7%) and attending clinics (15.5%) were the most critical instruments for overcoming negative cultural restrictions. A majority of the women (44.2%) felt that women should attend clinics and 29.1% felt that women should eat a balanced diet. The Table also shows the distribution of responses on the

role the community should play in the promotion of maternal health. A total of 490 women responded to the question, 32.4% felt of whom felt that the community should assist expectant mothers in their daily chores, 16.7% recommended that the community should encourage attendance to antenatal clinics.

Table 4.21a: Opinions on How to Promote Maternal Health

Label	**Number**	**Percentage**
Attend clinic	18	15.5
Educate mothers	56	48.3
Abandon cultural practices	31	26.7
Others	11	9.5
Total	116	100
Role of mothers	**Number**	**Percentage**
Attend clinic	296	44.2
Education of mother	14	2.1
Avoid sex in pregnancy	8	1.2
Eat balanced diet	195	29.1
Observe hygiene	17	2.5
Use mosquito nets	28	4.2
Avoid hard work	65	9.7
Don't know	5	0.7
Do exercises	41	6.1
Total	669	100
What community can do	**Number**	**Percentage**
Assist expectant mothers in daily chores	159	32.4
Train more TBAs	66	13.5
Stop old TBAs from practice	3	0.6
Promote clean environment	36	7.3
Encourage antenatal attendance	82	16.7
Encourage hospital delivery	27	5.5
Advice mothers to have balanced diet	27	5.5
Discourage retrogressive cultural practices	13	2.7
Help maintain health facilities	15	3.1
Build more health facilities	9	1.8
Provide land for building health facilities	10	2.0
Respect expectant mothers	17	3.5
Provide them with basic needs	7	1.5
Have mothers educated on maternal health	12	2.4
Did not know	7	1.4
Total	490	100

Another 13.5% indicated that the TBAs should be trained, 7.3% indicated the community ought to promote a clean environment, 5.5% suggested that the community should encourage mothers to deliver in hospitals, 5.5% suggested that the community should encourage expectant mothers to take balanced diet, 3.1 % suggested that the community should help maintain health facilities, 2.7% suggested the community should discourage retrogressive cultural practices, 1.8% suggested that the community should build more health facilities. Only 2.0% suggested the community should provide land to build health facilities, 3.5% emphasized the need to respect expectant mothers and 2.4% recommended that the community should have mothers educated on maternal health care.

In Table 4.21b, a majority of the respondents indicated that the government should provide health facilities (17%), supply more drugs (10.5%), improve quality of health care (9.7 %), supply mosquito nets (9.2%), employ more health personnel (6.3%) and provide free health services (5.2%).

Table 4.21b: Opinions on How to Promote Maternal Health

The role of the Government	Number	Percentage
Provide health facilities	170	17.0
Supply more drugs	105	10.5
Improve quality of healthcare	97	9.7
Supply mosquito nets	92	9.2
Employ more health personnel	63	6.3
Ensure antenatal clinic attendance by mothers	10	10.0
Repair roads	4	0.4
Train more TBAs	13	1.3
Provide free health services	52	5.2
Equip health facilities	35	3.5
Give community education to mothers	15	1.5
Provide food or proper diet	11	1.1
Bring MCH closer to people	9	0.9
Did not Know	19	1.9
Not stated	305	30.5
Total	999	100

4.3 The Estimate of Maternal Mortality

This section addresses the first objective of the study, to estimate the maternal mortality rate in Bondo District. In view of the inherent difficulties in obtaining data on maternal mortality from the population and the use of indirect methods of estimation as explained in Chapter Three, it was found necessary to use hospital data to estimate the maternal mortality rate in the District. To measure this rate, 2 maternal deaths that occurred in Bondo District health facilities in the months of July to September 2007 were obtained from the MOH quarterly reports. This number was divided by 419 (the number of live births) delivered at the health facility in the same period and multiplied by 100,000. This gave a maternal mortality rate of 477 maternal deaths per 100,000.

It was necessary to compute an independent estimate for comparative purposes. The estimated maternal mortality rate of 477 was above the national estimate of 414

maternal deaths (PSRI and UNICEF, 1994). This was lower than the rate of 620 maternal deaths per 100,000 reported by the MOH, 2007. This, therefore, implies that the District has a declining maternal mortality ratio though the rate remains high in comparison to the national estimate

4.4 Environmental Factors that Impact on Maternal Morbidity and Mortality

This section is designed to address the second objective of the study that is to determine environmental factors that impact on maternal morbidity and mortality and to ascertain the extent to which each of the environmental factors impact on maternal morbidity and mortality in the District. To achieve this objective, maternal, socio-economic, health care and household factors were regressed against risk factors for maternal morbidity and mortality. This was considered a more focused analysis of variables that the reviewed literature links to maternal morbidity and mortality. The use of risk factor approach was necessitated by the difficulties inherent in direct studies of maternal mortality cited in the section on methodology. Consequently, several risk factors associated with maternal mortality were identified from literature review. These were listed under questions 30, 43, and 44 of the questionnaire for the respondents. The purpose was to identify women of reproductive age that experienced these conditions in pregnancy, during delivery, and in the post-partum period. Based on identified risk factors, and given the dichotomous nature of each of the risk factors, four models were run. The first model consisted of regression analysis of maternal morbidities. These were malaria, cough, sexually transmitted diseases, lower abdominal pain, haemorrhage, fits, convulsions, and vomiting. Each of these factors was regressed against selected independent variables.

The second model consisted of regression analysis of complications for delivery which were treated as proxies of maternal mortality because complications of pregnancy are more often immediate causes of maternal deaths. These risk factors were: prolonged labour, obstructed labour, haemorrhage, retained placenta, placenta praevia, breach presentation, and ruptured uterus. The third model consisted of regression analysis of postpartum complications which in most cases are causes of serious maternal morbidity as well as maternal deaths. These were: fever, discharge, bleeding/postpartum haemorrhage, pain below umbilicus, and depression. Each of these risk factors was regressed against selected independent variables. The final model consisted of regression analysis of significant risk factors and selected household variables.

4.5 Classification of Variables Entered in the Regression Model

i. Maternal variables

Maternal factors that have an influence on maternal morbidity and mortality were operationlised through age of women, age at first birth and parity.

ii. The Socio-economic and Healthcare Variables

The socio economic and healthcare are considered an integral part of the social environment. These were operationlised through women's level of education, income, employment status, and husband's level of education, husband's occupation, family planning, and antenatal care, place of delivery, delivery attendant, the nearest health facility, and distance to the nearest health facility.

iii. The Household variables

Household factors are an integral part of the physical environment. These were operationlised through the built/man-made environment such as the type of house, source of water, type of fuel used for cooking and type of toilet facility. These are environmental factors which have been found to impact on people's health.

Table 4.22a Logistic Regression Coefficients for Maternal Morbidities: Significant Variables

Dependent	Independent	B	S.E	Wald	d.f.	Sig	Exp(B)
Anaemia	Pill	0.358	0.433	0.684	1	0.408	1.431
	IUD	0.690	0.649	1.129	1	0.288	1.993
	Injection	0.587	0.280	4.384	1	0.036	1.799
	d/foam	-	23,205,422	0.000	1	0.999	0.000
	Condom	-	11,147,524	0.000	1	0.999	0.000
	Norplant	1.111	0.589	3.557	1	0.059	3.037
	Rhythm	-0.121	1.053	0.013	1	0.908	0.886
	Natural	-	13,397,657	0.000	1	0.999	0.000
Cough	Parity1	-1.335	1.272	1.093	1	0.296	0.263
	Parity2	-1.768	1.278	1.913	1	0.167	0.171
	Parity3	-1.183	1.276	0.860	1	0.354	0.306
	Parity4	-1.054	1.276	0.682	1	0.409	0.349
	Parity5	-0.513	1.279	0.161	1	0.689	0.599
	Parity6	-0.802	1.289	0.387	1	0.594	0.448
	Parity7+	-1.739	1.296	1.801	1	0.180	0.176
	No income	-0.423	0.330	1.642	1	0.200	0.655
	1500-3000	0.513	0.230	4.990	1	0.025	1.671
	3000-5000	0.588	0.344	2.913	1	0.088	1.800
	6001-8000	-1.118	0.814	1.889	1	0.169	0.327
	900-10000	-0.475	1.172	0.164	1	0.685	0.622
	11000-15000	-0.438	0.760	0.332	1	0.565	0.645
	16000-18000	-0,182	27,735,635	0.000	1	0.999	0.000
	20,000+	-0,683	25,655,214	0.000	1	0.999	0.000
	Age 15-19	0.669	0.272	6.049	1	0.014	1.952
	Age20-24	0.383	0.301	1.703	1	0.182	1.482
	Age25-29	0.765	0.433	3.123	1	0.077	2.150
	Age30-34	1.816	0.694	6.839	1	0.009	6.145
	Age35-39	2.179	1.448	2.265	1	0.132	8.839

Table 4.22b Coefficients for Maternal Morbidities: Significant Variables

Dependent variable(Risk	Independent	B	S.E	Wald	d.f.	Sig	Exp(B)
Haemmorrhage	No income	-1.363	0.553	6.080	1	0.014	0.256
	1500-3000	-0.802	0.325	6.077	1	0.014	0.256
	3001-5000	-8.896	0.567	2.499	1	0.114	0.408
	5001-8000	--0.900	1.064	0.716	1	0.397	0.406
	8001-1000	-0.065	1.138	0.003	1	0.954	0.937
	10001-15000	-0.917	0.676	1.891	1	0.175	2.502
	15001-18000	-19591	28430722	0.000	1	0.999	0.000
	20,000+	-	28340495	0.000	1	0.999	0.000
	Age 14-19	0.029	0.412	0.005	1	0.944	1.029
	Age20-24	0.634	0.423	2.250	1	0.134	1.886
	Age25-29	-0.175	0.734	0.057	1	0.812	0.840
	Age30-34	1.026	0.831	1.216	1	0.270	2.791
	Age35-39	3.048	1.471	4.297	1	0.038	21.083
Vomiting	Age 15-19	-0.047	0.206	0.052	1	0.819	0.954
	Age20-24	0.132	0.235	0.345	1	0.557	1.141
	Age25-29	0.802	0.333	5.789	1	0.016	2.228
	Age30-34	1.454	0.636	5.228	1	0.022	4.280
	Age35-39	0.761	1.425	0.285	1	0.593	2.140

Tables 4.22a and 4.22b present regression coefficients for maternal, socio-economic and health care variables regressed against risk factors for maternal morbidity. As already mentioned, variables entered in the model included age of woman, parity, education of woman, education of husband, family planning method, husbands occupation, woman's occupation, antenatal care, place of delivery, mode of transport to the nearest health facility. A number of variables were eliminated from the model because of lack of significance. There were, however, a number of variables based on logistic regression co-efficients that portrayed significant effect on maternal morbidity. From the results, some family planning methods were found to have a significant positive effect on anaemia. The use of the injection and the use of Norplant as methods of family planning increased the risk of anaemia. The risk of anaemia was increased by 80% among women using the injection. This raised the odds by 1.79. The use of

Norplant by women raised the odds by 3.037, thus increasing the risk of anaemia by 300%. The results, therefore, attest to the fact that women using the injection and norplant experience more than average incidences of anaemia compared to those using other methods of family planning. Other methods of family planning such as the pill and intra-uterine devices (IUD) were insignificant, although they indicated similar causal direction.

From the District health reports, Depo-Provera (injectible) as a method of family planning was a preferred method because of some advantages to women. It is administered once in three months, does not require daily intake, and besides, women on this method do not get their menstrual periods in the three months unless a complication arises. The method is, therefore, preferred for its convenience. However, the positive association between the injectible and anaemia would appear to militate against efforts geared towards lowered maternal mortality since family planning has been advocated as an intervention strategy to lower maternal mortality (Winikoff, 1988). Though this finding is not supported by prior research, it may confirm some complications often linked to the injection. One common complication reported by women on this method is heavy bleeding. Besides, there are a number of injectibles administered under different brand names and with varying chemical compositions. The most widely used preparations are two progestins, depot medroxy-progestrone acetate (DMPA), marketed as Depo-Provera and norethindrone enanthate (NET EN), and marketed as Nor-isterat. In Kenya, the most common injectible is Depo-Provera. From the District quarterly reports, this injectible was a preferred method of family planning by women of reproductive age in the District (MOH, 2007 b).

A thorough investigation of the health status of a woman is often required before administration of the method. Heavy bleeding is a major complication linked to the method. Women are often asked to visit the clinic for checkup whenever they experience heavy bleeding. In such a case, immediate discontinuation is required. It is not very clear what the causal link is between the injectible and anaemia. The results may confirm fears expressed over the use of Depo-Provera a commonly used injectible and preferred by most women because of its convenience. The banning of Depo-Provera as a method of family planning was linked to some of these complications though its use appears to continue. Similarly, the use of Norplant has been associated with some complications among some women; common among these is heavy bleeding, a factor that may contribute to anaemia. The use of Norplant, however, appears to be unpopular going by the family planning report of May-June 2007 (MOH.2007b).

Equally important was the effect of age on cough. Based on logistic regression co-efficients, the model attests to the fact that young women aged 15-19 years and the women aged 30-34, experience more than average cough compared to those other age groups. The co-efficients for cough showed that the risk of coughing is raised by 95% in the age group 15-19 years, while the odds were raised by 6.145 in the age group 30-34 thus increasing the risk of cough by 600%. Young and middle aged mothers face elevated risk of coughing unlike other age groups.

Cough is considered a minor problem in pregnancy, whereas fever is considered a major serious problem in pregnancy (Everett and McMahon, 1999). These two conditions are linked to infection either by the tuberculosis bacteria or some chronic

respiratory disease such as bacterial lung infections. This finding is supported by studies elsewhere. The study by Islam et. al. (2004) found that duration of labour pain was significantly longer for women who had reported to have suffered from cough/fever. Though cough has not been considered as life threatening in relation to maternal mortality, the situation may be compounded by poverty.

Cough among teenagers and women who experienced the condition may result from infection either by the tuberculosis bacteria or may be a result of some chronic respiratory disease such as bacterial lung infections. It may also be a result of HIV/AIDS as evident studies elsewhere which have found increased incidences of cough among women with HIV/AIDS infection. The teenage mothers may be vulnerable to such infections due to poor living conditions, poverty, lack of education, and financial resources. Cough may also be linked to the type of fuel used for cooking and lighting by households as evident from the fact that 60% of the women sampled for this study used firewood or straw for cooking. These are burnt indoors in open fires resulting in high levels of air pollution, exposing women to the risk of respiratory diseases hence cough. Poverty is one of the main barriers to the use of cleaner fuels. Studies elsewhere have found positive association between teenage motherhood and maternal mortality (Alaudin, 1986; Wall, 1998; Mutura, 1990).

Another important variable which bore consistent results in terms of significance, as well as causal direction, was income. Based on the co-efficients, the model attests to the fact that women in the income group of 1500-3000 Kenya shillings per month, experienced more than average incidents of cough. The risk of cough among them was increased by 67%. Another income group which exhibited similar causal direction

though not at a significant level was the income group of 3000-5000 shillings a month. This result, therefore, attests to the contribution of poverty to the risk of coughing. Low income earners may find themselves in very poor living conditions such as overcrowded households which may expose them to risks of contracting tuberculosis or expose them to air pollutants resulting in lung diseases hence serious cough. On the contrary, higher income showed no significant effect on cough. Higher income is perceived to be an indicator of better living conditions, a factor central to mortality transition.

Sexually transmitted disease was found to be insignificant as a risk factor. All variables on sexually transmitted disease therefore were eliminated. This may be attributed to the level of insignificance.

On haemorrhage as a risk factor in pregnancy, the model attests to the fact that the women aged 35-39 experienced more than average incidents of ante-partum haemorrhage compared to the younger women aged 15-24 years. Co-efficients for haemorrhage showed that the risk was increased in the age group 35-39 by 2100 %. The odds were raised by 21.083 in this age group showing elevated risk haemorrhage. This shows that this age group constitutes a risk factor in ante partum haemorrhage. Other age groups exhibited similar trends though not at a significant level.

On the contrary, income earned by women portrayed a significant negative impact on ante partum haemorrhage among low income earners. The risk of hemorrhaging was reduced by 36% among women who had no income, and by 20% among those who

earned 1500-3000 Kenya shillings per a month. Other income groups showed no significant effect, although they had negative effect on haemorrhage.

In consideration of vomiting as a risk factor in maternal morbidity, age of the mother bore a significant positive effect on vomiting. Logistic regression co-efficients showed that women aged 25-29 and 30-34 experience more than average incidents of vomiting unlike other age groups. The risk of vomiting was increased by 28% in the age group 30-34, and by 23% in the age group 25-29. Nausea and vomiting is a minor problem in pregnancy. This may occur early in pregnancy and stop after twelve weeks. If vomiting occurs later in pregnancy, it may be due to an illness of malaria or some kidney problem (Everett and McMahon, 1999). The positive relationship between age and vomiting may not be clear. It may be attributed to either the common condition of vomiting in early pregnancy or to incidence of malaria so prevalent in the region. Otherwise age in itself may not be a cause of vomiting. Other variables entered in the model on vomiting were rendered insignificant. They were thus eliminated from the model.

It appears from the results of the study that malaria prevalence is high among women in Bondo District as evident from the percentage of women who suffered from the illness. A big percentage of women (74.8%) suffered from malaria during the last pregnancy. This was compounded further by abundant mosquito presence in the houses. Another big proportion (72.3%) of the respondents said they had mosquitoes in the houses. In view of the vulnerability of pregnant women to malaria infection and the toll it takes among them, it is, therefore, important that the mosquitoes as the principal carriers of the malaria parasite should be controlled. The women in the District have

attempted to apply various methods to control the presence of pests and vectors in their homes. The study revealed that the use of mosquito nets, repellants, and burning cow dung reduced risk of contracting malaria. This was encouraging result as support to malaria control efforts. The pregnant women who are particularly vulnerable ought to be encouraged to apply malaria control measures.

Table 4.23: Regression Co-efficients for Complications of Delivery

Complication	Variable	B	S.E	Wald	Df	Sig	Exp(B)
Breach	Age 15-19	-1.530	0.627	5.955	1	0.015	0.217
	Age 20-24	-2.319	1.072	4.685	1	0.030	0.098
	Age 25-29	-18.372	5.543,024	0.000	1	0.997	0.000
	Age 30-34	-17.909	11,398,961	0.000	1	0.999	0.000
	Age 35-39	-17.909	28,420,722	0.000	1	0.999	0.000
Obstruction	Parity1	-2.565	1.261	4.138	1	0.042	0.042
	Parity2	-4.019	1.529	6.906	1	0.009	0.018
	Parity3	-20.109	3.684484	0.000	1	0.996	0.000
	Parity4	-3.620	1.530	5.594	1	0.018	0.027
	Parity5	-20.104	4,641,085	0.000	1	0.997	0.000
	Parity6	-20.104	5.232,679	0.000	1	0.997	0.000
	Parity7	-20.104	4,260 446	0.000	1	0.996	0.055
Retained placenta	Pill	-17.204	5,232,679	0.000	1	0.997	0.000
	IUD	-17.204	9.220,900	0.000	1	0.999	0.000
	Injection	0.388	0.608	0.408	1	0.523	1.474
	Diaphragm/foam /jelly	3.306	1.270	6.776	1	0.009	27,278
	Condom	-17,204	11,147.524	0.000	1	0.999	0.000
	Norplant	17,204	9,473,574	0.000	1	0.999	0.000
	Rhythm/Counting days	-17,204	11,147,524	0.000	1	0.999	0.000
	Natural Method	-17,204	13,397,657	0.000	1	0.999	0.000
	Withdrawal	-17,204	40,192,970	1	1	1.000	0.000
Ruptured uterus	Age 15-19	0.000	3,844,097	0.000	1	1.000	--------
	Age 20-24	0.000	4,253,689	0.000	1	1,000	
	Age 25-29	17,500	3,207,748	0.000	1	0.996	33,665,570
	Age 30-34	0.000	12,037,963	0.000	1	1,000	1.000
	Age 35-39	0.000	28,601,173	0.000	1	1,000	1,000

Table 4.23 examines the effect of maternal, socio-economic and health care variables on complications of delivery as risk factors in maternal mortality. Complications of

delivery are immediate causes of maternal mortality hence their treatment as proxies of maternal mortality. A number of variables entered in the model were found to be insignificant. There were, however, a few exceptions based on logistic co-efficients, which though significant portrayed unexpected causal direction. Age and parity of women had a significant negative effect on breach presentation and obstructed labour respectively. Women aged 15-19 had 21% reduced risk of breach presentation, while women aged 20-24 had 9% reduced risk of breach presentation. Other age groups portrayed similar causal direction though at insignificant level. On parity, logistic regression co-efficients showed that parity, or number of children a woman ever had, had a significant negative effect on obstructed labour. Parity1, that is women having their first child had 13% reduced risk of obstructed labour, while Parity2, that is women having their second child, had 79% reduced risk of obstructed labour. Parity4 women had 98% reduced risk of obstructed labour. In other words, the higher the parity the greater the risk is reduced. These results, therefore, attest to the fact that parity does not seem to matter in obstructed labour. Logistic regression co-efficients for ruptured uterus showed no significant impact.

Parity does not appear to be a significant factor in maternal mortality in Bondo District. This is contrary to evidence from studies that have demonstrated increased health risks for mothers associated with parity (Ascadi and Ascadi 1986; Fisher, 1969). Other studies have found obstruction to be a common condition among young, short and primiparous mothers (Kwast et al., 1986; Abour Royston1991).

However, vomiting among women of higher parities was found to be a risk factor in maternal morbidity in the District. Vomiting is a common condition among pregnant

women in the first three months of pregnancy. Prolonged vomiting has been reported among some women owing to many factors among them illness such as malaria or pyelonephritis (infection of the kidneys). These conditions explain continued vomiting in late pregnancy. It is not easy to explain the observed result among older women of higher parities. Perhaps it may be illness such as malaria that could be the reason for vomiting among the older women.

Table 4.24 below examines the effect of maternal, socio-economic and healthcare variables on post-partum complications and illnesses. A number of variables were eliminated from the model due to their insignificance. However, based on logistic regression co-efficients for post-partum complications and illnesses, there were a few exceptions which indicated significant effect on some risk factors. The effect of age group 15-19 on fever was significant. Co-efficients showed that the risk of fever was increased by 59% among women of this age group, unlike the other age groups that indicated a negative effect on post-partum fever. On the contrary, three occupations of the women portrayed a significant negative effect on post-partum fever. These occupations were tailoring and housewives. The risk of fever was reduced by 81% among women engaged in tailoring and by 87% among housewives. Close to these were reduced risks among women who indicated they did nothing, where the risk of fever was reduced by 82%.

Table 4.24: Logistic Regression Co-efficients for Postpartum Illnesses

Illness/complication	Variable	B	S.E	Wald	Df	Sig	Exp(B)
Postpartum fever	Farming	-0.222	0.275	0.649	1	0.421	0.801
	Fishmonger	0.220	0.400	0.303	1	0.582	1.246
	Shop/kiosk	-0.271	0.289	0.877	1	0.349	0.763
	Hotel	- 20.595	23.110.732	0.000	1	0.999	0.000
	Hairdresser	-20.378	16.303,773	0.000	1	0.999	1.000
	Student	-20.270	16.408,711	0.000	1	0.999	0.000
	Tailoring	-1.660	0.779	4.544	1	0.033	0.190
	Labourer	0.094	0.906	0.011	1	0.917	1.099
	House wife	-2.067	0.644	10.301	1	0.001	0.127
	Employee	-.0.965	0.596	2.616	1	0.106	0.381
	Nothing	-1.671	0.778	4.615	1	0.032	0.188
	Other	-20.735	28.420.722	0.000	1	0.999	0.000
	Constant	-0.731	0.239	9.375	1	0.002	0.481
	Age15-19	0.466	0.231	4.061	1	0.044	1.593
	Age20-24	-0.109	0.268	0.165	1	0.685	0.897
	Age25-29	-0.370	0.465	0.633	1	0.426	0.691
	Age30-34	-19.658	11.414.459	0.000	1	0.999	0.000
	Age35-39	-20.262	28.252.778	0.000	1	0.999	0.000
	Constant	-0.933	0.294	10.076	1	0.002	0.393
Haemorrhage	Farming	0.567	0.637	0.792	1	0.373	1.763
	Fishmonger	-0.471	1.172	0.161	1	0.688	0.625
	Shop/kiosk	0.927	0.634	2.135	1	0.144	2.526
	Hotel	-17.830	23,156,817	0.000	1	0.999	0.000
	Hairdresser	1.537	1.252	1.507	1	0.222	4.650
	Student	2.957	1.103	7.184	1	0.007	19,241
	Tailoring	1.138	0.857	1.762	1	0.184	3.121
	Labourer	-17.797	16,352.546	0.000	1	0.999	0.000
	House wife	1.118	0.737	2.303	1	0.129	3.059
	Employee	1.028	0.778	1.746	1	0.186	2.795
	Nothing	0.740	0.948	0.609	1	0.435	2.095
	other	3.253	1.539	4.467	1	0.035	25.872
	Age15-19	0.397	0.442	0.807	1	0.369	1.487
	Age20-24	0.555	0.464	1.426	1	0.232	1.741
	Age25-29	1.307	0.546	5.729	1	0.017	3.697
	Age30-34	2.055	0.756	7.385	1	0.007	7.810
	Age35-39	-17.956	27,695.997	0.000	1	0.999	0.000
	Constant	-3.650	0.683	28.521	1	0.000	0.026
Depression	Farming	-0.777	0.742	1.097	1	0.295	0.460
	Fishmonger	0.201	0.933	0.046	1	0.830	1.222
	Shop/kiosk	0.100	0.680	0.022	1	0.883	1.105
	Hotel	-17.958	23,205.422	0.000	1	0.999	0.000
	Hairdresser	-17.958	16,408.711	0.000	1	0.999	0.000
	Student	-17,958	16,408.711	0.000	1	0.999	0.000
	Tailoring	0.067	1.178	0.003	1	0.955	1.069
	Labourer	-17.958	16,408.711	0.000	1	0.999	0.000
	House wife	-0.667	1.169	0.325	1	0.568	0.513
	Employee	0.817	0.842	0.942	1	0.332	2.265
	Nothing	1.859	0.772	5.795	1	0.016	6.417
	Other	-17.958	28,420.722	0.000	1	0.999	0.000
	Constant	-3.245	0.588	30.409	1	0.000	0.039

The model thus attests to the fact that age of the women matters in postpartum fever, while occupation of the women is generally insignificant. Women who indicated that they were "students" showed significant effect on post-partum haemorrhage. This category of respondents had 24% elevated risk of post-partum haemorrhage, whereas women who indicated that they did nothing had the risk of post-partum haemorrhage increased by 87%.

The age of the women also bore consistent significant results as well as causal direction when regressed against post-partum haemorrhage. Women aged 25-29 and those aged 30-34 experienced more than average incidents of post-partum haemorrhage in comparison to other age groups. The risk of post-partum haemorrhage was increased by 69% and by 81% among these respective age groups. This could be attributed to multiparity. Multiparous women are particularly vulnerable because their uteri tend to be stretched and scarred from numerous pregnancies (Abour and Royston, 1991). Haemorrhage is a serious problem occurring in pregnancy. It can occur early or late. Haemorrhage both in the ante partum and post partum period is a direct cause of maternal death. It is difficult to predict as it causes sudden death. The causes of haemorrhage after 28 weeks of pregnancy could be due to premature separation of the placenta from the walls of the uterus, or due to abnormal presentation of the placenta where it is attached to the lower rather than the upper part of the uterus (placenta praevia). In the post-partum period, haemorrhage is caused by retention of the placenta after delivery, or failure of the uterus to contract and close down the blood vessels after delivery.

The reduced risk of haemorrhage among women of low income in this study is encouraging. These are women endowed with meagre resources and, therefore, may not access obstetric emergency services were they to experience a complication like haemorrhage. This could also mean that haemorrhage is mainly determined by maternal factors and not level of income. The control of deaths resulting from haemorrhage requires obstetric emergency services for transfusion and operation. The women ought to be encouraged to deliver in hospitals. Haemorrhage is compounded by anaemia during pregnancy. The increased risk of bleeding among students portrayed in this study may be attributed to injury of the uterus as a result of procured abortion or attempted abortion. It is difficult to offer any other explanation. The increased risk of hemorrhaging among women who said they do nothing may be attributed to many of the causes already referred to above.

The model also attests to the effect of occupation on post-partum depression. The women who indicated they do nothing had 41% increased risk of depression. The odds were raised in this group by 6.417, thus showing an increased risk of 642%. The depressed state may result from unwanted pregnancy or economic hardship thus leading to depression.

Tables 4.25a and 4.25b below examine the effect of household variables on maternal morbidity, complications of pregnancy and post-partum complications. These two Tables represent the Combined Model.

Table 4.25a: Logistic Regression Co-efficients for Environment

Illness/ complication	Variable	B	S.E	Wald	Df	Sig	Exp(B)
Malaria	Rodenticides	-0.458	0.210	4.764	1	0.029	0.633
	Untreated nets	-0.492	0.191	6.620	1	0.010	0.611
	Attractive-devices	-0.640	0.275	5.409	1	0.020	0.527
	Burning dung	-1.359	0.545	6.213	1	0.013	0.257
	constant	-0.172	0.115	2.238	1	0.135	0.842
Fever	Piped water	-0.008	0.036	0.046	1	0.830	0.992
	Public tap	0.29	76.152	0.000	1	0.997	1.338
	Well water	-0.135	43.171	0.000	1	0.998	0.874
	Well- pump	0.135	43.171	0.000	1	0.998	0.784
	Lake/pond	0.155	112.450	0.000	1	0.999	1.173
	Rain water	0.159	92.344	0.000	1	0.000	0.999
	Other	0,004	0.007	0.430	1	0.512	1.004
	Flush	0.377	23,472,111	0.000	1	1.000	1.457
	Shared Flush	9.623	21,017,632	0.000	1	1.000	15,114,398
	Pit	-17,279	19,702,632	0.000	1	0.999	0.000
	Ventilated pit	-17326	18,702,632	0.000	1	0.999	0.000
	Bush	-16,652	18,702,632	0.000	1	0.999	0.000
	Natural floor	0,164	0.493	0.111	1	0.739	1.179
	Rudimentary	17,331	17,920,188	0.000	1	0.999	33,639,205.86
	Finished	18,090	12,868,713	0.000	1	0.999	71,812,182.652
	Ceramic floor	-1.726	1.193	2.098	1	0.147	0.178
	Grass thatch	-18.364	28,156,114	0.000	1	0.999	0.000
	Corrugated	-18.367	28,155.114	0.000	1	0.999	0.000
	Tiles	-0.587	31,366.227	0.000	1	0.999	0556
	Mosquitoes	0.994	32,561.540	0.000	1	0.999	2.703
	Bed bugs	-15.901	18,887.533	0.000	1	0.999	0.000
	Rodents	16.037	26,597.988	0.000	1	1.000	9,224,880.810
	House fly	-0.341	24,353,031	0.000	1	1.000	0.711
	Cockroaches	0.363	20,845,122	0.000	1	1.000	1.438
	Ticks	-16.950	8,553,940	0.000	1	0.998	0.000
	Others	-0.850	0.650	1.713	1	0.191	0.427
	Constant	7.773	236,331.156	0.000	1	1.000	2,374,417
Bleeding	Piped water	-0.001	0.027	0.000	1	0.983	0.999
	Public tap	0.329	79.180	0.000	1	0.997	1.389
	Well water	0.027	0.030	0.830	1	0.362	1.028
	Well pump	-0.022	0.013	2.941	1	0.086	0.979
	Lake/pond	0.416	109.321	0.000	1	0.999	1.158
	Rain water	-0.031	0.018	2.946	1	0.086	0.979
	Other	0.000	0.005	0.003	1	0.956	1.000
	Flush	-18.497	20,286.378	0.000	1	0.999	1.158
	Shared Flush	0.919	21,499.710	0.000	1	1.000	2.508
	Pit	-17.946	20,286.378	0.000	1	0.999	0.000
	Ventilated pit	-17.350	20,286.378	0.000	1	0.999	0.000
	Bush	-18,380	20,286.378	0.000	1	0.999	0.000
	Natural floor	0.334	0.330	1.024	1	0.312	1.397
	Rudimentary	-2.067	1.438	2.066	1	0.151	0.127
	Finished	-0.900	0.851	1.119	1	0.290	0.406
	Ceramic floor	18.693	15,808.364	0.000	1	0.999	-
	Grass thatch	2.707	1.455	3.461	1	0.063	14.981
	Corrugated	1.840	1.429	1.659	1	0.198	6.296
	Tiles	1.213	1.854	0.428	1	0.513	3.363

Table 4.25b: Logistic Regression Co-efficients for Household Factors.

Pain below umbilicus	Piped water	-0.018	0.03	2.028	1	0.154	0.982
	Public tap	0.004	0.008	0.220	1	0.639	1.004
	Well water	0.016	0.014	1.350	1	0.245	1.016
	Pump Well	0.003	0.012	0.042	1	0.837	1.003
	Lake/pond	0.001	0.013	0.002	1	0.966	1.001
	Rain water	-0.012	0.010	1.253	1	0.263	0.988
	Other	-0.004	0.003	2.112	1	0.146	0.996
	Flush	-18.627	21,754.682	0.000	1	0.999	0.000
	Shared Flush	-20.347	21,754.682	0.000	1	0.999	0.000
	Pit	-19.232	21,754.682	0.000	1	0.999	0.000
	Ventilated pit	-20.342	21,754.682	0.000	1	0.999	0.000
	Bush	-19.338	21,754.682	0.000	1	0.999	0.000
	Natural floor	0.301	0.246	1.504	1	0.220	1.351
	Rudimentary	20.704	19,448.056	0.000	1	0.999	-
	Finished	20.116	13,068.890	0.000	1	0.999	-
	Ceramic floor	0.637	1.182	0.290	1	0.590	1.891
	Grass thatch	-19.337	28,401.175	0.000	1	0.999	0.000
	Corrugated	-19.544	28,401.175	0.000	1	0.999	0.000
	Tiles	-20.421	28,401,175	0.000	1	0.999	0.000
Depression	Piped water	-0.008	0.036	0.046	1	0.830	0.992
	Public tap	0.291	76.152	0.000	1	0.997	1.338
	Well water	-0.135	43.171	0.000	1	0.998	0.874
	Pump Well	0.135	43.171	0.000	1	0.998	1.145
	Lake/pond	0.155	112.450	0.000	1	0.999	1.173
	Rain water	0.159	92.344	0.000	1	0.999	1.173
	Other	0.004	0.007	0.430	1	0.512	1.004
	Flush	0.377	23,472.111	0.000	1	1.000	1.457
	Shared Flush	9.623	21,017.832	0.000	1	1.000	15,114.398
	Pit	-17.279	19,702.632	0.000	1	0.999	0.000
	Ventilated pit	-17.326	19,702	0.000	1	0.999	0.000
	Bush	-16.652	19,702	0.000	1	0.999	0.000
	Natural floor	0.164	0.493	0.111	1	0.739	1.179
	Rudimentary	17.331	17,920.188	0.000	1	0.999	33,639,205,863
	Finished	18,090	12,868,713	0.000	1	0.999	71,812,162,652
	Ceramic floor	-1.728	1.193	2.098	1	0.147	0.178
	Grass thatch	-18.364	28,155.114	0.000	1	0.999	0.000
	Corrugated	-18.367	28,155.114	0.000	1	0.999	0.000
	Tiles	-0.587	31,366.227	0.000	1	1.000	0.556

The variables entered in the Model are source of water, type of toilet facility, type of floor material, type of roof material, and presence of vectors in the houses. A number of variables were eliminated from the model due to insignificance. There were, however, a few exceptions based on logistic co-efficients which indicated positive effect on maternal morbidity. Methods of controlling vectors showed that the use of

rodenticides, untreated mosquito nets, attracting devices and the burning of cow dung had a significant negative relationship with malaria. Attracting devices reduced risk of fever by 36%, while mosquito nets reduced the risk of malaria by 50%, and burning cow dung reduced the risk by 65%. This means that women using any of these methods had reduced risks of contracting malaria.

Logistic regression co-efficients for household factors and fever showed no significant relationship. There were variables that demonstrated positive effect on fever though at insignificant level. These were the presence of mosquitoes, which raised the odds by 2.073 in mosquito-infested houses. This means the risk of fever was increased by 207% in such houses. The positive impact of presence of mosquitoes on fever is attributable to malaria infection.

Logistic regression co-efficients for bleeding demonstrated no significant impact of household variables on bleeding except for women living in grass thatched houses. Among these women, the odds were raised by 14.98, showing that the risk was increased by 1500% thus demonstrating a positive impact on bleeding though not at a significant level. Logistic regression co-efficients for household variables and discharge, pain below umbilicus, and depression, similarly showed no significant relationships. Household variables, therefore, were found to be insignificant in relation to risk factors in maternal morbidity and mortality.

Abdominal pain was found to be associated with mode of transport in the logistic regression analysis. However, no plausible explanation could be offered for the positive impact of mode of transport to lower abdominal pain, hence its treatment as a

nuisance variable. Abdominal pain in early pregnancy, however, may be linked to the presence of adhesions or fibroids which may prevent expansion of the uterus in the abdomen. This will lead to abdominal pain, associated with retention of urine, or in some cases, abdominal pain is caused by fibroids. This may necessitate bed rest (Chamberlain and Morgan; 2002). The severity of lower abdominal pain may make it difficult for the patient to use public transport to the nearest health facility thus making it necessary to use a private vehicle to the nearest health facility.

4.6 Progress Made to Lower Maternal Mortality in Bondo District

This section was designed to meet the third objective of the study. It was necessary to assess progress made toward reduction of maternal mortality in Bondo District for comparative purposes and to inform the general public and stakeholders in general. The UN process indicators were used to gauge progress made towards lowering maternal mortality in the District.

Table 4.26 below shows results of process indicators. The Table reveals that the District had only one Comprehensive Obstetric Care facility in one division, namely Maranda division in which Bondo town is located. Two other divisions, namely Usigu and Madiany had Hospitals which offered Basic Emergency Obstetric Care services, while Nyang'oma and Rarieda divisions did not have Comprehensive Obstetric Care facilities. The District had two private nursing homes all located in Bondo town. These nursing homes also offered basic Emergency Obstetric Care. There were eight health centres which provided some Essential Obstetric Care services in the District. These were not fairly distributed. Madiany had three such facilities while Nyang'oma had one

run by the Catholic Church. In addition, these health facilities were not within easy reach of most women in need of healthcare. It is expected that all sub-national areas receive 100% coverage of Essential Obstetric Care. This, it is hoped, will enable women receive needed care in order to cater for all emergency and essential obstetric services.

Table 4.26: Process Indicators and Levels Attained in Bondo District- 2007

Indicator	**Definition**	**Level realised**	**Recommended level**
EmOC services available	Number of facilities that provide EmOC	1 EmOC,	1 EOC for 500,000.
Geographical distribution of EmOC	Distribution of Health facilities in the District.	1 EmOC and 2 Basic EmOC facilities in 3 Divisions in the District.	Minimum:100%of sub-national areas have minimum expected numbers of basic and comprehensive EmOC facilities
Proportion of all births in EmOC facilities	Proportion of all births that take place in EmOC facilities	37.5%	Minimum 15%
Caesarean Section as a percentage of all births	Caesarean deliveries as a percentage of all births in the population	4.1%	Minimum 5% Maximum 15%
Births attended by a skilled personnel	Births attended by Doctor/Nurse /Midwife	71.9%	100%
Met need for EmOC Services	Proportion of women with obstetric complications treated in EmOC facilities	65.2%	100%

Source: Author, based on survey results.

Concerning proportion of births that take place in EmOC facilities, Table 4.26 shows that 37.5 % of the women indicated they gave birth in a health facility. This percentage is below the national average of 40 percent registered in KDHS 2003, although above the minimum of 15% expected in the process indicators. This means that women in Bondo have made some effort to deliver in a health facility. The quality of Emergency service at the District however is still wanting. The facilities are overstretched given that only the District Hospital offers these services.

Caesarean section is a health measure taken to save the life of the mother and the foetus whenever an obstetric complication that cannot be handled otherwise is encountered. This is an Emergency Obstetric Care service whose availability in the District would result in saving lives of mothers who would have perished in the course of delivery. In Bondo, caesarean section is performed at the District hospital. From the results, Caesarean sections constituted only 4.1% of all births in the sampled population, showing a lower risk compared to the optimum range of 5% to 15 % (Table: 4.26).

The Table also shows that that 71.9% of births were attended by skilled delivery attendants which exceeds the national average of 40% recorded in the KDHS 2003 (NCPD, 2003), but falls below 100% recommended in the process indicators.

Table 4.27: Bondo District Health Facilities: Geographical Distribution

Facility type	Maranda	Rarieda	Usigu	Madiany	Nyang'oma
Hospital	1	-	1	1	
Health Centres	1	2		3	1
Dispensaries	3	6	5	6	5
Nursing homes/Hospitals	2	-	-	-	-
Clinics	3	-	1	3	
Total	10	8	7	13	6

Source: MOH-Bondo 2007.

Table 4.27 shows the geographical distribution of health facilities in the District. The pattern of distribution shows disparities between different divisions of the District. Maranda division had more hospitals, nursing homes and clinics. This is because Bondo town is located here. In this division, women can easily access maternal health care services, unlike women in Nyang'oma division with only one health centre run by the Catholic Mission. It is more difficult for women who develop sudden delivery complications in Nyang'oma division to be taken to the District hospital for emergency care. This sorry state is particularly worse for women in the Islands of Mageta, Oyamo and Ndeda. This is mainly due to poor communication which is exacerbated by lack of boat transport at night. Madiany division appears better than the three divisions. In Madiany, the hospital offers basic Emergency Obstetric Care and all health centres offer Essential Obstetric Care. Plans to provide maternity care services in all dispensaries in the District were under way at the time of the study. These plans included provision of beds and labour wards in all dispensaries to enable mothers to deliver in appropriate health facilities under the care of skilled birth attendants (MOH, 2007).

4.7 Summary of Findings

The main study was conducted in five divisions of Bondo District of Kenya. A random sample of 50 enumeration areas was drawn from a total of 686 enumeration areas in the District. From each of the enumeration areas, sets of households were systematically sampled in proportion to size of the enumeration area. From each household, a female of reproductive age 15-49 was selected for interview. A total of 1000 female respondents were interviewed in the study. Two questionnaires were designed, one for

the female respondents aged 15-49, and the other for the MOH in Bondo District Hospital for data on health facilities, personnel and services offered in the District. The questionnaires were administered by research assistants to a sample of 1000 women in the District in the Month of December 2006. A total of 999 questionnaires were returned, representing 99.9% return rate.

Data analysis was undertaken using the statistical package for social sciences (SPSS). Logistic regression was used to determine environmental factors that impact on maternal morbidity and mortality.

Chapter 4 reports the results and discusses the findings of the study. From the background characteristics, 67.3% of the women were married; the mean age at marriage was 18 years; some had gotten married at an early age of 12; most of them, that is 77.7% had given birth by age 20. The antenatal clinic attendance was 96 % although 20% of the women started attendance as late as the sixth month of pregnancy. It was found out that slightly over 50% of the women delivered at home. Most of deliveries were assisted by nurses/midwives, friends, relatives and traditional birth attendants.

On maternal morbidity, most women suffered from malaria in pregnancy. Sexually transmitted disease was least suffered illness. The results of logistic regression analysis showed that age, occupation, income and family planning methods were some of the factors that had an impact on some risk factors in maternal morbidity and mortality. The study confirmed increased risk for haemorrhage among older women, but reduced

risks among women of low income. Age was also found to have a positive impact on other conditions such as cough, anaemia and fever.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The results in Chapter 4 have pointed to issues pertinent to maternal morbidity and mortality in Bondo District. The conviction at the onset was that the environment could be at play in the well documented disparity in maternal morbidity and mortality in the District in comparison to other regions which report lower maternal mortality rates. The preceding treatise has explored the environmental factors and their impact on maternal morbidity and mortality in the District. In this Chapter, conclusions and recommendations are elaborated.

5.2 Conclusions of the Study

This study set out to determine environmental factors that impact on maternal morbidity and mortality in Bondo District of Kenya. The first objective was to estimate the maternal morbidity and mortality levels in the District. The estimation of the maternal mortality level is an important bench mark from which to base the results of the study. In this study, a maternal mortality rate of 477 maternal deaths per 100,000 live births was estimated. In comparison to the national level estimated at 414 maternal deaths per 100,000 live births (PSRI and UNICEF, 1994), and to the maternal mortality rates obtained in the developed world, this study concludes that the maternal mortality rate in the District is on the decline. There is marked improvement from the rate of 620 maternal deaths reported by the MOH, 2007. The estimated rate, however, falls short

of targets set in the National Population Policy for Sustainable Development (NCPD, 1998). The target in the policy was to reduce maternal mortality rate in Kenya to 170 maternal deaths per 100,000 live births by the year 2010. It would be expected that two decades after the launch of the Safe Motherhood Initiative, and various interventions in place, maternal mortality rate in Kenya should have reduced to the rates realised in the developed countries.

Process indicators were used in this study to gauge progress made towards reduction of maternal mortality rate as designed to meet the third objective of the study. The results revealed progress in terms of number of health facilities in the District. There were three hospitals in the District, two of which had recently been upgraded from Health centre status to Hospital status. Only one Hospital, however, offered Comprehensive Obstetric Care, while the other two and eight health centres offered Essential Obstetric Care. Going by the recommended levels, it is therefore concluded that the District has adequate Comprehensive Obstetric Care facilities to meet the needs of women who develop sudden obstetric complications. One Comprehensive Obstetric Care facility should serve 500,000 according to WHO, UNICEF and UNFPA (1997). However, in practice the adequacy of one Comprehensive care facility may depend on a number of factors such as availability of necessary equipment to handle emergency care as well as the availability of skilled personnel to handle emergency care. In terms of personnel the District is understaffed and therefore overwhelmed in handling emergencies. Perceived from this view, one Comprehensive Care facility is hardly adequate to serve women from scattered settlements, some of whom may not easily access the only facility due to communication difficulties.

The unevenness in geographic distribution of health facilities was evident. Some divisions in the District were lacking basic Obstetric Care facilities. Perceived from this point, the uneven distribution of Obstetric Care facilities in the District is likely to slow down progress in bringing down maternal morbidity and mortality.

On proportion of births in an EmOC facility, the results obtained from the study showed that 37.5 % of births took place in an EmOC facility, though the overall percentage that took place in a health facility was 49.9. Some women delivered in dispensaries, others in health centres and clinics. This percentage falls far below the 100% level recommended in the Process indicators. This study, therefore, concludes that the district is lagging behind in terms of utilization of health facilities for delivery care.

Births attended by skilled birth attendants were 71.9%. Again this falls below the recommendation in the Process indicators. For maternal mortality rate to be under control, it is expected that l00% of all births should be attended by skilled personnel as recommended in the Process indicators. Again for this measure, this study concludes that the District has not achieved the recommended level to bring down maternal mortality. Substantial progress has been made, however, towards this end.

In relation to caesarean section as a percentage of all births, the level realised in Bondo District is small and below the optimum range in accordance with expected levels in the process indicators. It is not possible to ascertain why the percentage of caesarean sections is low in the District. This study, therefore, concludes that women in the

District may not be at risk of indications for caesarean sections, hence the low percentage realised for the caesarean section.

In Summary, the results of the process indicators revealed that Bondo District has not achieved the recommended levels of processes required to bring down maternal mortality level. Respondents cited some factors which inhibited utilisation of health services. These were: inadequate health personnel at the health facilities, lack of drugs, rude / harsh nurses and lack of finance among others. In addition, the education level of respondents (68% of respondents had primary level education) and low socio-economic status (most were in menial economic activities, Table 4.2) may be an inhibition to delivery in a health facility. Though the District health department has expanded health facilities, utilization of such services is hampered by a number of factors such as inadequate health personnel and low socio-economic status of women.

The estimate of maternal morbidity was based on proportions of respondents that suffered from various illnesses in pregnancy and the postpartum period (Table 4.8 and 4.12). It was not possible to obtain incidence or prevalence rates because the survey was based on a sample of females in the population. However, the results from the study showed that 29% of the women always suffered from malaria. This was followed by 15.3% that always suffered from vomiting, and 14.7% that reported that they always suffered from lower abdominal pain. The least reported illness was Sexually Transmitted Disease which recorded a low of 0.5%. In the postpartum period, 33.6 % of women suffered from fever, 26.7% suffered from pain below umbilicus and 11.8% suffered from heavy bleeding. It is, therefore, concluded that the burden of illness

borne by women in the District is occasioned by malaria, fever, pain in the lower abdomen or below umbilicus and haemorrhage in the post-partum period.

It is evident from the results of this study that maternal morbidity both in the ante partum and postpartum period are of concern. The prevalence of malaria, anaemia and haemorrhage ought to be given the serious attention they deserve. This is because haemorrhage and malaria are some of the major causes of maternal deaths in Sub-Saharan Africa.

Concerning hypothesized relationships, there is strong evidence from this study that demographic factors have a significant positive impact on risk factors in maternal morbidity and mortality. The results of this study found that age of the mother had a significant positive impact on a number of risk factors in maternal morbidity and mortality. Teenage motherhood was found to have a significant positive impact on cough. Cough may be linked to the type of fuel used for cooking and lighting. It was found out that 60% of the respondents used firewood or straw for cooking. These are burnt indoors in open fires and as a result there are high levels of air pollution, to which the women are exposed.

Indoor air pollution results in acute respiratory infection. Cough may also be a result of tuberculosis so common in HIV positive mothers. However, we cannot be certain from these results the causes of the impact of teenage motherhood on cough. Studies elsewhere have documented positive association between teenage motherhood and maternal mortality (Alaudin, 1986; Wall, 1998; Mutura, 1990), while others document

complications such as breach presentations, toxemia, anaemia and premature rapture of the membranes as common among young mothers having their first baby.

On the other hand, while teenage mothers in the District were found to suffer from cough, the older women experienced more than average incidents of haemorrhage both in the ante-partum and post-partum period as well as post-partum depression. The age group 35-39 was found to have a significant positive impact on haemorrhage both during pregnancy and in the post-partum period. This confirms findings from other studies that haemorrhage is a condition that commonly affects older mothers (Chamberlain and Morgan, 2002). Haemorrhage among the older mothers could result from frequent pregnancies. This is because of a weakened body system as a result of several pregnancies and pressure of physical labour. This makes older women less capable of withstanding the pressures associated with pregnancy and childbirth. Maternal mortality has been found to rise sharply beyond age 35 (Khan, et al., 1986; Meme, 1975). The common cause of postpartum haemorrhage is retention of the placenta after delivery and failure of the uterus to contract and close the blood vessels after delivery. Post-partum haemorrhage is common among multiparous women who are particularly vulnerable because their uteri tend to be stretched and scarred from numerous pregnancies (Abour and Royston, 1991). This study therefore concludes that maternal age is a critical determinant of maternal morbidity and mortality.

Contrary to studies that have demonstrated increased health risks for mothers associated with parity, this study found significant negative impact of parity on maternal morbidity and mortality. Parity1, Parity2 and Parity4 had significant negative impact on obstruction.

It was hypothesised that there is a positive relationship between socio-economic factors and maternal morbidity and mortality. The results of this study show that two variables connected to socio-economic environment, that is, occupation and income, emerge as statistically significant. While respondents who were students had a likelihood of experiencing post-partum haemorrhage, women who had no gainful occupation had a likelihood of suffering from depression. Depression is a condition that has lately been found to cause maternal deaths. Housewives/Homemakers and students are regarded as part of the population which is not economically active. The evident depression among housewives or women without gainful employment suggests a serious condition that ought to be investigated further. Women could be depressed after delivery due to a number of reasons. First, the newborn may be viewed as a burden. On the other hand, an unwanted baby or an unplanned birth can elicit depression. This may be true when a woman has no gainful economic activity.

Levels of income emerged to be critical in determining cough. There was elevated risk of cough among low income earners, unlike the high income earners who portrayed reduced risks of cough. This appears to suggest that cough may be a condition determined by poverty and living conditions. In contrast, income was found to impact negatively on haemorrhage. The risk of haemmorrhage was reduced in all income groups thus suggesting that haemorrhage is not necessarily determined by levels of income. Based on these results, this study concludes that there is a positive impact of socio-economic factors on maternal morbidity and mortality, thus leading to acceptance of hypothesised relationship.

Healthcare factors were hypothesised to have a negative relationship with maternal morbidity and mortality. Contrary to hypothesised relationship, the results of this study found a positive impact of family planning on anaemia. Two methods of family planning, namely injection and Norplant, were found to have a significant positive impact on anaemia, a common risk factor in maternal mortality. Whereas studies have identified causes of anaemia to be insufficient iron intake, worm infestation, malaria, chronic infectious disease and others (Lewis, 2002), this study makes a major contribution by establishing a significant impact of injection and Norplant method of family planning on anaemia. Women on these methods are advised to discontinue use whenever heavy bleeding occurs. This is a precautionary measure taken to avoid serious consequences that may result from continued use. It appears, therefore, that anaemia may result from heavy bleeding induced by some components in these methods of family planning. This relationship needs further investigation to establish the mechanisms through which these methods of family planning operate to impact on anaemia. Besides family planning methods, other healthcare factors did not demonstrate a significant impact on maternal morbidity and mortality hence their elimination from the logistic regression model.

The study hypothesised a negative relationship between household factors maternal morbidity and mortality. The results of this study however showed that the household factors were found to have no significant effect on risk factors in maternal morbidity or mortality. This was a confirmation that maternal morbidity and mortality are not determined by living conditions but rather by maternal, socio-economic and healthcare factors. There was abundant mosquito presence in houses as reported by respondents. The presence of mosquitoes demonstrated a positive impact on fever in the post-partum

period though at insignificant level. The positive impact of presence of mosquitoes on fever is attributable to malaria infection. However, generally the environmental factors had insignificant effect on fever. Methods of controlling vectors showed that the use of rodenticides, untreated mosquito nets, attracting devices and the burning of cow dung had a significant negative relationship with malaria. This means that women using any of these methods had reduced risks of contracting malaria.

On the basis of these results, this study concludes that household factors have no significant impact on maternal morbidity and mortality. On the contrary the natural environment has positive impact on maternal morbidity.

5.3 Recommendations

The results of this study have pointed to some issues central to the problem of maternal morbidity and mortality that need to be given serious consideration in addressing these phenomena. This study has outlined some unique findings, some of which have been reported in other findings.

It is recommended that programmes to bring down maternal mortality rate be mounted in Bondo District to reduce the maternal mortality rate from the current 477 deaths per 100,000 live births to about 170 deaths per 100,000 live births. In mounting these programmes, the Ministry of Health should step up efforts aimed at increasing the percentage of deliveries in health facilities from the current level of 49.9% to the ideal target of 100%. To achieve this target, issues that appear to prevent women from

delivery in a health facility should be addressed. These issues have been clearly elaborated in Chapter Four.

Similarly, the Ministry of Health should aim at increasing the percentage of births attended by skilled personnel from the current 71.9% to the desired target of 100%. This requires more qualified personnel at the District level. Efforts must be stepped up to train skilled birth attendants to ensure adequacy of the requisite personnel.

This study recommends that women should make efforts to give birth in the safer age group of 24-34. Births by women at extremes of reproductive life should be avoided. The results of this study showed clear evidence of early marriage and early age at first birth. Teenage motherhood had a significant effect on maternal morbidities. There was evidence of haemorrhage in the age group 35-39. This clearly points to the risks of maternal morbidity and mortality linked to births at extreme age of reproductive life. To be able to achieve concentration of births in the safer age group, women and girls must be educated and sensitised to understand the importance of giving birth at the right age. This type of sensitisation ought to be slotted in life skills programme in primary and secondary schools.

It is recommended that issues pertaining to the social environment which appear to lead to early marriage, early age at first birth and low standards of education be addressed immediately by the Government. The socio-cultural issues that trigger early marriage as evident in the sample characteristics (section 4.2), and school dropout should be given the serious consideration that they urgently deserve. The social environment appears to affect the socio-economic environment leading to wide spread poverty as

evidenced from the menial socio-economic activities the women in this study were involved in.

It is recommended that women in the District be empowered through education. The community and individual families ought to mobilise resources towards the enhancement of education for girls in the District. Specific learning programmes that will attract and retain girls in schools should be developed to enable them achieve higher academic qualifications. Empowerment through education has benefits that cut across a broad spectrum. Education will increase the knowledge base, broaden level of understanding, delay early marriage and increase status of women in society. Girls must be made aware of the benefits of education as the main means through which they will escape abject poverty. Girls must be made to understand that education of women has a major positive impact on economic empowerment of women and society as a whole.

This study recommends that women be empowered economically. It was observed in the study that women were not engaged in meaningful economic activities. In addition, it was found out that low income had positive impact morbidity and mortality. Economic empowerment of women will enable them to have access to financial resources which will in turn facilitate their access to better health care. The government should strengthen programmes aimed at economic empowerment of women and poverty eradication.

The study recommends an integrated approach to seeking solutions to the problem of maternal morbidity and mortality. The Government, the community and the individual

women have to play a Government-Community Partnership role in ensuring reduced morbidity and mortality. The role of the Government should be to improve healthcare environment through provision of more health facilities, training more health personnel, ensuring adequate equipment and supply of drugs to the health facilities. Equally important is for the Government to ensure improvement of infrastructure that will enable women access health facilities promptly. The community also has an important role to play in the improvement of the socio-economic and cultural environment by working closely with the Government to ensure that expectant mothers, as well as the entire society, have access to improved health care. The women on their part have to ensure they maintain good health practices, attend antenatal clinics promptly and ensure they deliver in a health facility.

In view of the fact that women in this study were more susceptible to malaria infection during pregnancy, this study recommends that the Ministry of Health should intensify integrated approaches to the eradication of malaria infection in the District. The Ministry should encourage other methods of vector control to help bring down incidences of malaria in the District.

This study also recommends that elaborate programmes be designed and implemented in order to minimize risk factors that precipitate crises in pregnancy, delivery and post-partum period. The study has demonstrated that risk factor approach could be used to identify women at risk of maternal morbidity and mortality. This approach should be popularised since it is addressing issues among women who are alive but in need of care to avert impending complications of pregnancy and delivery. Precautionary measures ought to be taken well in advance once diagnosis has been undertaken.

In light of complications during pregnancy and delivery among teenage mothers, there is need to formulate a policy on minimum age at first birth. This would help minimise pregnancy and delivery complications. The benefits of compulsory education would ultimately lead to delayed age at first birth and age at marriage.

This study makes a strong recommendation for mandatory delivery in a health facility. This ought to be backed by policy formulation to ensure that all births take place in a recognised health facility. Such a policy would accord women opportunity to access Essential Obstetric Care (EOC) and Emergency Obstetric Care (EmOC), which are perceived to be the most effective strategies in place to bring down maternal morbidity and mortality.

5.5 Recommendations for Further Research

The results of this study have pointed to a need to conduct community based studies that target causes of specific risk factors in maternal mortality. This will highlight the magnitude of the problems, associated factors and suggest possible solutions to these problems.

Scanty information on the causal link between the injectibles and anaemia calls for further research into the problem. This method of family planning was found to be popular among current contraceptive users in Bondo District. It is, therefore, necessary that further studies be conducted to unravel the causal linkages. This will help to

elaborate necessary precautionary measures for women who may wish to use these methods.

In addition, it would be necessary to undertake a study to determine the causal link between depression and maternal morbidity and mortality.

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APPENDICES

APPENDIX 1

QUESTIONNAIRE FOR FEMALE RESPONDENTS
(AGE=15-49 YEARS ONLY)

DISTRICT : _____

DIVISION : _____

LOCATION : _____

SUB-LOCATION : _____

HOUSEHOLD NUMBER : _____

NUMBER OF WOMAN : _____

QUESTIONNAIRE ADMINISTRATOR : _____

LANGUAGE OF QUESTIONNAIRE : ENGLISH

RESPONDENTS LOCAL LANGUAGE : _____

TRANSLATOR USED : _____

DATE OF COMPLETION :

DAY	
MONTH	
YEAR	

You have been carefully selected to take part in this research study entitled "Environmental Determinants of Maternal Morbidity and Mortality in Bondo district, Kenya"

The purpose of this questionnaire is to get your views on some of the environmental factors that contribute to maternal morbidity and mortality in Bondo District of Kenya. The study is intended to contribute to improvement of maternal health in Bondo District. Please read each question carefully and indicate in the box or in the spaces provided, the response that best answers the questions.

The information obtained from this questionnaire is mainly for the purpose of this research and will therefore be treated with the desired confidentiality.

Thanking you in advance for your anticipated cooperation.

BACKGROUND CHARACTERISTICS

1. How old are you. Please indicate in the box provided ☐

2. In the boxes provided below, please indicate the month and year in which you were born.

Month ☐ Year ☐

3. What is your current marital status? Please indicate as appropriate in the box provided. ☐

1=Married
2=Single
3=Widowed
4=Divorced
5=Living together
6=Separated
7=Never married
8=Other (Please Specify)_____

4. If married, how old were you when you got married? Please indicate in the box provided ☐

5. Have you ever given birth? ☐
1= Yes 2=No

6. If your answer to question 5 is yes, how old were you when you gave birth to your first child? ☐

7. Were you in a marital union when you gave birth to your first child? ☐
1= Yes 2=N0
8. How many times have you ever given birth in your life? ☐

0= none
1=One
2=Two
3=Three
4=Four
5=Five
6=Six
7=Seven +

9. Have you ever used anything or tried in any way to delay or avoid getting pregnant? ☐
1=Yes 2= No

10. If your answer to question 9 is Yes, Please indicate in the box provided which of the following methods of family planning you have used. ☐

1=pill
2=IUD
3=Injection
4=diaphragm/foam/jelly
5=Condom
6=Norplant
Rhythm/counting days
8=Natural method
9=Withdrawal
Any other (please specify) _____

SOCIO-ECONOMIC CHARACTERISTICS

11. In the box provided below, please indicate the highest level of Education you have attained. ☐
1= No Education
2= Primary
3= Secondary
4= College
5= Any Other (Please specify) _____

12. What do you do for a living?_____

13. If you are currently employed, state the name of your employer or organisation that employs you_____

14 A side from your own housework, are you currently working in any of the following? Please use a tick or ticks for appropriate response.

	Always	At times	Mostly	Occasionally	Never
Selling things					
Work on family land					
Teaching					
Medical field					
Financial institution					
Agricultural sector					
Tailoring					
Transport					
Handicraft					
Any other(please specify)					

15. In the box provided, please indicate your monthly income on average from the activities you have indicated in question 14? ☐
0=No income
1=1500-3000
2=3000-5000
3=6000-8000
4=9000-10000
5=11000-15000
6=16000-18000
7=20000 +
8=Any other, (Please specify)_____

16. Are you satisfied with the income you earn from activities stated in question14 above? ☐
1=Very dissatisfied
2=Dissatisfied
3=Satisfied
4=fairly satisfied
5=Very satisfied

Please give reasons for your answer to this question.

_____

_____

_____

17. If you are currently in a marital union did your husband or partner ever attend school? Please indicate in the box provided ☐
1=Yes 2= No

18. If your answer to question 17 is yes, what was the highest level of schooling did your husband attain? ☐
1=Primary
2=Secondary
3=College
4=University
5=Other (Please Specify) _____

19. What kind of work does your husband mainly do? Please use a tick to indicate the appropriate response

	Always	At times	Mostly	Occasionally	Never
Selling things					
Work on family land					
Teaching					
Medical field					
Financial institution					
Agricultural sector					
Fishing					
Mining					
Building					
Carpentry					
Tailoring					
Any other					

HEALTH CARE CHARACTERISTICS

20. In reference to your last pregnancy, from the time you became pregnant, did you see anyone for antenatal care for the pregnancy? Please indicate in the box. ☐
1=Yes 2=No

21. If your answer to question 20 is 'No', please explain the reasons for failing to see someone for antenatal care.

_____
_____
_____
_____
_____

22. If your answer to question 20 is yes, indicate in the box provided whom you saw. ☐
1=Doctor
2=Nurse/midwife
3=TBA (trained
4=Untrained TBA
5=Other (specify)_____

23. Please indicate in the box provided, how many months you were pregnant when you first visited someone for antenatal check on this pregnancy.

Months ☐ does not know ☐

24. How many ante natal visits did you make in the course of the pregnancy? ☐
Please could you show the clinic card?
Yes ☐ No☐

25. Did you take any special diet during this pregnancy other than your usual diet? Please indicate in the appropriate box. ☐
1=Yes 2= No

26. If your answer to question 25 is No, please explain some of the reasons that led to your inability to take a special diet

_____
_____
_____
_____
_____

27. Please tick how many servings of the following food groups you took in a day during your last pregnancy?

	1	2	3	4	5
Milk, Yoghurt					
Beef/Chicken/Fish/Eggs/Dry beans					
Vegetables					
Fruits					
Bread/Rice/sweet potatoes/Cassava					

28. In some communities, women are not allowed to eat some types of foods during pregnancy. If this applies in your community, specify some of foods that are prohibited

_____
_____
_____
_____
_____

29. In your opinion, what are the reasons why the foods you have listed in question 28 are prohibited?

_____
_____
_____
_____
_____

30. Please indicate in the box provided, if you ever suffered any illness in the course of the pregnancy? ☐

1=Yes 2=No

31. Listed below are some common diseases that women may suffer from in pregnancy. If your answer to question 30 above is yes, please indicate which of the following illnesses you suffered from.

	Always	At times	Mostly	Occasionally	Never
Malaria					
Cough					
Sexually Transmitted disease					
Anaemia					
Lower Abdominal pain					
Haemorrhage					
Fits/Convulsions					
Vomiting					
Any other					

32. In the box provided, please indicate if you ever saw anyone for the treatment of the illness. ☐
1= Yes
2=No

33. If your answer to question 32 is 'No', please explain the reasons for failing to see someone for treatment of this illness.

_____
_____
_____
_____
_____

34. If your answer to question 32 is yes, please indicate in the box provided whom you saw. ☐
1=Doctor
2=Nurse/midwife
3=TBA (trained)
4= TBA (Untrained)
5=Traditional healer
9=Any other _____

35. Which is the nearest health facility that offers maternity care services to people in this village? ☐
1=hospital
2=Health Center
3=Dispensary
4=Private clinic

5=Any Other_____(please specify).

36. How do people in this village get to the nearest health facility that offers maternity care services ? ☐

1=car
2=public transport
3=Bicycle
4=Animal
5=walking
6=Any other (please specify)

37. How long does it take to travel to the nearest health facility that offers maternity services by the following means of transport? (Please indicate in Hours or minutes)

1=car_____
2=public transport_____
3=Bicycle_____
4=Animal_____
5=walking_____
6=Any other (please specify)_____

38. Where did you give birth to your last child? Please indicate as appropriate in the box. ☐

1=Home
2=Government hospital
3=Health centre
3=Mission hospital
4=Private hospital/clinic
5=Other (specify)_____

39. Who assisted with the delivery? Please indicate as appropriate? ☐
1=Doctor
2=Nurse/midwife
3=T.B.A (trained
4=Untrained T.B.A
5=Relative/friend
6=Other person (specify)_____

40. Did you deliver normally or by caesarean? Please indicate as appropriate in the box. ☐

1=Normal
2=Caesarean

41. If you delivered by caesarean section, please explain in the space provided below why this was necessary.

1. _____

2. _____

3. _____

42. For normal deliveries, did you experience any complications at giving birth? Please indicate as appropriate. ☐

1=Yes 2=No

43. If your answer to question 42 above is yes, from the list of common complications of delivery below, please indicate which complication you experienced. ☐

1=Prolonged labour
2=Breach presentation
3=Obstructed labour
4=Haemorrhage
5=Placenta previa
6=Retained placenta
7 = Ruptured uterus
9= Any other (please specify) _____

44. Some mothers suffer from illnesses listed below after delivery. Please indicate if you suffered from any of the illnesses within two weeks of delivery? ☐

1=Fever
2=A discharge from private parts
3=Bleeding or passing large amounts of blood
4=Pain below the umbilicus
5=Depressed/ anxious
6=Any other (specify) _____

45. What is your opinion about the quality of health services offered in the nearest health facility that offers maternity care?

_____

_____

_____

_____

_____

46. What are some of the problems that you feel this health facility ought to overcome?

_____

_____

_____

ENVIRONMENTAL AND HOUSEHOLD FACTORS

47. Below is a list of sources of water within this region. Please indicate the source of water your household uses for cooking and drinking.

	Always	At times	Mostly	Occasionally	Never
Piped into House or plot					
Public tap					
Well water					
Well with pump					
Lake/river/pond					
Rain water					
Other specify					

48. Please indicate as appropriate, the type of toilet facility your household uses.☐
1=Flush toilet
2=Shared flush toilet
3=Pit latrine
4=Ventilated/improved pit latrine
5=No facility bush/field
6=Other specify_____

49. Listed below are common types of floor materials. Could you please indicate in the box provided the main material used on the floor of your house? ☐
1=Natural floor/earth dung
2=Rudimentary floor/wood planks
3=Finished floor parquets of polished wood
4=Ceramic tiles
5=Cement
6=Other (Please specify)

50. Listed below are common types of roof material. Could you please indicate in the box, the main material of the roof of your house? ☐
1=Grass thatched
2=Corrugated iron
3=Tiles
4= Other (Please specify) _____

51. Listed below are some disease-causing pathogens. By means of a tick or ticks, please indicate which of these are found in your house.

	Always	At times	Mostly	Occasionally	Never
Mosquitoes					
Bed bugs					
Rodents					
House flies					
Cockroaches					
Ticks					
Any other(please specify)					

52. Some ways of controlling disease causing pathogens are listed below. By means of a tick or ticks; please indicate which method or methods you use to control insects and pests in your home?

	Always	At times	Mostly	Occasionally	Never
Pesticides					
Fungicides					
Insecticides					
Rodenticides					
Treated mosquito nets					
Untreated mosquito nets					
Attracting devices					
Repellants					
Burning cow dung					
Draining stagnant water					
Spraying stagnant water					
Herbicides					

53. Does your household have the following facilities? Please indicate as appropriate in the box provided.

(Yes=1 2= NO)

Electricity ☐
Solar ☐
Radio ☐
Television ☐
Telephone/ Mobile ☐
Refrigerator ☐

54. From the list provided below; please indicate by means of a tick or ticks what your household uses for cooking?

	Always	At times	Mostly	Occasionally	Never
Electricity					
Gas					
Biogas					
Paraffin/Kerosene					
Charcoal					
Firewood/Straw					
Dung					
Any Other					

SOCIO-CULTURAL FACTORS

55. From the list of major religions below, please indicate your religion in the box provided ☐
1=Catholic
2=Protestant
3=Muslim
4=No religion
5=other (specify) _____
56. Does your religion allow people to undergo blood transfusion? ☐
1=Yes 2= NO

57. If your answer to question 56 is No, explain some of the reasons why your religion does not allow blood transfusion.

_____
_____
_____
_____
_____

58. Does your culture place restrictions on pregnant women? ☐
1=yes
2=No

59. If your answer to question 58 above is yes, please state some of these restrictions.

_____
_____
_____
_____
_____

60. Are there any cultural practices related to pregnancy and childbirth you consider a risk to maternal illnesses and deaths? Please elabourate in the space provided below.

1_____
_____

2_____
_____

3_____
_____

61. In your opinion, how can the adverse cultural handicaps to pregnancy and childbirth be overcome
Please suggest in the space provided.

_____
_____
_____
_____
_____
_____

62. Suggest what the following can do to improve and protect the health of expectant mothers during pregnancy and at delivery.

The expectant women

_____
_____

The Community

_____
_____

The Government

_____

APPENDIX 2

SERVICES AVAILABILITY QUESTIONNAIRE

DISTRICT : _____

DIVISION : _____

LOCATION : _____

SUB- LOCATION : _____

DATE OF COMPLETION

DAY	
MONTH	
YEAR	

INFORMANTS:

(E.g. NURSE IN HEALTH CENTRE, DOCTOR IN HOSPITAL, M.o.H, CLINICAL OFFICER)

1. _____
2. _____

INTERVIEWER'S NAME:

_____

SIGN: _____ DATE: _____

HOSPITALS

1. How many hospitals provide Health Services to people in this District?

—

2. How many of these Hospitals are Government, Private, and how many are operated by a church?

Government	1 __
Mission/ Church	2 __
Private	3 __
Other Private	4 __
Other	5 _____

3. Are the following species provided at the hospitals

Blood Transfusion	01 __
Intensive Care	02 __
Caesarean Section	03 __
Intraveneous Oxytocin	04 __
Manual Vacuum Aspiration	05 __
Treatment for Shock	06 __
Treatment for Hypersensitive Disorders of Pregnancy	07 __

4. Does this Hospital provide

Antenatal Care	01 __
Delivery Care	02 __
Family Planning Services	03 __
Iron Foliate to Expectant Mothers	04 __

HEALTH CENTRES

5. How many Health Centres provide Health Services to people in this District?

_____

6. How many of these Health Centres are Government, Private Health Centres and how many are operated by a church?

Government	01__
Mission/ Church	02 __
Private	03 __
Other Private	04 __
Other	05 __

7. Are the following services provided at the Health Centres?

Blood Transfusion	01 __
Intensive Care	02 __
Caesarean Section	03 __
Intraveneous Oxytocin	04 __
Manual Vacuum Aspiration	05 __
Treatment for Shock	06 __
Treatment for Hypersensitive Disorders of Pregnancy	07 __

8. Do these Health Centres provide?

Antenatal Care	01 __
Delivery Care	02 __
Family Planning Services	03 __
Iron Foliate to Expectant Mothers	04 __

9. How many of the following are serving in the Hospitals, Health Centres and Dispensaries in the District:

Doctors	01__
Clinical Officers	02__

Midwives 03__
Nurses 04__
Traditional Birth Attendants 05__
