A COMPARATIVE STUDY OF THE DETERMINANTS OF INFANT & CHILD MORTALITY IN KENYA & GHANA

By

Eva Wambui Kiragu

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Population Studies and Research Institute

University of Nairobi

Kenya

DECLARATION

I hereby declare that this research project is my original work and has not been submitted for a degree in any other University.

Signed: ..... Date: 23/11/2006

Eva Wambui Kiragu

Q56/7666/04

This project has been submitted for examination with our approval as the University Supervisors.

Signed: ..... Date: 23/11/2006

Dr. Anne Khasakhala

Signed: ..... Date: 23/11/2006

Dr. A.T.A. Otieno

DEDICATION

I dedicate this work to my mum Violet W. Kiragu and dad Edward M. Kiragu, who have always supported me in everything and for the most part my academics; my brothers Robert, Tim and Eric to whom I am indebted in so many ways, as well as my one and only sister Millie whom I hope will always be inspired to dream big.

Finally, this work is dedicated to Mutie Kavila; he has taught me the true meaning of selfless love and perseverance.

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ABSTRACT

Under-five mortality (U5MR) and infant mortality (IMR) have been used as measures of children's well-being for many years (Hill et al, 1996). The high number of children under five years of age dying each year in Africa is shocking, particularly compared to the dramatic progress in the rest of the world. While the number of under-five deaths outside Africa fell from 18.1 to 6.4 million (65 percent decrease) annually between 1960 and 2000, under-five deaths in Africa increased from 2.3 to 4.5 million (96 percent increase). With the technology to address the principal causes of child death now available at reasonable cost and being applied successfully in other regions, the situation in Africa represents a grim picture of the failure of African countries and the global community to address this basic humanitarian issue (SARA, 2005). The Ghana Demographic and Health Surveys carried out in 1993, 1998 and 2003 indicated that U5MR decreased from 119 to 108 and leveled off to 111 per 1000 live births (GSS and MII, 1999 and 2005). Results of the 1998 and 2003 Kenya Demographic and Health Surveys showed that U5MR underwent an increase from 112 to 114 having been 96 per 1000 live births in 1993 (NCPD, CBS & MII, 1999 and 2003).

The main study objective was to carry out a comparative analysis of the determinants of infant and child mortality in Kenya and Ghana. Data was obtained from the Demographic and Health Surveys carried out in both countries in 2003. Survival analysis was utilized to calculate the probability of a child's risk of dying within the first five years of life due to socioeconomic among other factors. Children born alive were the focus of study and Cox's proportional hazard model was used to account for censoring[1] in the estimation of exposure time since not all children had had the chance to survive to the oldest age under investigation by the time of the interview.

Results on the analysis of the factors associated with infant and child deaths in Kenya and Ghana indicated that in Kenya, maternal education, birth order, preceding birth interval and ethnicity were strongly associated with risk of infant death. In Ghana on the other hand, the most crucial determinants of the risk of infant death were maternal level of

[1] Censored observations occur whenever the dependent variable of interest represents the time to a terminal event, and the duration of the study is limited in time. Censored observations may occur in a number of different areas of research, for example, in the demography we may study the "survival" of children. By the end of the study period, some children will still be alive and such subjects represent censored observations.

education, birth order and preceding birth interval. Again in Kenya, risk of childhood death was robustly associated with maternal education, maternal age at birth and ethnicity while in Ghana, maternal education, source of drinking water, type of toilet facilities and marital status were strong determinants of the risk of childhood death.

From the findings, it is quite clear that in both countries infant mortality determinants were more biological than those of childhood mortality which were more to do with the mother's socioeconomic status. As hypothesized, maternal education was largely associated with decreased risk of infant and child death. This was however not the case for infant mortality in Ghana where infants of women with primary education had increased risk of death. Higher maternal education leads to better hygiene and sanitation for children hence increasing their survival chances but low level of education has been found to be associated with increased risk of death of children in the first two years of life.

Both Ghana and Kenya show an increased risk of infant death due to short preceding birth intervals. Preceding birth interval is ideally supposed to be at least 24 months so as to give the mother ample time to recuperate after birth and take good care of the newly born child as well as limit the number of children in the household. Short birth intervals expose both mother and child to ill health hence one or the other or both has an elevated risk of death compared to those with longer birth intervals. Higher birth order also increases chances of death of both mother and child due to maternal depletion and other stress associated with many children e.g. exposure to more pathogens and financial strain. Ghana showed a higher association with risk of infant death from short birth intervals and high birth order than Kenya.

Ethnicity was strongly associated with infant and child deaths in Kenya which can be explained by the different environments and socioeconomic situation these people are exposed to. Elevated risk of child deaths is dominant among those that live in areas that are prone to Malaria, drought/famine and are less urbanized e.g. Nyanza, Coast, Eastern and Western Province. The environmental factors such as drinking water and toilet facilities became important in childhood since this is the time children get more exposed to the environment around them. Socioeconomic situation is strongly linked to the hygiene and sanitation that children are exposed to with better facilities increasing children's survival status.

The study findings pointed out the measures that could be taken to improve child survival more so in Kenya and Ghana. First, education exposes women to the knowledge of better healthcare, hygiene and sanitation i.e. seeking prenatal and post natal health services, delivering in appropriate health facilities, having their children immunized and ensuring that the environment under which they raise them is clean. It also allows women to understand that they have the right and obligation to plan and appropriately space their births in order to give their children the best living conditions.

CHAPTER ONE

INTRODUCTION AND PROBLEM STATEMENT

1.0 Introduction

The under-five mortality rate (U5MR), the probability of dying between birth and age 5 expressed per 1,000 live births, is widely recognized as an important indicator of development in any country. Under-five mortality and infant mortality (IMR), the probability of dying before age one expressed per 1000 live births, have been used as measures of children's well-being for many years (Hill et al, 1996). Until the 1960s, most of the highest child mortality countries were in West Africa with the lowest mortality countries being found in South and Eastern Africa. Come the 1970s and early 1980s, the trend changed and child mortality fell rapidly in some Western African countries but stagnated at relatively high levels in parts of Eastern and Southern Africa (Timæus, 1997). This observation suggests a correlation between the prevalence of HIV/AIDS and child survival since the disease has higher prevalence levels in Eastern and Southern Africa (Mahy, 2003).

In the period between the end of World War II and the early 1970's, child death rates were halved, even in the developing countries. A large amount of these gains was achieved through interventions aimed at communicable diseases (diarrhoea, respiratory infections, malaria, measles and other immunizable childhood infections). Data on accurate cause of death is scanty in Sub-Saharan Africa but the cause of the death structure of under-5 mortality in most countries here was almost certainly dominated by pneumonia, malaria, measles and diarrhoeal disease, which are estimated to have been to blame for about 60 percent of the disease burden in the region around 1990 (Murray and Lopez, 1996).

In spite of this, mortality in Ghana has gradually improved over the last four decades although economic conditions may have affected the pace of this improvement (NRC, 1993). Conditions in Ghana deteriorated in the late 1970s through to the mid 1980s, ceasing earlier improvements, and there was a slight/no change. The economy began to improve in the mid 1980s followed years later by renewed mortality declines that have continued since then (Adlakha, 1996). The Ghana Demographic and Health Surveys carried out in 1993, 1998 and 2003 indicated that U5MR decreased from 119 to 108 and leveled off to 111 per 1000 live births (GSS and MII, 1999 and 2005).

In Kenya, the 15–20 year period following independence experienced strong economic growth which took the edge off the harmful effects of the high fertility and high population growth that existed. Until around 1980 the U5MR fell at an annual rate of 4 percent per annum but this decreased to 2 percent per annum in the early 1980s. Factors such as reduced government expenditure and adverse movement trade-wise coincided with a reverse of U5MR; it not only stopped decreasing but began heading in the opposite direction (Hill et al., 2001). Results of the 1998 and 2003 Kenya Demographic and Health Surveys showed that U5MR underwent an increase from 112 to 114 having been 96 per 1000 live births in 1993 (NCPD, CBS & MII, 1999 and 2003). This adverse trend from the late 1980s to the mid 1990s coincided with adverse trends like stagnation in growth of per capita income, declining immunization levels, falling school enrolment and the emergence of the HIV/AIDS epidemic (Hill et al., 2001).

1.1 Problem statement

The mortality situation of young children in Sub-Saharan Africa reveals a crisis that needs to be dealt with urgently. According the 2003 World Health Report, of the 20 countries in the world with the highest child mortality, 19 are in Africa, the exception being Afghanistan. A baby in Sierra Leone is three and half times more likely to die before its fifth birthday than a child born in India and more than a hundred times more likely to die than a child born in Iceland or Singapore. In Sub-Saharan Africa, U5MR is 75 percent greater than in other regions in the world. With 10 percent of the world's population, Africa produces 20 percent of the world's live births and 41 percent of under-five deaths.

Although Sub-Saharan African countries have achieved a small reduction in the U5MR, the much greater rate of population growth means that the total number of under-five deaths continues to grow; 36 of the 42 countries with the highest mortality rates in the world are in Sub-Saharan Africa. Maternal mortality rates are also high and contribute to the high neonatal death rates (SARA, 2005). In his study on the factors affecting child survival in Kenya, Ikamari (1996) pointed out that research on infant and child mortality is important because of the assumed relationship between fertility and mortality. He added that improvement in infant and child mortality rates may be necessary for prompting a decline in fertility and also that this decline has been considered a necessary necessity for contraception acceptance. Lastly, he pointed out that a fall in fertility can also

bring about a reduction in infant and child mortality by reducing high order births which are usually subject to higher risk of mortality.

Infant mortality accounts for about 60 percent of deaths in the under-five age group in Africa. Neonatal deaths contribute to almost half of infant mortality. The neonatal period is the most delicate in a child's first five years of life. A child's risk of dying in the first month of life is 30 times greater than the average monthly risk over the next 59 months (Save the Children, 2001). In 2002, almost half of Sub-Saharan countries had infant mortality rates greater than 100 per 1,000 live births. The highest rates occurred in Sierra Leone, Liberia, Niger, and Angola; the countries that had the highest under-five mortality rates. On the Sub-Saharan continent (excluding the small islands), Eritrea and South Africa have the lowest infant mortality rates (UNICEF, 2004). In 2003, Kenya's infant mortality rate was 77 per 1000 live births while that of Ghana was 64 according to their respective demographic and health surveys.

Neonatal mortality rates have increased or stayed the same, between 1997 and 2002, in Sub-Saharan Africa, i.e. 35 to 55 percent of all infant deaths (UNICEF, 2004). In Ghana, neonatal mortality rate was 43 while that of Kenya was 33 per 1000 live births according to their 2003 demographic and health surveys. The details of their childhood mortality rates can be seen in table 1.1.

Table 1.1: Early childhood mortality rates in Kenya and Ghana, 2003

	Neonatal mortality[2]		Post neonatal mortality[3]		Infant mortality		Child mortality		Under-five mortality	
	Kenya	Ghana	Kenya	Ghana	Kenya	Ghana	Kenya	Ghana	Kenya	Ghana
2003	33	43	44	21	77	64	41	50	115	111
1998	32	39	41	26	73	65	40	46	110	108

Source: GDHS and KDHS Reports, 2003

In countries affected by conflict or HIV/AIDS, the number of children who die before age five has gone up i.e. in Central African Republic, Cote d'Ivoire, Iraq, Rwanda, Botswana,

[2] Neonatal mortality – probability of dying within the first month of life
[3] Post neonatal mortality – difference between neonatal and infant mortality

Kenya, Lesotho, South Africa, and Swaziland. At the other extreme are African countries achieving exceptionally sharp increases in child survival – Eritrea, Comoros, Cape Verde, Mozambique, Guinea and Egypt. Originally, HIV and AIDS emerged as adult health problems but they have become a major killer of under-five year old children, especially in developing countries. Almost 90 percent of paediatric infections occur in Sub-Saharan Africa, where there are both high fertility rates and high HIV prevalence rates among women (De Cock KM et al., 2000). About 25-30 percent of children born to infected mothers become infected with HIV and almost all of them die before age five in most developing countries with high (above 5 percent), HIV prevalence e.g. Kenya. Under-five mortality rates among children of HIV infected mothers are two to five times higher than among children of HIV negative mothers. Even among children who are not infected, many will die because the resources needed to ensure their survival and health care are used to care for HIV positive adults (Boerma and Whitworth, 1998).

In 2004, 3.1 million people died of AIDS, 510,000 of whom were children (UNAIDS/WHO, 2004). HIV/AIDS has thus led to significant increases in mortality in many countries: it is a leading cause of death among women and children in the most severely affected countries in Sub-Saharan Africa (Zaba et al., 2004). The 2003 GDHS report indicated that adult HIV prevalence in Ghana was 2.2 percent with that of adult women (those aged 15-49) being 2.7 percent (GSS, MII, 2005). On the other hand, the adult HIV prevalence of Kenya was 6.7 percent in 2003, with that of adult women being 8.7 percent (NCPD, CBS & MII, 1999 & 2003).

Immunization against childhood diseases contributes to reductions in morbidity, mortality and permanent disability among children. The six major childhood diseases that are immunizable are tuberculosis, diphtheria, pertussis, polio, tetanus and measles (GSS, MII, 2005). According to the 1998 and 2003 GDHS reports, Ghana's immunization coverage among children aged 12-23 months increased from 51 to 69 percent (GSS, MII, 1999, 2005) while that of Kenya decreased from 65 to 59 percent (NCPD, CBS & MII, 1999, 2003). Despite advances in health and sanitation, Sub-Saharan Africa continues to show a distinct pattern of high childhood mortality dominated by infectious and parasitic diseases, diarrhoea being one of the leading causes (Kirkwood, 1991; WHO, 1996).

Poverty undermines progress. Many of the countries whose child mortality rates are stagnating or reversing are poor in terms of gross domestic product; others are facing

economic downturn. According to the World Bank (2004), income poverty is on its way out because the proportion and the total number of people around the world living on less than US$ 1 per day is decreasing but unfortunately almost all of this progress has been made in Asia. Sub-Saharan Africa, where most of the countries whose child mortality rates have stagnated or reversed are, has emerged as the region with the highest incidence of extreme poverty, and the greatest depth of poverty (UNDP, 2004). Furthermore, the average income of poor people in Africa has been falling over time, in contrast with that of poor people in the rest of the developing world (Chen, Ravaillon, 2004).

The proximate determinants of child mortality for both Kenya and Ghana like in other Sub-Saharan countries are maternal and demographic factors, nutrition, illness and injury. Socio-economic variables that influence child mortality include parents' education, access to health services and household environment (unlike the maternal and demographic factors which increase infants' risk of death, these are enhanced as the child gets older). Considerable differentials in child mortality levels by region in both countries also emerged in their 2003 DHS findings. This could be attributed to the uneven distribution of important epidemiological, biomedical, social and behavioral "risk factors" across the nations (Hill et al., 2001).

Many of the studies that have been done in Kenya in relation to infant and child mortality have concentrated on estimating mortality levels by different socioeconomic, demographic and other factors (Omariba, 2005) while a few others have been carried out to compare the effects of the various factors on infant and child mortality in various regions of the country (Ikamari, 1996). These regions have however been known to cover up a variety of differences. Studies have also been done in Ghana to estimate infant mortality levels by different cultural backgrounds by Gyimah (2002). Another study has been done by Gyimah (2005) on polygamous marital structure and child survivorship in Ghana. It should however be noted that none of these studies has critically compared determinants of infant and child mortality in sub-Saharan countries e.g. Kenya and Ghana.

This study aimed at exploring the determinants of infant and child mortality but took a further step of comparing them in Kenya and Ghana. African countries, more so those in the East and West seem to have a lot of masked differences in the determinants of their child mortality. They also seem to have very different infant and child mortality levels in their rural and urban areas. This study is carried out to compare and contrast the

determinants of child mortality in Ghana and Kenya, and find out their differences and similarities using the 2003 demographic and health survey data for both countries. Efforts that have led to improvement in certain areas could be borrowed in order to bring down the high child mortality rates that are exhibited in these countries. Practices that are found to contribute negatively towards the reduction of child deaths could also be discouraged.

1.2 Research questions

1) What are the socio-economic determinants of infant and child mortality in Kenya and Ghana?
2) What are the bio-demographic determinants of infant and child mortality in Kenya and Ghana?

1.3 Study objectives

The general objective of this study was to establish the determinants of infant and child mortality in Ghana and Kenya. The specific objectives of the study were:

1. To establish the socio-economic determinants of infant and child mortality in Kenya and Ghana while controlling for the bio-demographic and socio-cultural factors.
2. To examine the impact of the determinants of infant and child mortality in Kenya and Ghana.

1.4 Justification

Monitoring of trends in infant and child mortality is important since it provides a basis for assessing the performance of health programmes over time. What's more it serves as a platform for the government and its international development partners to set new goals in meeting the health needs of the society (Omariba, 2005). Differentials of the infant and child mortality in Kenya and Ghana, according to the 2003 DHS findings, justify a comparative analysis of the determinants of this disparity in child mortality levels. Goal 4 of the Millennium Development Goals (MDGs) is the improvement of child health. The target linked to this goal is to reduce the under-five mortality rate by two-thirds between 1990 and 2015. This study aimed at finding out the most crucial determinants of child mortality in Kenya and Ghana especially those that would require the most consideration. The results of this exercise could aid in the further improvement of current policies in

order to turn around Kenya's present child mortality trend and bring about an even further decrease in child deaths in Ghana. This will hopefully be a contribution towards the achievement of goal 4 of the MDGs by the two countries.

1.5 Scope and limitations

The data utilized for this analysis was collected from women aged between 15 and 49 in Kenya and Ghana from the Demographic and Health Surveys carried out in 2003. The limitations of the study were; quality of data may have been compromised since the recording is done retrospectively hence could have led to underreporting of child deaths especially those that occurred very soon after birth. Due to this only the live births in the five years preceding the survey were considered to reduce the recall bias. Also the use of secondary data restricted the use of variables to those used in the survey. This did not allow for certain control and/or independent variables to be tested against the dependent one hence restricted new knowledge.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter reviewed the literature on determinants of infant and child mortality, in developing countries including Ghana and Kenya. This literature endeavored to especially point out the socioeconomic, bio-demographic, socio-cultural and environmental factors that determine infant and child mortality. Following this was the presentation of the conceptual and operational frameworks and hypotheses and lastly a definition of the key variables.

2.1 Determinants of infant & child mortality in developing countries – especially Kenya & Ghana

Child mortality determinants all over the world have been seen to be centered on socioeconomic, bio-demographic, socio-cultural and environmental factors. Many of the determinants of child mortality are properties of the household within which the child is located. They include levels of the household income, adult literacy, health practices among household members, sanitary facilities and so on. Other determinants are organization of the healthcare system, ecological characteristics such as climate, rainfall, presence of disease vectors and distribution of land and resources (Caldwell, 1979; Preston, 1978).

Bio-demographic factors consist of age of mother at time of birth, child's birth order, preceding and succeeding birth interval, size of child at birth, length of time the child is breastfed and the survival status of previous sibling. Changes in reproductive patterns can influence child health and survival through a number of different mechanisms especially through changes in maternal age at child birth, birth order and/or the interval between births. Short birth intervals, it is suggested, may result in a higher risk of death among children in three ways: first, premature weaning of a child since a following child is conceived. Secondly, mother's reproductive health is not entirely regained between births, and may increase the risk of premature and low birth weight babies. Thirdly greater number of children in the household increases contagion of infectious diseases and greater competition for resources and child care within the household (Da Vanzo et al., 1983).

As indicated by the 2003 GDHS report, U5MR was 192 per 1000 for children born less than two years after the previous sibling while it was 82 per 1000 for children born at least three years after the previous child (GSS and MII, 2005). In Kenya, the 2003 KDHS report showed that U5MR was 182 per 1000 for children born less than two years after the last sibling while it was 83 per 1000 for children born at least four or more years after the last child (NCPD, CBS & MII, 2003). These statistics show the importance of giving adequate time for physiological and physical healing to the mother after delivery. It also emphasizes the significance of family planning methods that are easily available and affordable so as to give mothers a chance to space their births appropriately.

According to the 1998 GDHS report, the relationship between maternal age and childhood mortality (with the exception of postneonatal mortality) is for the most part an expected U-shaped curve, if data's restricted to the age group 15-49. Childhood mortality is substantially higher among mothers aged less than 20, due to physiological immaturity and the social and psychological stress that comes with it and those more than 30 years. High risk at older ages is due maternal depletion associated with pregnancy complications and repeated child births (Gyimah, 2002). Also, first births and higher order births experience higher mortality.

Size of the child at birth, with reference to the 2003 KDHS report, also affects childhood mortality rates. Children whose birth size is small or very small have a 50 percent greater risk of dying before their first birthday than those whose birth size is average or larger. However, the birth size of the child seems to affect only the neonatal mortality rate and has no effect during the postneonatal period. Also despite their size, infants who are breastfed adequately not only have normal growth but are also protected against malnutrition, diseases and infections (Knodel & Kintner, 1977) hence increasing their chances of survival.

Socioeconomic factors include maternal education, her rural-urban place of residence, access to health facility and wealth index. Advances in female education may represent a potent and cost effective means of reducing child mortality (Caldwell, 1979; Preston, 1978). Educated mothers are less likely to experience childhood deaths because they are thought to have a better understanding and appreciation for health related matters. Also they are less submissive to norms and practices that adversely affect the health and welfare of their children (Gyimah, 2002).

In a study on the link between parents' education and child mortality on the Tigrai region of Northern Ethiopia, Kiros and Hogan (2001) pointed out that although limited information exists on mechanisms by which parental education might improve child survival, social scientists have speculated that higher levels of education lead to increased income, which in turn decreases malnutrition. Educated mothers may be more likely to implement simple health-promoting practices, such as increasing cleanliness or using health services. Educated fathers may boost their children's chances of survival through their greater affluence and knowledge.

In a population-based case-control study carried out by Binka et al. (1995) to investigate potential risk factors for post-neonatal and child mortality in Northern Ghana were child survival rates are among the lowest in Africa, the mortality rate for children aged six months to four years was estimated as 24 per 1000 children per year. An increased risk of death was observed where the delivery was not performed by a trained person, if the preceding birth interval was less than 24 months, if the father beat the child's mother or if the water source was unprotected. However, no association was found between weaning practices, parental education, or any of the socioeconomic or hygiene variables considered.

According to Ainsworth (1994) high child mortality rates may encourage large families as parents have more children to replace children who die. Couples also may raise their fertility in response to high child mortality in their community. At the same time, high fertility may raise child mortality through the effects of frequent, closely spaced pregnancies on the mother's capacity to bear healthy children and the strain that large families can place on household resources. In most of Africa, lower levels of infant mortality have been correlated with lower fertility rates, underscoring the importance of health programs that target prenatal and postnatal health as well as family planning programs.

In-depth studies found that women's education has a smaller impact on reducing child mortality in Cote d'Ivoire, where levels of schooling are very low, than in Ghana, where female schooling is more widespread. Proximity to health care also was associated with lower child mortality in Cote d'Ivoire, where the average distance to health care is 12 kilometers. But that was not the case in Ghana, where facilities already are much closer to households (7 kilometers, on average). In both countries, on average, women compensate

for child mortality by having one more birth for every five child deaths they experience (Ainsworth, 1994).

Mothers with secondary and above education exhibited a U5MR of 34 per 1000 in Ghana compared to a U5MR of 125 per 1000 for mothers with no education (GSS and MII, 2005). In Kenya, mothers with education beyond secondary school had a U5MR of 63 per 1000 while those with no education exhibited a U5MR of 127 per 1000 live births (NCPD, CBS & MII, 2003). The importance of having mothers who are educated is more than clear from these statistics.

On average, according to the Panel on Urban Population Dynamics (2003) city populations in developing countries show lower levels of child mortality than are found in rural populations, and similar urban–rural differences are noticeable across a range of health indicators. But urban averages can mask striking within-city disparities in health: the urban poor often face health risks that are nearly as bad as those seen in the countryside, and sometimes the risks are irrefutably worse. In the slums of Nairobi, rates of child mortality considerably exceed those found elsewhere in the city; they are high enough even to surpass rural mortality in Kenya. They concluded that if urban populations have an advantage in health relative to rural populations it must be very unequally shared (Montgomery, 2005).

When no other variables are controlled, babies born in rural areas are more likely to die. This difference is not due to rural residence per se but to other factors e.g. poorer sanitation and less well educated mothers, which are correlated with rural areas (Da Vanzo et al., 1983). Rural populations in Ghana are not only disadvantaged socio-economically but are also under-served in terms of health infrastructure and personnel (Brown, 1986). They are also more likely to subject their children to harmful traditional customs and taboos compared to their urban counterparts. According the 2003 DHS findings in Kenya, infant mortality was 61 and 79 per 1000 live births in urban and rural areas respectively (NCPD, CBS & MII, 2003), while the 2003 GDHS showed that of Ghana being 55 and 70 per 1000 births (GSS and MII, 2005). These statistics show the disparities that exist in rural and urban populations in both countries. Both countries in 2003 had U5MR being 93 in urban areas, and that in rural areas being 117 per 1000 live births. These gaps need to be addressed.

A study done by Gyimah (2002) in Ghana on ethnicity and infant mortality in Sub-Saharan Africa pointed out that it was higher among some ethnic groups e.g. the Grussi and Gruma relative to the Ashanti in the bivariate results. However in the multivariate results the ethnic differences disappeared once socioeconomic variables were controlled for. This implied that the observed ethnic differences in infant mortality are mainly a sign of socioeconomic inequalities among groups rather than native cultural norms. Therefore to improve child survival, efforts should be directed towards enhancing the socioeconomic status of women from the disadvantaged ethnic groups.

Environmental factors associated with infant and child deaths include source of drinking water and type of toilet facility. Environmental risk factors account for about one-fifth of the total burden of disease in low income countries according to recent estimates (World Bank, 2001). WHO (2002) reports that among the ten identified leading mortality risks in high-mortality developing countries, unsafe water, sanitation and hygiene ranked 2nd, while indoor smoke from solid fuels ranked 4th. About 3 percent of these deaths are ascribed to environmental risk factors and child deaths account for about 90 percent of the total (Mutunga, 2004). In their study on how biological and behavioral influences on mortality in Malaysia vary during the first year of life, Da Vanzo et al. (1983) found out that toilet sanitation is associated with lower post neonatal mortality even when a number of potential confounding variables were controlled.

Residence in a house with piped water according to Gyimah (2002) was associated with a 35 percent reduction in the risk of infant deaths compared to that in a house whose source of drinking water was a river or stream. Also, children in households with flush toilets were 63 percent less likely to die compared to those in households with no toilet facility. A study by Omariba (2005) on changing childhood mortality conditions in Kenya, found out that there was a 20 percent increase in the risk of infant deaths in households with no toilet facility compared to those living in households with a pit latrine while risk of child deaths was 25 percent higher given the same circumstances.

In Ghana's capital city, Accra, most residents have access to treated and piped water, but the systems often don't work. High connection charges also mean many homes do not have access to the city's central sewage system. In this case, they use pit, pan, or bucket latrines which they later empty into containers provided by the city council. The waste is then dumped at a station near the shore or into the city's open drainage system, according

to the London-based International Institute for Environment and Development. 16 percent of Accra's households use flush toilets, but such modern plumbing is only found in middle and upper-income homes. Because of growing populations, residents in Accra, Ghana, generate about 800 tons of solid wastes per day, with an annual increase of 6%, according to a 1992 report by the Stockholm Environment Institute. Most of the waste is organic, including ashes from fuel wood and charcoal, as well as the remains of common foods such as sugar cane, mangoes, and bananas. With little equipment to manage the refuse, garbage is only collected in high-income areas. The rest is dumped in unauthorized dumping sites, primarily along waterways. Associated health problems include high incidences of cholera, diarrhea, and dysentery, especially in children who tend to play in such areas (Clay, 1994).

The **socio cultural factors** often included are ethnicity, marital status and type of marriage. Analysis of recent survey data by Martin Brockerhoff and Paul Hewett (1998) reveals large differentials in child mortality among ethnic groups in countries throughout Sub-Saharan Africa. These disparities correspond with the prominence of specific ethnic groups in the national political economy. In many countries where heads of state since independence have come from one or two ethnic groups e.g. Côte d'Ivoire, Kenya, and Niger, these groups have experienced levels of early child mortality at least one-third lower than those of other groups.

In other countries where there have been several transitions in state control, as in Ghana and Uganda, descendants of pre-colonial kingdoms such as Asante and Buganda have experienced much lower mortality than others. In most countries, the lower mortality of dominant ethnic groups (who typically represent small proportions of national populations) is strongly related to economic privilege. Constant inequalities among African ethnic groups require strong consideration in planning economic development and child health strategies.

According to Gyimah (2005) in his paper on polygamous marital structure and child survivorship in Ghana and whether it was an age dependent effect, in the multivariate analysis, children in polygamous marriages were consistently found to be at a higher risk of death than those from monogamous families. In models with interactions, the effect of polygamy was also found to be time-dependent with the effect being more pronounced in the later childhood. Women who are single often contend with a lot of discrimination in

the society. Traditionally, children were supposed to be borne in a family consisting of a mother and father but this is rapidly changing with development, with girls getting pregnant earlier. In several countries of sub-Saharan Africa, adolescent fertility is sanctioned and valued within the adequate ritual framework (marriage), but strongly condemned when out of wedlock (Bledsoe and Cohen, 1993). Hence children borne outside marriage are most likely to be exposed to higher risk of death that accompanies the trauma from rejection and economic hardship that follows single motherhood. In a few countries, however, mostly those in the infertility belt (Central African Republic, South-west Sudan, Congo, Gabon and Cameroon), a pregnancy constitutes a prerequisite to marriage, and adolescent girls who cannot prove their ability to conceive, find no partners.

In Ghana, within the cultural context, children continue to be subjected to harmful traditional practices. According to the 2006 UNICEF official summary of the state of the world's children focusing on Ghana, many of these include ritual servitude (trokosi), female genital mutilation (FGM), widowhood rites, early marriage and polygamy. UNICEF has had a campaign in the country, drawing attention of the general public to the direct linkages between HIV/AIDS and polygamy as well as FGM through a nation wide television programme.

2.2 A summary of the literature review

After a review of the various literature, it is fair to conclude that the following issues are associated with an increase/decrease in infant and child mortality; education status of women, rural or urban residence, delivery in the presence of a birth attendant, preceding birth interval, source of drinking water and toilet sanitation. Others include region of residence, proximity to health care centres, birth intervals, maternal age at birth, birth order, survival status of the last birth, ethnicity, marital status and harmful cultural practices.

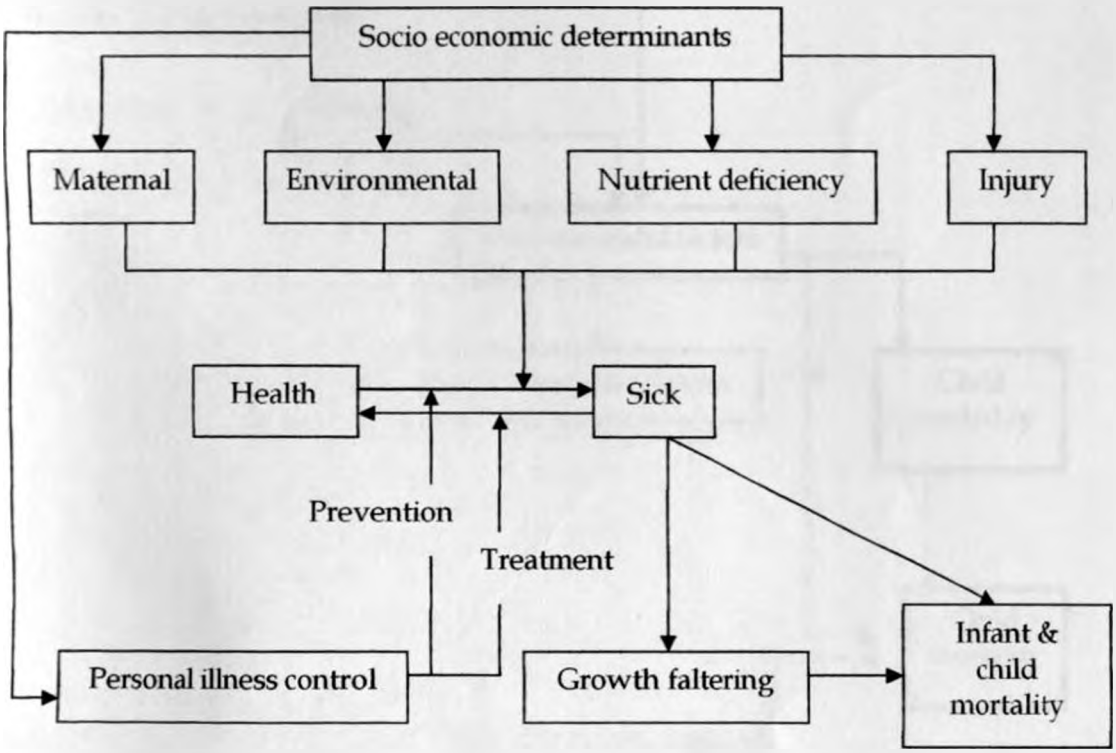
Some studies however contradicted these conclusions for example the study by Binka et al (1995) which found no association between weaning practices, parental education or any of the socioeconomic or hygiene variables considered and an increased risk of death in children aged between six months to four years. Also according to Ainsworth (1994) proximity to health care was not associated with lower child mortality in Ghana where

facilities were much closer to households compared to Cote d'Ivore where they were further away. This calls for further investigation into the factors that influence child mortality. It should be noted that HIV/AIDS has brought about complexity in the study of infant and child mortality determinants. This is because it is a major cause of death in countries with high prevalence (≥ 5 percent) such as Kenya.

A useful framework for exploring child survival interventions is that proposed by Mosley and Chen (1984). Background social, economic, cultural and public policy factors operate through a set of proximate determinants, which and only which influence child survival. The proximate determinants proposed by Mosley and Chen are divided into five categories: maternal factors, environmental contamination, nutrition, injuries, and personal health practices (both preventive and curative).

Figure 1: Conceptual framework

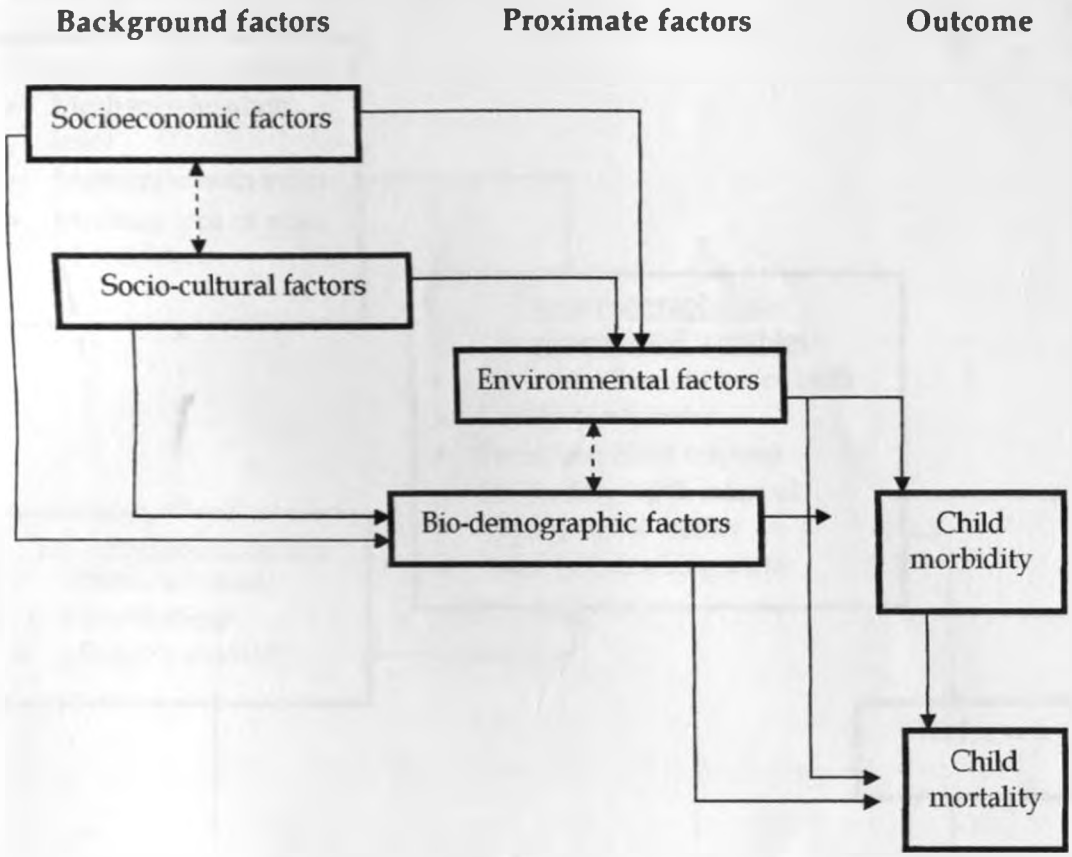
Mosley and Chen Model (1984)



Source: Mosley W. H. & Chen L.C. (1984). Population and Development Review, a Supplement to Vol. 10: 29.

According to the Mosley and Chen framework all socioeconomic and socio-cultural determinants of child mortality operate through a common set of five proximate determinants; maternal and household environment factors, nutrient deficiency, injury and personal illness control. These proximate determinants affect the state of health of the child and determine whether the child is sick or healthy and once the child is sick, they do go on to establish whether the child gets well or dies.

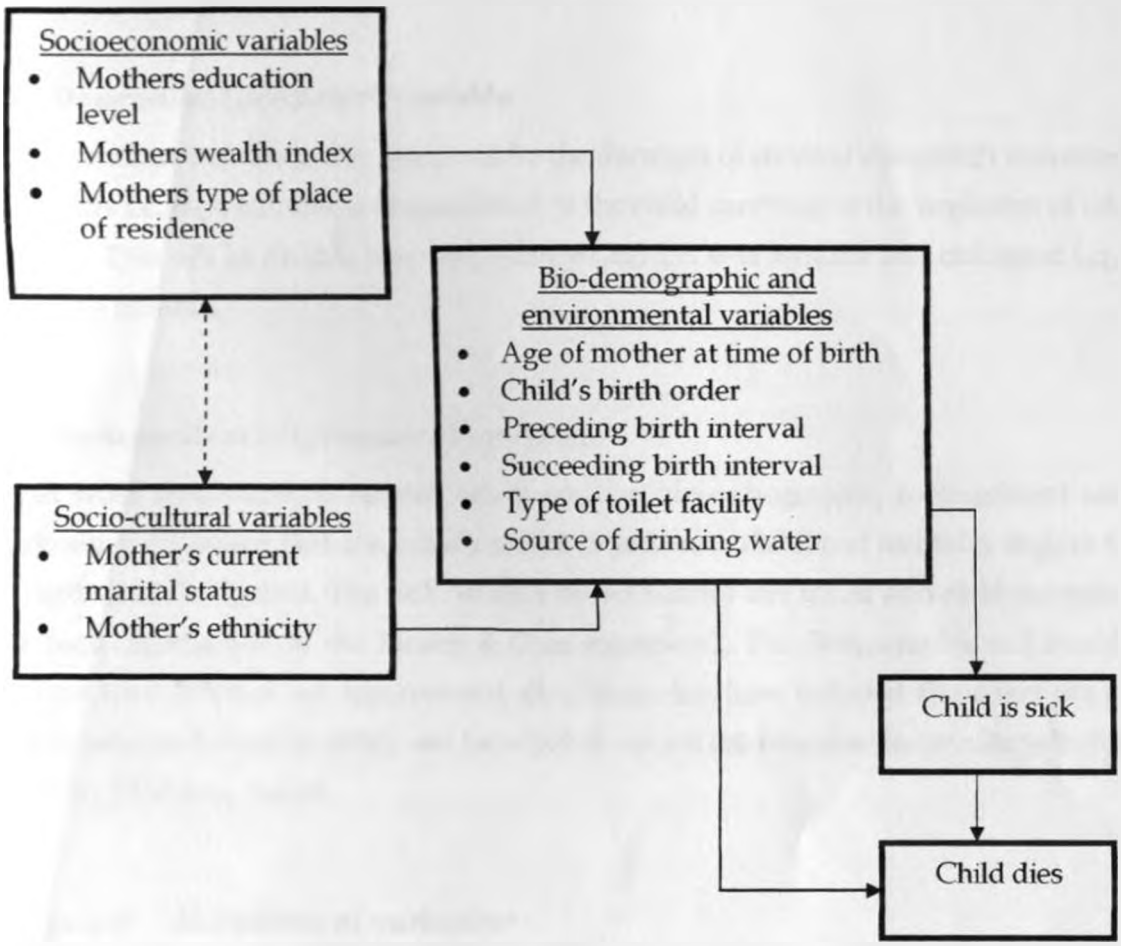
Figure 2: Conceptual model



Source: Adapted from the Mosley & Chen framework, 1984: 25

Bio-demographic and environmental factors may be the principal determinants of child morbidity and mortality but child morbidity and mortality levels are also affected, promoted and/or modified by socioeconomic and socio-cultural factors that prevail in a given society/household.

Figure 3: Operational framework



Source: Adapted from the Mosley & Chen Framework, 1984: 25

2.3 Operational hypotheses

1) Maternal level of education is associated with a child's survival status.
2) A child's survival status is associated with mother's wealth index.
3) A mother's type of place of residence has a relationship with a child's survival status.
4) The higher the age of the mother at time of birth, the higher the birth order and the shorter the birth interval the lower the chances of a child's survival.
5) A mother's marital status and ethnicity have an association with a child's survival status.

6) Whether a child survives or not has a relationship with the presence of a toilet facility and source of drinking water in a household.

2.4 Dependent (predictor) variable

The dependent variable in this study will be the duration of survival since birth measured in months i.e. 0-59 months. It is conditional to the child surviving to the beginning of this interval. This will be divided into two; infancy (${}_1q_0$) i.e. 0-11 months and childhood (${}_4q_1$) i.e. 12-59 months.

2.5 Independent (explanatory) variables

Apart from socioeconomic factors, others such as bio-demographic, socio-cultural and environmental factors that are usually known to influence childhood mortality require to be statistically controlled. The link between causal factors and infant and child mortality has been summarized in the Mosley & Chen framework. The Demographic and Health Surveys have however not incorporated all of them but have included those that are of utmost interest for public policy and for which there are interventions known for reducing mortality (Rutstein, 2000).

2.5.1 Definition of variables[4]

Socioeconomic variables include mother's education level, her wealth index and type of place of residence. Maternal education is the highest standard of formal education attained by the mother. It was categorized as those with no education[A], those with primary education and those with secondary and higher education. It was expected that the risk of child deaths would decrease with the amount of education that the mothers have.

Wealth index is based on household ownership of material possessions such as radio, television, telephone, refrigerator, bicycle, motorbike/scooter and car/truck. It also includes the housing quality, whether the house has electricity, a finished floor and a permanent roof i.e. corrugated iron or tiles (Hill et al, 2001). It is constructed to serve as a proxy for household wealth and disposable income. It was classified as low[A] (0 – 30 percent), medium (31-70 percent) or high (71-100 percent). Those in the high wealth index were expected to experience the lowest fatalities of their children. Type of place of

[4] The [A] represents the reference category

residence considers the usual residing place. It was grouped into rural^ and urban. As is common in the developing countries, those in the rural areas were expected to exhibit higher infant and child deaths.

Bio-demographic variables included in the study were mother's age at birth, child's birth order, preceding and succeeding birth interval. The age of mother at the time of birth was classified as under 20, 20-29^, 30-34 and above 35 years. It was used as a proxy for mother's physiological, mental and emotional maturity as well as the mother's experience with childcare (Ikamari, 1996). The relationship between infant and child mortality and maternal age at birth was expected to take the U-shape with the risk of dying being highest at both the lower and upper ends. Mortalities of children are usually lowest between 20-29 years since this is the age band in the fertility span of women during which reproductive risks are at a minimum.

Birth interval is the length of time in months between two births. Preceding birth interval was grouped into below 24, between 24 and 36^ and above 36 months. Generally, the probabilities of child survival are significantly lower among closely spaced infants. This could be explained through the dynamics of sibling competition and maternal depletion syndrome (Gyimah, 2002). Succeeding birth interval was classified the same way as preceding birth interval and child survival was expected to be higher when siblings were born at least 24 months after. Birth order of the index child was classified as first, 2-3^, 4-5 and above 6. The risk of death was expected to be higher among first and higher order births. For the sake of taking care of the confounding effects of birth order and preceding birth interval (since 1st births don't experience a preceding interval) the birth order and preceding birth interval variables were combined to come up with a new variable.

Environmental variables considered included source of drinking water and type of toilet facility. Disease exposure especially to diarrhoea is associated to these two facilities. Conditions may have been recently upgraded hence the index child could have previously been exposed to poorer conditions. Since they're the only variables available for study it was assumed like in other studies (Gyimah, 2002; Omariba, 2005) that conditions had not changed considerably in the period under study. For source of drinking water, it was classified into piped^, well, stream/river/lake and other (rain, truck, bottled). Type of toilet facility was grouped into those who had toilet^ and those with no toilet. It was

expected that children born in households with piped water and toilet facilities would experience the lowest risk of death.

Socio-cultural variables included in the study were mother's current marital status and her ethnicity. Mother's current marital status was categorized as currently married^, never married and formerly married. Children born in stable family unions where their mothers are married were expected to have higher chances of survival compared to those with never/formerly married mothers. Mother's ethnicity (Ghana) was categorized as Akan^, Ga-adangbe, Ewe, Mole-dagbani and others. Children borne of Akan mothers were expected to have the highest chances of survival nationally. Ethnicity (Kenya) was categorized as Kikuyu/Embu/Meru^, Kamba, Kisii/Kalenjin, Luhya, Luo, Mijikenda/Swahili and others. Children borne of Kikuyu, Embu or Meru mothers were expected to experience the lowest deaths nationally. Mother's ethnicity was considered bearing in mind women's heavy responsibility for childrearing.

CHAPTER THREE

DATA AND METHODOLOGY

3.0 Introduction

This chapter presents a description of the source of data used in the study as well as the analytical methods that were utilized in order to come up with the necessary conclusions on a comparison of determinants of infant and child mortality in Kenya and Ghana.

3.1 Source of Data

Data on child mortality and other socioeconomic, socio-cultural and bio-demographic and environmental factors used in this study was from the Kenya and Ghana Demographic and Health Surveys conducted in 2003. Since children were the basic units of the analysis, the data was transformed such that each child constituted a unit of observation. In these surveys, each female respondent in the reproductive ages, (15 – 49 years) was asked on an individual interview (using the women's questionnaire) to report on the number of sons and daughters who lived with her, the number who lived elsewhere, and the number who had died. Further, she was asked to provide a detailed birth history of her childbearing experience, covering such items as sex, date of birth, whether a birth was single or multiple, survival status, current age of each live birth and, if not alive, the age at death of each live birth. Information was also collected on child and maternal health and family planning.

3.1 Analytic methods

Survival analysis was utilized in this study to calculate the probability of a child's risk of dying within the first five years of life due to socioeconomic, bio-demographic and other factors. Children born alive were the focus of study and their mortality patterns were modeled from birth until the age of five. Since not all children had had the chance to survive to the oldest age under investigation by the time of the interview, Cox's proportional hazard model was used to account for censoring in the estimation of exposure time. The coefficients in the multivariate models were interpreted as the effects of a given variable on the odds of dying. The coefficients were exponentiated and interpreted as odds ratio. For categorical variables, odds ratios greater than one represented a higher risk while those less than one represented a lower risk of dying.

Cox's Proportional Hazard Model

Cox regression (or proportional hazards regression) is a method for investigating the effect of several variables on the time a specified event takes to happen. In the case of an outcome such as a child's death, this is known as Cox regression for survival analysis. The method does not assume any particular "survival model". However it is not truly non-parametric because it assumes that the effects of the predictor variables upon survival are constant over time and are additive in one scale. The hazards ratio associated with a predictor variable is given by the exponent of its coefficient. The model is represented as:

$$\lambda_i(t) = \lambda_0(t) * \exp(\beta_1 * z_1 + ... + \beta_m * z_m) \text{ OR } \lambda_i(t) = \lambda_0(t)\exp(z_i'\beta_i)$$

Where:

- *i* are the index subjects (in this case the children),
- $\lambda(t)$ denotes the resultant hazard[5] (probability of child dying), given the values of the *m* covariates (socioeconomic, bio-demographic, etc) for the respective cases ($z_1, ..., z_m$) and the respective survival time (t),
- $\lambda_0(t)$ is the baseline hazard; it is the hazard for the respective individual (the child) when all independent variable values are equal to zero,
- β_i represents the associated coefficients for the respective cases ($z_1, ..., z_m$).

Four models controlling for the correlation between infant and child survival risk and unobserved factors were estimated. The first model consisted of socioeconomic and socio-cultural variables i.e. maternal education, her wealth index, type of rural-urban place of residence, ethnicity and current marital status. The second model consisted of bio-demographic and socio-cultural variables i.e. age of mother at time of birth, preceding birth interval, succeeding birth interval (for child mortality), birth order of the index child and ethnicity and current marital status. The third model included the socioeconomic, bio-demographic and environmental variables, as control variables, and tested their net effect on infant and child mortality. The fourth model incorporated all the variables (full model). These results were used for the comparative study of the effect of these variables on infant and child mortality in both countries.

[5] The hazard rate is defined as the probability per time unit that a case that has survived to the beginning of the respective interval will fail in that interval. Failure in this context will be death of the index child.

CHAPTER FOUR

CHARACTERISTICS OF STUDY POPULATION AND DATA QUALITY

4.0 Introduction

This chapter examined the characteristics of the population under study as well as the quality of the data used in the analysis.

4.1 Population Characteristics

Data for the study was from the 2003 Kenya and Ghana Demographic and Health Surveys. The study was confined to children born to the sample of women in the five years preceding the survey, yielding a sample size of 3,844 children (with 314 deaths) in Ghana and 5,949 children in Kenya (with 502 deaths). The study's restriction to these recent births ensured that the background maternal and household characteristics related to the most current conditions.

Table 4.1.1 represented the characteristics of the study population by background variables for both Kenya and Ghana. While majority of women in Kenya had at least primary education i.e. 58.1 per cent, majority of those in Ghana had no education i.e. 47.5 per cent. In both countries, most of the women in the samples fell in the low wealth index with much higher poverty being exhibited in Kenya at 77.2 per cent. Most women in the samples were from the rural areas. Majority of women were in the 20 to 29 age bracket in both samples. In both countries, 33.9 and 35.4 per cent of the women in Kenya and Ghana respectively were at the 2nd and 3rd birth order. Birth interval varied for Kenyan and Ghanaian women. While Kenyan women waited for at least 24 to 36 months before having their next child, most of the Ghanaian women in this sample had longer intervals of 36 months or more until their next birth i.e. 53.8 per cent.

Table 4.1.1: Distribution of the study population by background variables for both Kenya and Ghana – KDHS, 2003

	Kenya		Ghana	
Variables	**Frequencies**	**Percent**	**Frequencies**	**Percent**
Mother's education level				
No education	1210	20.3	1824	47.5
Primary education	3456	58.1	823	21.4
Secondary education	1283	21.6	1197	31.1
Wealth index				
Low	4592	77.2	2087	54.3
Medium	1233	20.7	1668	43.4
High	124	2.1	89	2.3
Type of place of mother's residence				
Rural	4415	74.2	2801	72.9
Urban	1534	25.8	1043	27.1
Mother's age at birth				
<20	1067	17.9	427	11.1
20-29	3051	51.3	1752	45.6
30-34	801	13.5	615	16.0
35+	1030	17.3	1050	27.3
Birth order of child				
First	1488	25.0	840	21.9
2-3	2105	35.4	1303	33.9
4-5	1184	19.9	891	23.1
6+	1172	19.7	810	21.1
Preceding birth interval (months)				
<24	1051	17.7	399	10.4
24-36	1717	28.9	989	25.7
36+	1693	28.4	1608	41.8
First birth	1488	25.0	840	21.9
Succeeding birth interval (months)				
<24	738	12.4	241	6.3
24-36	915	15.4	507	13.2
36+	251	4.2	257	6.7
Last birth	4045	68.0	2839	73.9
Source of drinking water				
Piped	1627	27.3	920	23.9
Well	1139	19.1	1880	48.9
Spring/river/lake	2691	45.2	944	24.6
Other	492	8.3	100	2.6
Type of toilet facility				
Have toilet	1583	26.6	2255	58.7
No toilet	4366	73.4	1589	41.3
Mother's ethnicity (Kenya)				
Kikuyu/Embu/Meru	1274	21.4		
Kamba	562	9.4		
Kisii/Kalenjin	877	14.7		
Luhya	980	16.5		
Luo	685	11.5		
Mijikenda/Swahili	466	7.8		
Others	1105	18.6		
Mother's ethnicity (Ghana)				
Akan			1478	38.4
Ga-adangbe			254	6.6
Ewe			424	11.0
Mole-dagbani			930	24.2
Others			758	19.7
Mother's current marital status				
Never married	355	6.0	97	2.5
Currently married	5113	85.9	3512	91.4
Formerly married	481	8.1	235	6.1
Total	**5949**	**100.0**	**3844**	**100.0**

The main source of drinking water for Kenyan women was from springs, rivers or lakes, at 45.2 per cent, while most Ghanaian women according to the 2003 GDHS sourced their drinking water from wells i.e. 48.9 per cent. For both samples of women, only 27.3 and 23.9 per cent of Kenyan and Ghanaian women had access to piped drinking water which is traditionally supposed to be safest source of drinking water for the household. Only 26.6 per cent of women in the Kenyan sample had toilet facilities within their households compared to 58.7 per cent of the Ghanaian sample of women, more than double that of Kenyan women. In considering the mother's ethnicity, majority of the Kenyan women belonged to the Kikuyu, Embu or Meru ethnic groups while in Ghana, a substantial portion of the women were in the Akan ethnic groups which comprise of the Asante, Fante and Other Akan ethnicities. For both samples of women, the majority of them were currently married.

In summary, regarding the distribution of background characteristics, a greater part of Kenyan women had at least some education i.e. primary and/or secondary education compared to the Ghanaian women at 79.7 per cent. Kenya had majority of its women in the low wealth index while in Ghana; almost half of the women were in the medium and high wealth indices at 45.7 per cent. Again, slightly more Ghanaian women lived in the urban areas compared to the Kenyan ones. In Kenya, more women gave birth when they were below 20 years than in Ghana while the Ghanaian women exhibited higher births when aged over 30 years. Women in Ghana went on to have their 4th or above child at 44.3 per cent than Kenyan ones at 39.6 per cent. Almost double the women in Kenya had a preceding birth interval of less than 24 months than Ghanaian women. This was also exhibited for the succeeding birth interval.

Table 4.1.2 shows the distribution of children's deaths by the covariates used in the infant and child mortality analysis in this study. There were more child deaths among Kenyan women with primary education at 60.8 per cent while those with no education in Ghana exhibited the highest infant and child fatalities at 49.4 per cent. In both countries the women in the lowest wealth index and those living in the rural areas, as is normally inferred, experienced the highest child deaths. Considering the mother's age at birth in both Kenya and Ghana, most were in the 20 to 29 age bracket which is the peak of child bearing and this could explain why in both countries; the women in this age bracket exhibited the highest child deaths.

Women in both countries having their first birth experience had almost the same child death experience while Kenyan women experienced slightly higher infant and child deaths when having their 6th or above birth than Ghanaian women at 26.7 per cent. Kenyan children born with a preceding birth interval of less than 24 months had higher fatalities at 27.7 per cent compared to the Ghanaian ones at 18.8 per cent. Similar trends were exhibited when looking at the succeeding birth interval where the Ghanaian children experienced 6.7 per cent deaths while the Kenyan ones experienced 10.4 per cent.

For both the Kenyan and Ghanaian women, children born to them when they lacked toilet facilities, as is expected, experienced the highest fatalities. Availability of proper toilet facilities is a reflection of the socioeconomic status. The better the status the lower the number of child deaths due to hygiene and sanitation. The Mijikenda/Swahili in Kenya and the Ga-adangbe in Ghana seemed to exhibit the lowest infant and child deaths at 6.0 and 5.4 per cent respectively. For both samples, the currently married women who were the majority were depicted to experience the highest infant and child deaths at 86.7 per cent in Kenya and 91.1 per cent in Ghana. Figures 4.1 to 4.4 show a clearer picture of the distribution of infant and child deaths according to socioeconomic and bio-demographic factors in both countries.

Table 4.1.2: Distribution of children's deaths by covariates used in the infant and child mortality analysis in Kenya and Ghana – GDHS, KDHS, 2003

	Kenya		Ghana	
Variables	**Number**	**Percent**	**Number**	**Percent**
Mother's education level				
No education	121	24.1	155	49.4
Primary education	305	60.8	82	26.1
Secondary education	76	15.1	77	24.5
Wealth index				
Low	360	71.7	157	50.0
Medium	113	22.5	152	48.4
High	29	5.8	5	1.6
Type of place of mother's residence				
Rural	378	75.3	240	76.4
Urban	124	24.7	74	23.6
Mother's age at birth				
<20	93	18.5	42	13.4
20-29	248	49.5	133	42.4
30-34	63	12.5	51	16.2
35+	98	19.5	88	28.0
Birth order of child				
First	109	21.7	70	22.3
2-3	170	33.9	94	29.9
4-5	89	17.7	74	23.6
6+	134	26.7	76	24.2
Preceding birth interval (months)				
<24	139	27.7	59	18.8
24-36	124	24.7	77	24.5
36+	130	25.9	108	34.4
First birth	109	21.7	70	22.3
Succeeding birth interval (months)				
<24	52	10.4	21	6.7
24-36	76	15.1	30	9.6
36+	24	4.8	24	7.6
Last birth	350	69.7	239	76.1
Source of drinking water				
Piped	112	22.3	64	20.4
Well	106	21.1	157	50.0
Spring/river/lake	229	45.5	80	25.5
Other	56	11.1	13	4.1
Type of toilet facility				
Have toilet	143	28.5	144	45.9
No toilet	359	71.5	170	54.1
Mother's ethnicity (Kenya)				
Kikuyu/Embu/Meru	51	10.2		
Kamba	40	8.0		
Kisii/Kalenjin	63	12.5		
Luhya	97	19.3		
Luo	113	22.5		
Mijikenda/Swahili	30	6.0		
Others	108	21.5		
Mother's ethnicity (Ghana)				
Akan			120	38.2
Ga-adangbe			17	5.4
Ewe			34	10.8
Mole-dagbani			76	24.3
Others			67	21.3
Mother's current marital status				
Never married	29	5.8	15	4.8
Currently married	435	86.7	286	91.1
Formerly married	38	7.5	13	4.1
Total	**502**	**100.0**	**314**	**100.0**

Note: The preceding birth interval samples do not add up to 5,949 in Kenya and 3,844 in Ghana since this variable does not include first births. 1,488 and 840 children were first births in Kenya and Ghana respectively.

Figure 4.1 shows that according to the 2003 KDHS, mothers with primary education experienced the highest infant and child deaths followed by those with no education and those with secondary and above education have their children dying the least. With reference to wealth index, those in the low wealth index as is expected, experience the highest infant and child deaths with those in the high wealth index experiencing the least. Rural mothers have most of their children dying according to this figure; more than double those dying in the urban areas.

Figure 4.1: Graph of percent distribution of infant and child deaths against socioeconomic factors in Kenya

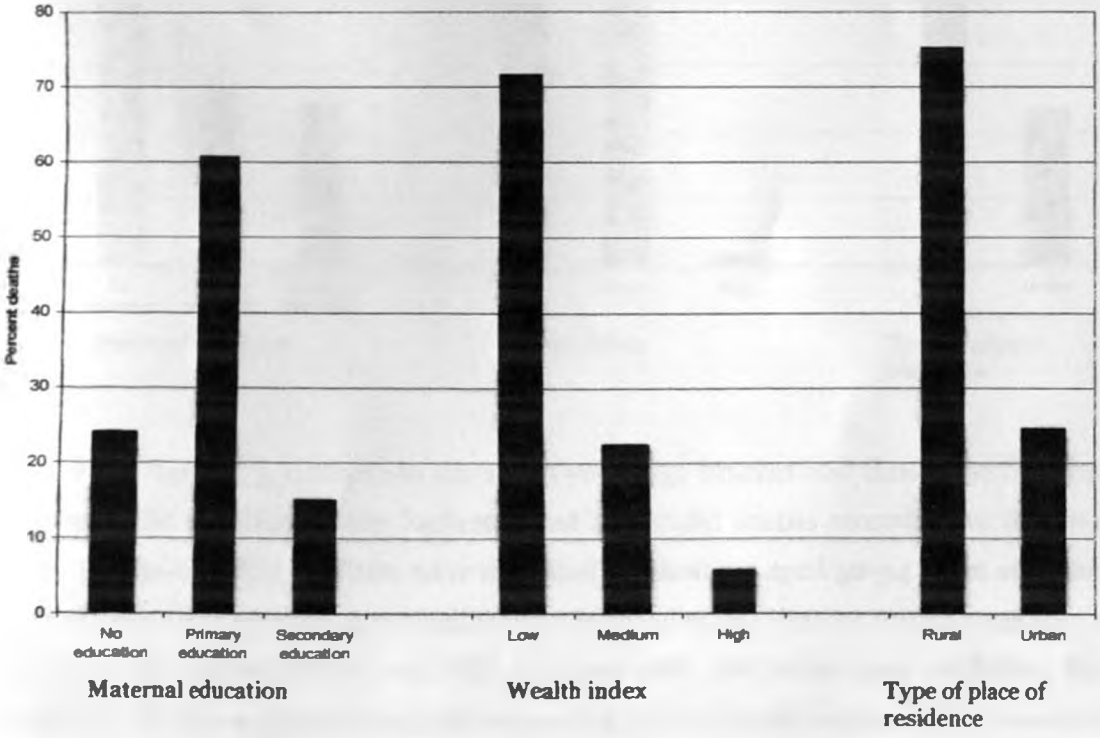
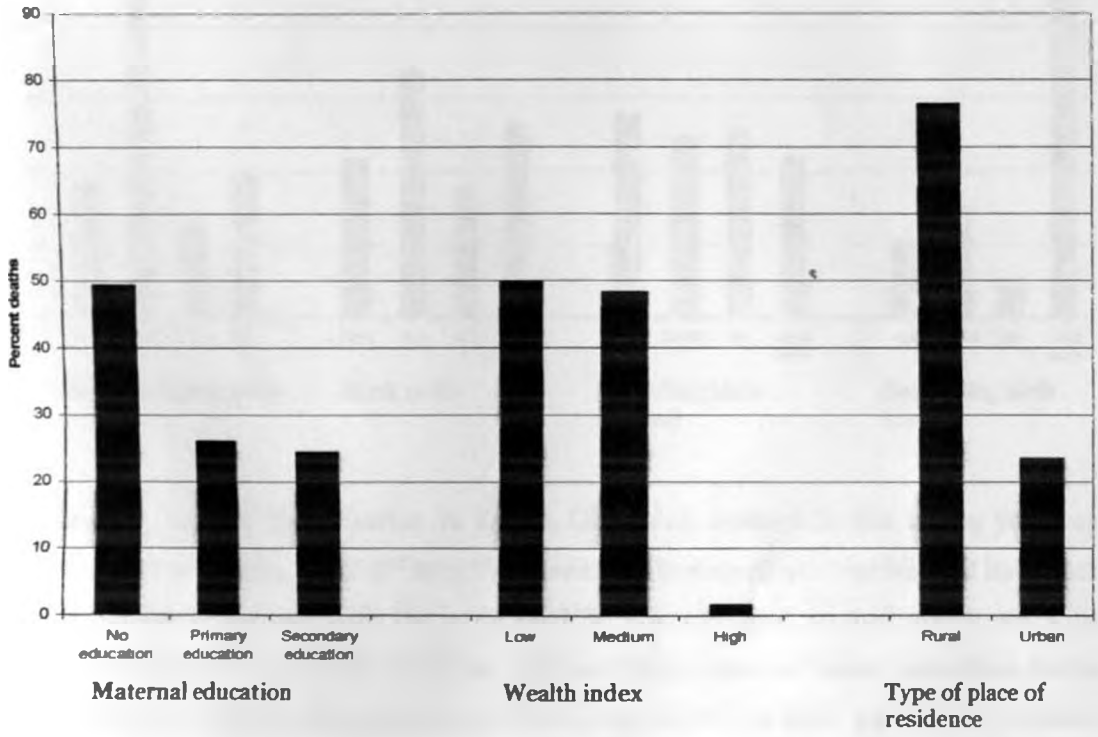


Figure 4.2 depicts the situation in Ghana with reference to the 2003 GDHS. Unlike in Kenya, the women with no education in Ghana exhibited the highest infant and child deaths with those having primary and secondary and higher education experiencing almost the same amount of child deaths. With regards to the wealth index, children whose

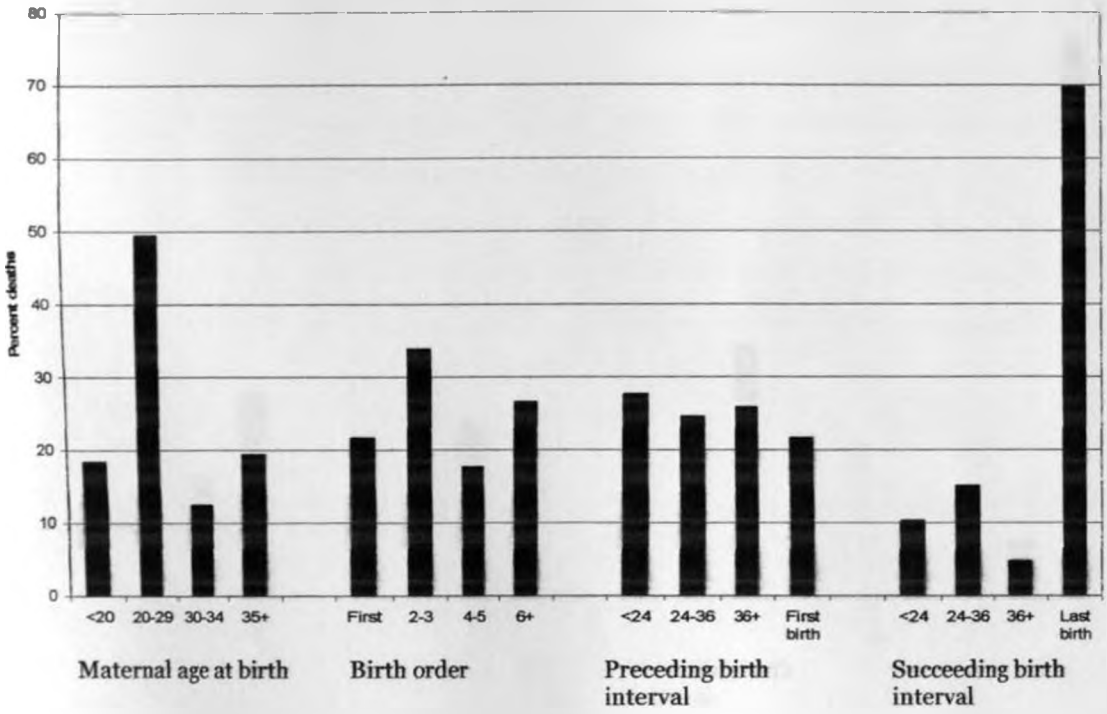
mothers were in the low and medium wealth indices experienced high deaths while those with mothers in the high index experienced very low rates of death. As with the Kenyan situation, mothers in the rural areas had more of their children dying than those in the urban areas.

Figure 4.2: Graph of percent distribution of infant and child deaths against socioeconomic factors in Ghana



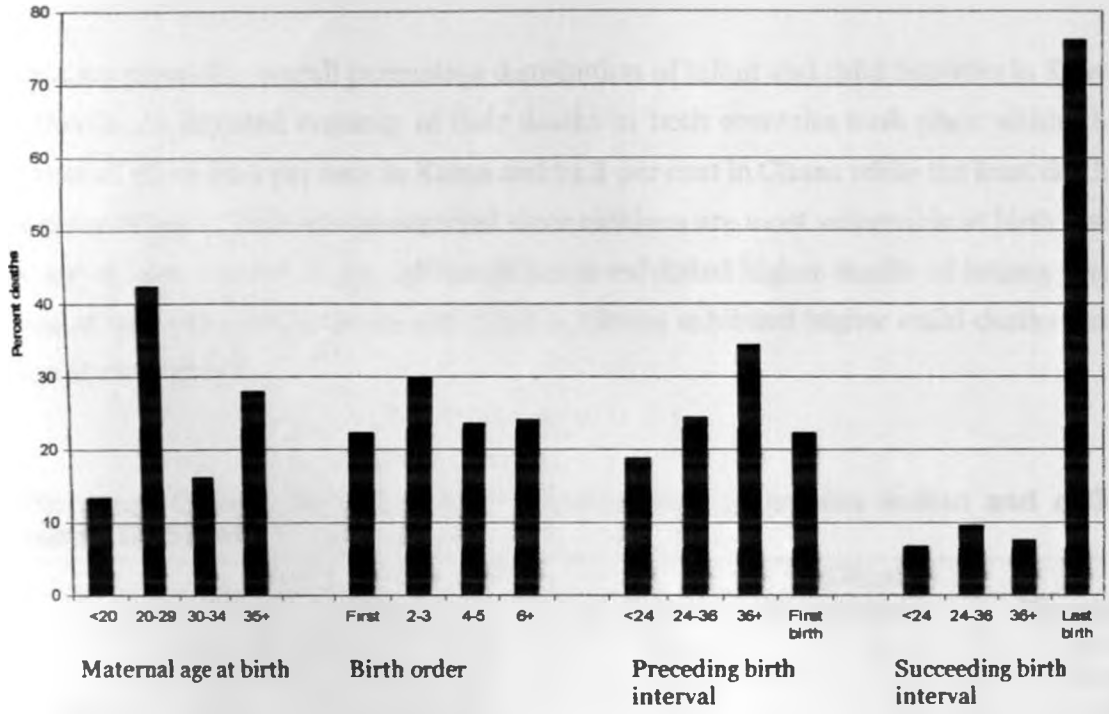
As shown in figure 4.3, mothers in the 20-29 years age bracket and those who had their 2nd or 3rd child experienced the highest infant and child deaths according to the 2003 KDHS. The lowest child fatalities were exhibited by mothers aged 30-34 years and those who had their 4th or 5th child. A preceding birth interval of less than 24 months was seen to experience the highest infant and child fatalities with first births also exhibiting high instances of the same. Considering the succeeding birth interval, many children were last births hence did not experience it but nevertheless those who had an interval of 36 months or more were seen to experience the least deaths.

Figure 4.3: Graph of percent distribution of infant and child deaths against bio-demographic factors in Kenya



In figure 4.4, as was the situation in Kenya, Ghanaian women in the 20-29 years age bracket and those having their 2nd or 3rd birth seemed to experience the highest incidences of child deaths in keeping with the 2003 GDHS. Women aged 35 and above years and those having their 6th or above child also exhibited high rates of infant and child deaths. While in Kenya children with a preceding birth interval of less than 24 months exhibited the highest rate of fatalities, in Ghana, those with an interval of 36 months or more seemed to die most. In contrast, those with an interval of less than 24 months exhibited the lowest rate of death. Looking at the succeeding birth interval, children with an interval of 24-36 months experienced the highest fatalities although majority of the children were last birth and did not get to experience this interval.

Figure 4.4: Graph of percent distribution of infant and child deaths against bio-demographic factors in Ghana



By and large, with reference to the death rates in the two countries, women in Kenya with primary education exhibited about thrice the child deaths of those with the same level of education in Ghana. However, those with no education and secondary and higher in Kenya experienced much lower infant and child deaths compared to the Ghana women. While child deaths were almost equally distributed among the women in the low and medium wealth indices in Ghana, in Kenya, majority of these deaths occurred in women in the low wealth index. In both countries, women residing in the rural areas experienced almost an equal amount of infant and child deaths. Ghanaian women aged below 20 years and those in the 20-29 years age bracket had their children dying less the Kenyan women in these ages but for the women above 30 years, the Kenyan children experienced less fatalities.

First births in both countries experienced about the same death, while sixth and higher births in Kenyan women seemed to exhibit slightly higher rates of death. Ghana displayed a much lower fatality rate of children born in preceding birth intervals of less than 24 months compared to Kenya. Regarding the over 36 months preceding birth interval however, Kenyan women exhibited lowered infant and child deaths. Kenyan women with succeeding birth interval of less than 24 months and 24-36 months exhibited higher infant

and child fatalities compared to the Ghanaian ones. Their children experienced less deaths however when the succeeding birth interval was 36 months and over.

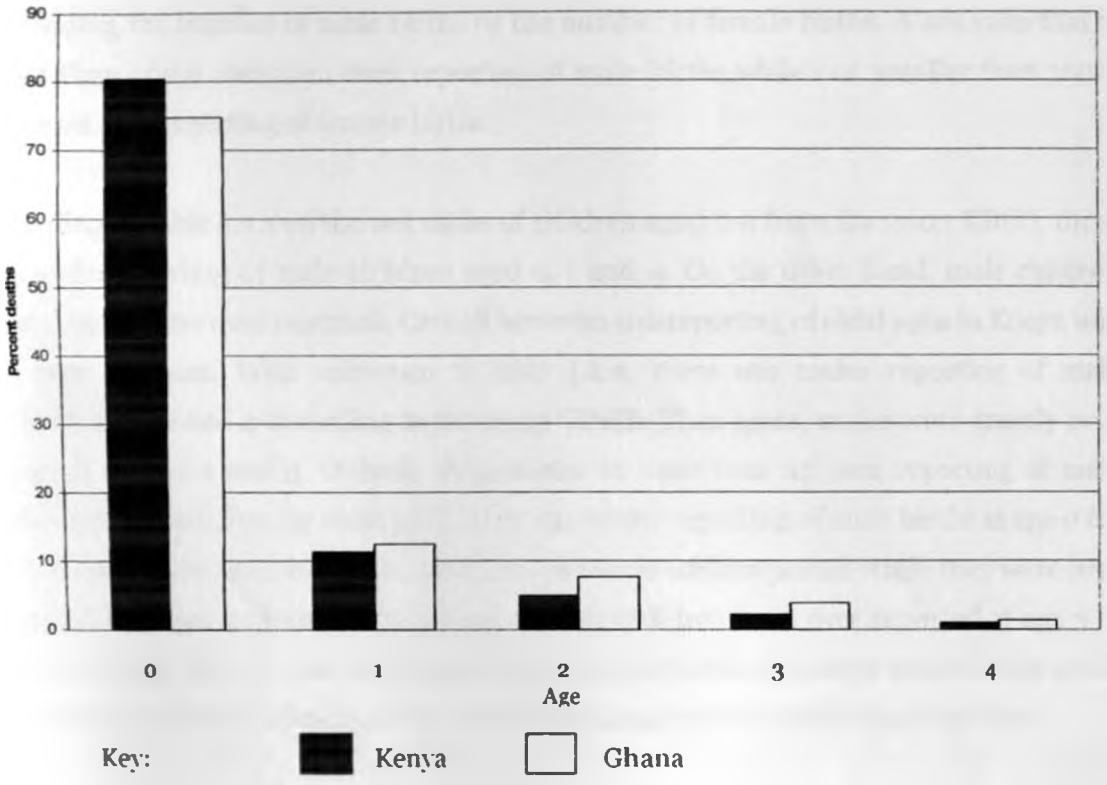
Table 4.1.3 shows the overall percentage distribution of infant and child fatalities in Kenya and Ghana. As depicted majority of their deaths in both countries took place within the first year of life at 80.4 per cent in Kenya and 74.8 per cent in Ghana while the least deaths took place at age 5. This was as expected since children are most vulnerable at birth until they are at least 2 years of age. Although Kenya exhibited higher deaths at infancy than Ghana at 91.8 per cent, between age 2 and 4, Ghana exhibited higher child deaths than Kenya at 12.7 per cent.

Table 4.1.3: Overall distribution of Kenyan and Ghanaian infant and child deaths KDHS, 2003

		Kenya		Ghana	
		Frequency	**Percent**	**Frequency**	**Percent**
Child's age at death	0	404	80.4	235	74.8
	1	57	11.4	39	12.5
	2	25	5.0	24	7.6
	3	11	2.2	12	3.8
	4	5	1.0	4	1.3
	Total	**502**	**100.0**	**314**	**100.0**

Figure 4.5 clearly points out that while Kenyan women had the majority of child deaths under the age of 1, from ages 1 to 4; Ghana exhibited a higher percentage of infant and child deaths. As is depicted vividly in the diagram as well, majority of children born died at age zero which was expected due to their vulnerability at this age to infectious and contagious diseases that can prove to be fatal after a very short period of time.

Figure 4.5: Graph of overall distribution of Kenyan and Ghanaian infant and child deaths



4.2 Data quality

Data quality in the estimation of infant and child mortality is affected by among other factors, age misreporting among women, omission of dead children, heaping of children's ages and sex ratios at birth. The nature of errors in data in younger age groups is different from that in adult ages. While age data for adults is mostly affected by errors due to deliberate age misreporting as well as digit preference, younger ages are affected more by omission. It is a common observation that there's gross under enumeration for children aged between zero and four and there is over estimation of those aged between five and nine at the expense of those aged between 0 and 4.

4.2.1 Sex ratios at birth

In many African societies there is the tendency to prefer male children over female ones. Hence, women tend to remember and report their male children better than females (Singh, 1987). This can lead to underreporting of the total number of children ever born as well as higher proportion of male children dead since more males die than females at

infancy. The extent of under enumeration can be observed by computing the percentage distribution and sex ratio of single year ages for those aged between 0 and 4. This is done by dividing the number of male births by the number of female births. A sex ratio that is larger than 100.0 shows an over reporting of male births while one smaller than 100.0 shows an over reporting of female births.

According to table 4.2.1 on the sex ratios of children aged 0-4 from the 2003 KDHS, there was underreporting of male children aged 0, 1 and 4. On the other hand, male children aged 2 and 3 were over reported. Overall however, misreporting of child ages in Kenya was not very rampant. With reference to table 4.2.2, there was under reporting of male children aged 0 and 2 according to the 2003 GDHS. Then again, males were grossly over reported at ages 1 and 3. Overall, there seems to have been an over reporting of male children in Ghana. For the most part, there was under reporting of male births at age 0 for both countries. At age 1 in Kenya, male children were underreported while they were over reported in Ghana and vice versa for age 2. Male children were over reported at age 3 in both countries. Finally, male children were over reported in Ghana at 102.52. This could have compromised the quality of the end results as under/over reporting often does.

Table 4.2.1: Sex ratios for Kenyan children aged between 0 and 4

		Current age of child (years)					Total
		0	1	2	3	4	
Sex of child	Male	601	546	524	564	493	2728
	Female	621	553	513	536	496	2719
Sex ratio		**96.78**	**98.73**	**102.14**	**105.22**	**99.40**	**100.33**

Source: KDHS, 2003

Table 4.2.2: Sex ratios for Ghanaian children aged between 0 and 4

		Current age of child					Total
		0	1	2	3	4	
Sex of child	Male	363	395	322	390	317	1787
	Female	385	340	350	354	314	1743
Sex ratio		**94.29**	**116.18**	**92.00**	**110.17**	**100.96**	**102.52**

Source: GDHS, 2003

4.2.2 Reporting of age among women

This variable and any other variable computed on the basis of the mother's reported age affects results of analysis of infant and child mortality if reported poorly. Mothers who misreport their age are also likely to misreport their maternity history (Ikamari, 1996). A common type of error is age misstatement/misreporting arising from digital preference that takes place at ages that end in 0 or 5 which arises when respondents cannot remember their exact age hence round it off to these preferred digits. The extent of age misreporting especially age heaping is considered by percentage distribution of all women by their current single year of age.

Figure 4.6 shows that there was age heaping at the ages of 20, 24, 25, 28, 35, 40, 43 and 45 among the women in the 2003 KDHS. Digit preference was exhibited although ages ending in 0 and 5 were not the only ones preferred. Overall however, there seems to have been no dominance of age misreporting in this sample of women. Looking at figure 4.7, there was age heaping at the ages of 20, 25, 30, 32, 35, 38, 40, 42 and 45 according to the 2003 GDHS sample. There seemed to be high digit preference for ages ending in 0 and 5 although it was not the only one exhibited. In this sample of women, there was dominant age heaping which implies that there was rampant age misreporting among them. Comparing the Kenyan and Ghanaian age misreporting among the 2003 KDHS and GDHS samples, Ghana clearly had higher misreporting hence there were underlying errors arising from some women being included in age groups in which they did not belong.

Gross misreporting can be detected by analyzing the 5-year distribution of respondents. With no serious age misreporting, proportion of women in successive age groups is expected to decrease monotonically with increasing age. This takes place in conditions of stable fertility, declining mortality and closed migration. Age misreporting can result in the transfer of women into wrong age group, distort the expected pattern of distribution of mean number of children ever born, mean number of children dead and proportion of dead children by age of mother (Ikamari, 1996).

Figure 4.6: Graph of percentage distribution of women by single age years in Kenya KDHS, 2003

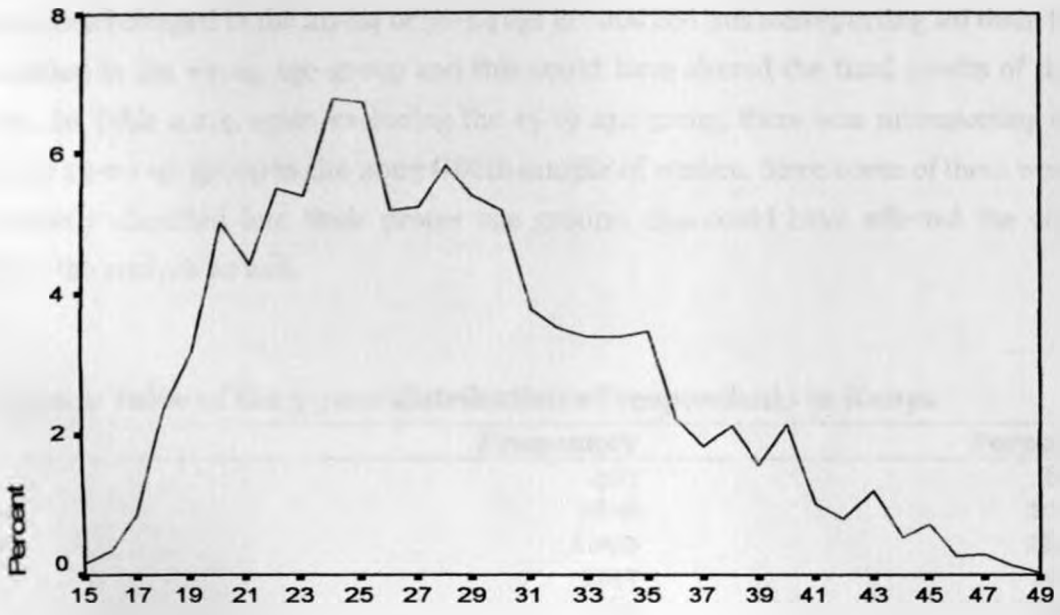
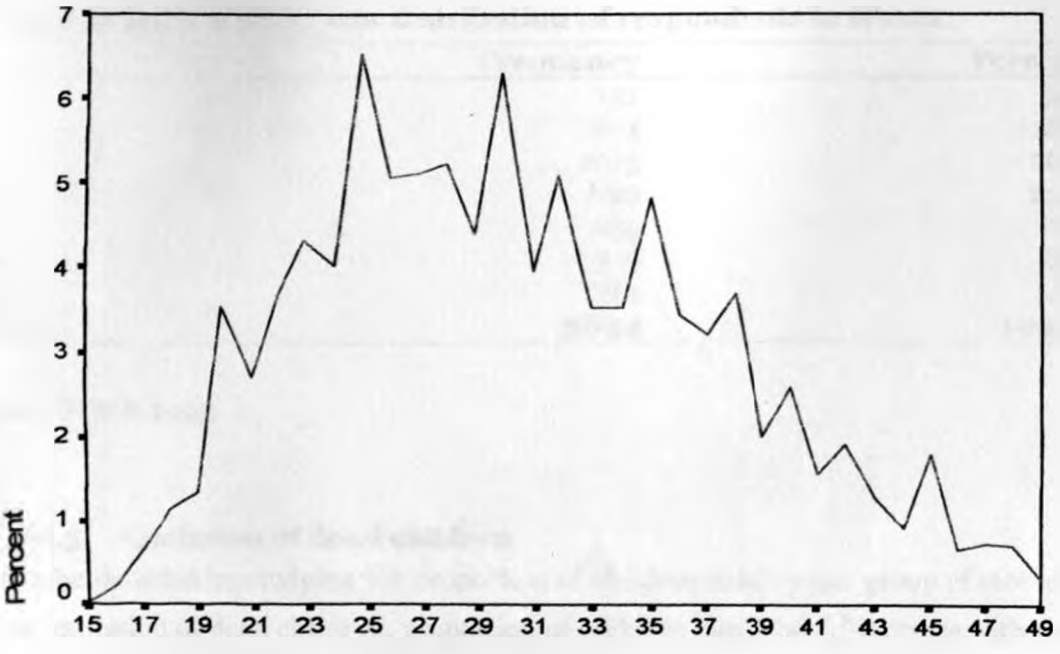


Figure 4.7: Graph of percentage distribution of women by single age years in Ghana GDHS, 2003



According to Table 4.2.3, excluding the 15-19 age group, there seemed to have been misreporting of age in the 25-29 age group in the 2003 KDHS sample of women. Some of these women belonged in the 20-24 or 30-34 age groups and this misreporting led them to be classified in the wrong age group and this could have altered the final results of the analysis. In Table 4.2.4, again excluding the 15-19 age group, there was misreporting of age in the 25-29 age group in the 2003 GDHS sample of women. Since some of them were not correctly classified into their proper age groups, this could have affected the end results of the analysis as well.

Table 4.2.3: Table of the 5-year distribution of respondents in Kenya

Age	Frequency	Percent
15-19	407	6.8
20-24	1616	27.2
25-29	1690	28.4
30-34	1147	19.3
35-39	665	11.2
40-44	337	5.7
45-49	87	1.5
Total	**5949**	**100.0**

Source: KDHS, 2003

Table 4.2.4: Table of the 5-year distribution of respondents in Ghana

Age	Frequency	Percent
15-19	131	3.4
20-24	704	18.3
25-29	1013	26.4
30-34	860	22.4
35-39	659	17.1
40-44	316	8.2
45-49	161	4.2
Total	**3844**	**100.0**

Source: GDHS, 2003

4.2.3 Omission of dead children

This can be detected by studying the proportion of children dead by age group of mother. With no omission of dead children, proportion of children dead should increase with age of mother as long as childhood mortality has not been increasing since children of older mothers have had longer exposure to risk of death. They also have most likely had higher

mortality risk than children of relatively younger mothers. This pattern may be broken for mothers aged 15-19 since their children usually have a higher risk of dying (Hobcraft, 1992).

4.2.4 Heaping of children's ages

Recall problems may produce errors in the reporting of children's ages. Extent of age heaping is assessed by examining the percentage distribution of all living children by current single years of age and percentage distribution of all dead children by their age at death in months. Age heaping at 12 months posses a problem because it can affect estimates of both infant and childhood mortality since 12 months is the cut off point (Ikamari, 1996).

CHAPTER FIVE

DETERMINANTS OF INFANT AND CHILD MORTALITY IN KENYA AND GHANA

5.0 Introduction

This chapter examines the results of the analysis carried out on the factors that are associated with infant and child deaths in Kenya and Ghana using the 2003 KDHS and GDHS data as well as a discussion of the findings.

5.1 A comparative analysis of the determinants of infant mortality

According to model I in table 5.1.1 (Kenya), infants born to women with secondary and higher education in Kenya had a 0.7 lower chance of dying compared to those born to mothers with no education. Also, in contrast to common occurrences, women in the high wealth index exhibited a 3.5 higher chance of infant death compared to those in the low wealth index. Using the Kikuyu, Embu and Meru women as the reference, children born to women who were Kisii/Kalenjin, Luhya, Luo or 'other' ethnicity were 1.8, 1.8, 3.0 and 1.9 times respectively more likely to die. No significant association with the risk of infant death was found to be associated with the type of place of mother's residence and her current marital status.

In model II, that considered bio-demographic and socio-cultural variables association with the risk of infant death, women with a preceding birth interval of less than 24 months had a 1.4 higher chance of infant death compared to those with an interval of 25 and above months. Again, with reference to those who had an interval of 25+ months, mothers who had a preceding interval of less than 24 months had a 1.9 higher chance of infant death when having higher order births. Also evident was that women who had had their 4^{th} and above child compared to those who had had their 2^{nd} or 3^{rd}, had infants with a 1.9 higher chance of death. Infants born to Kisii/Kalenjin, Luhya, Luo and others ethnicities had higher risk of death compared to the Kikuyu, Meru and Embu ones at 1.8, 1.8, 3.0 and 2.1 times higher. No significant association was found between maternal age at birth and marital status with infant risk of death.

In model III, mothers with secondary and higher education experienced 0.6 times lower death risk of their infants compared to those with no education. Those in the high wealth index with reference to those in the low wealth index had children with a 3.3 higher chance of death. Compared to mothers who had a preceding birth interval of 25 and above months, those who had an interval of less than 24 months had infants with a 1.5 higher risk of death. Again those who had a less than 24 months interval had infants who were twice likely to die compared to those who had an interval of 25 and over months for higher order births. In addition, mothers who sourced their drinking water from the 'other' category had infants who experienced 1.6 times higher deaths compared to women who drew their water from piped sources. Type of place of mother's residence, maternal age at birth and type of toilet facility were found not to be significantly associated with the risk of infant death.

In model IV which encompasses all the variables, infants born to mothers with secondary or higher education experienced 0.6 times lower deaths compared to infants born to mothers with no education. Again, mothers in the high wealth index had infants with a 3.2 higher chance of dying compared to mothers in the low wealth index. A preceding birth interval of less than 24 months provided infants with a 1.4 higher chance of death compared to an interval of 25 and above months while a 4th or higher birth with an interval of less than 24 months gave infants a 1.7 higher chance of death compared an interval of 25+ months. Marital status, maternal age at birth and type of place of mother's residence were not significantly associated with risk of infant death in this model.

Table 5.1.1: Hazard model of infant mortality associated with socioeconomic, bio-demographic and socio-cultural variables in Kenya and Ghana

Variables	Model I		Model II		Model III		Model IV	
	Kenya	Ghana	Kenya	Ghana	Kenya	Ghana	Kenya	Ghana
Maternal education								
None [a]	1.000	1.000			1.000	1.000	1.000	1.000
Primary education	0.866	1.354**			0.838	1.353**	0.829	1.354**
Secondary and higher education	0.666*	0.915			0.630*	0.966	0.637*	0.954
Wealth index								
Low [a]	1.000	1.000			1.000	1.000	1.000	1.000
Medium	1.125	1.060			1.078	1.083	1.088	1.045
High	3.456***	0.991			3.316***	1.015	3.238***	1.001
Type of place of residence								
Rural [a]	1.000	1.000			1.000	1.000	1.000	1.000
Urban	1.029	0.794			1.080	0.845	0.981	0.837
Maternal age at birth (years)								
20 – 29 [a]			1.000	1.000	1.000	1.000	1.000	1.000
Under 20			0.943	1.264	0.972	1.204	0.875	1.199
30 – 34			1.009	1.076	0.976	1.086	1.044	1.092
35+			1.193	1.028	1.117	1.039	1.196	1.050
Birth order and Preceding birth interval (months)								
2 – 3 and 25+ [a]			1.000	1.000	1.000	1.000	1.000	1.000
2-3 and <24			1.415*	2.523***	1.510*	2.476***	1.411**	2.471***
4+ and 25+			0.915	1.268	0.961	1.224	0.872	1.227
4+ and <24			1.883***	2.728***	2.002***	2.582***	1.722*	2.575***
First birth			0.970	1.354	0.964	1.385	1.008	1.393
Drinking water								
Piped [a]					1.000	1.000	1.000	1.000
Well					1.083	0.975	1.098	0.973
Stream/Lake/River					1.089	1.084	1.077	1.088
Other					1.561*	1.428	1.765*	1.459
Toilet facility								
Have toilet [a]					1.000	1.000	1.000	1.000
No toilet					1.157	1.061	1.356*	1.086
Ethnicity								
Kikuyu/Embu/Meru [a]	1.000		1.000				1.000	
Kamba	1.376		1.389				1.389	
Kisii/Kalenjin	1.832*		1.787*				1.907*	
Luhya	1.808*		1.754*				1.780*	
Luo	3.037***		2.977***				3.222***	
Mijikenda/Swahili	1.369		1.484				1.666**	
Others	1.917*		2.090***				1.994*	
Ethnicity								
Akan [a]		1.000		1.000				1.000
Ga-adangbe		0.767		0.804				0.768
Ewe		0.861		0.942				0.861
Mole-dagbani		0.824		0.881				0.850
Others		0.998		1.057				1.025
Marital status								
Currently married [a]	1.000	1.000	1.000	1.000			1.000	1.000
Never married	0.938	1.665	1.041	1.662			0.934	1.691
Formerly married	1.036	0.409*	1.042	0.402*			1.006	0.405*

Statistical significance: ***<0.00, *<0.05, **<0.10

Among the Kenyan women in the 2003 KDHS sample, those with mothers who fetched drinking water from other category had infants with a 1.8 higher chance of death with reference to those who fetched it from piped sources. Also, infants born in households with no toilet facilities had a 1.4 times higher chance of death compared to those born in households with toilet facilities. Toilet facilities become significantly associated with the risk of infant death on the introduction of the socio-cultural factors. Regarding the mother's ethnicity, infants born to mothers who were Kisii/Kalenjin, Luhya, Luo, Mijikenda/Swahili and Other category were 1.9, 1.8, 3.2, 1.7 and 2.0 times respectively more likely to die compared to those born to mothers who were Kikuyu, Embu and Meru in Kenya.

Table 5.1.1 (Ghana) shows the hazard ratios of infant mortality associated with socioeconomic, bio-demographic and socio-cultural factors in Ghana. In model I, it is clear that infants born to mothers with at least primary education had a 1.4 higher risk of dying compared to those born to women with no education. This is in contrast to common occurrence. Looking at the current marital status of the mother, formerly married women had infants with a 0.4 lower risk of death compared to women who were currently married. There was no significant association between the risk of infant mortality with wealth index, type of place of mother's residence, ethnicity and current marital status in this model.

In model II, with reference to mothers with a preceding birth interval of 25 or more months, mothers with a preceding birth interval of less than 24 months had infants who were 2.5 times more likely to die while those who had their 4th and above child and had an interval of less than 24 months provided their infants with a 2.7 higher chance of death. Also, women who were formerly married compared to those who were currently married had infants with a 0.4 lowered chance of fatality. Maternal age at birth and mother's ethnicity had no significant association with risk of infant death.

According to model III, infants born to Ghanaian mothers with primary education experienced 1.3 higher rates of death compared to those born to mothers with no education. As in model II, an infant born with a less than 24 months preceding interval had a 2.5 higher chance of death compared to one born with a 25+ months interval while an infant born as the 4th or above child with an interval of less than 24 months had a 2.6 higher chance of dying. No significant association was found between wealth index, type of

place of mother's residence, maternal age at birth, source of drinking water or type of toilet facility and risk of infant death.

In model IV, infants born to mothers with primary education compared to those with no education had a 1.4 higher chance of death. With reference to mothers with a preceding birth interval of 25 or more months, mothers with a preceding birth interval of less than 24 months had infants with a 2.5 higher chance of death while those who had their 4th or above child with an interval of less than 24 months had infants with a 2.6 higher chance of death. Regarding the mother's current marital status, those that were formerly married had infants with a 0.4 lower chance of death compared to the currently married mothers. Again, no significant association was found between wealth index, type of place of mother's residence, maternal age at birth, source of drinking water, type of toilet facility or mother's ethnicity and risk of infant death.

5.2 A comparative analysis of the determinants of child mortality

Looking at table 5.1.2 (Kenya), model I displays that for maternal education, children born to mothers with secondary and higher education had a 0.4 lower chance of death compared to those born to mothers with no education in Kenya. Regarding ethnicity, with reference to mothers who were from the Kikuyu, Embu and Meru ethnicities, mothers from the Kamba, Luhya and Luo ethnicities had children with increased risk of death at 5.3, 9.6 and 16.7 times respectively. No significant association was obtained between risk of childhood death and wealth index, type of place of mother's residence and current marital status of the mother.

In model II, children born to mothers who were aged less than 20 years had 1.7 increased chance of dying compared to those born to mothers who were 20 to 29 years old. Regarding ethnicity, compared to the Kikuyu, Embu and Meru borne children, those born of Kamba, Luhya and Luo mothers had higher chances of death at 5.8, 9.9 and 15.9 respectively. The 'others' ethnic group became significantly associated with the risk of childhood death in this model at 4.2. There was no significant association between birth order and preceding birth interval, succeeding birth interval and mother's current marital status and the risk of childhood death in this model.

Table 5.1.2: Hazard model of child mortality associated with socioeconomic, bio-demographic and socio-cultural variables in Kenya and Ghana

Variables	Model I		Model II		Model III		Model IV	
	Kenya	Ghana	Kenya	Ghana	Kenya	Ghana	Kenya	Ghana
Maternal education								
None [a]	1.000	1.000			1.000	1.000	1.000	1.000
Primary education	0.654	0.788			1.141	0.904	0.622	0.820
Secondary and higher education	0.388*	0.433*			0.647	0.521**	0.387*	0.467*
Wealth index								
Low [a]	1.000	1.000			1.000	1.000	1.000	1.000
Medium	1.425	1.707*			1.432	1.672*	1.452	1.757*
High	0.614	0.000			0.591	0.000	0.605	0.000
Type of place of residence								
Rural [a]	1.000	1.000			1.000	1.000	1.000	1.000
Urban	0.673	1.166			1.061	1.274	0.798	1.266
Maternal age at birth (years)								
20 – 29 [a]			1.000	1.000	1.000	1.000	1.000	1.000
Under 20			1.661**	1.458	1.815*	1.375	1.385	1.329
30 – 34			0.835	0.836	0.843	0.830	0.894	0.823
35+			1.162	0.913	1.078	0.946	1.190	0.948
Birth order and Preceding birth interval (months)								
2 – 3 and 25+ [a]			1.000	1.000	1.000	1.000	1.000	1.000
2-3 and <24			0.780	0.562	0.887	0.602	0.790	0.597
4+ and 25+			1.005	1.295	1.050	1.264	0.825	1.251
4+ and <24			1.111	1.573	1.279	1.616	0.904	1.589
First birth			0.943	0.870	0.991	0.957	1.090	0.989
Succeeding birth interval (months)								
24 – 36 [a]			1.000	1.000	1.000	1.000	1.000	1.000
Under 24			0.715	1.701	0.716	1.872	0.700	1.836
36+			0.677	4.015*	0.672	3.836*	0.690	3.825*
Last birth			0.946	2.047	0.910	2.176**	0.915	2.066
Drinking water								
Piped [a]					1.000	1.000	1.000	1.000
Well					2.236*	1.155	2.044*	1.131
Stream/Lake/River					1.586	0.793	1.531	0.752
Other					1.513	2.967*	1.899	3.017*
Toilet facility								
Have toilet [a]					1.000	1.000	1.000	1.000
No toilet					1.093	1.595**	1.149	1.731**
Ethnicity								
Kikuyu/Embu/Meru [a]	1.000		1.000				1.000	
Kamba	5.284*		5.847*				5.585*	
Kisii/Kalenjin	1.028		1.130				1.072	
Luhya	9.575***		9.877***				9.046***	
Luo	16.656***		15.879***				17.695***	
Mijikenda/Swahili	2.032		2.729				2.309	
Others	2.727		4.231*				2.799	
Ethnicity								
Akan [a]		1.000		1.000				1.000
Ga-adangbe		0.842		0.938				0.769
Ewe		1.189		1.285				1.116
Mole-dagbani		1.136		1.582				0.835
Others		0.978		1.428				0.790
Marital status								
Currently married [a]	1.000	1.000	1.000	1.000			1.000	1.000
Never married	0.602	2.968*	0.644	2.745*			0.629	3.128*
Formerly married	0.666	1.723	0.648	1.544			0.649	1.852

Statistical significance: ***<0.00, *<0.05, **<0.10

In model III, children born to mothers who were less than 20 years had a 1.8 higher chance of dying compared to those with mothers in the 20 to 29 years age bracket and the impact increased with the addition of socioeconomic and environmental variables in this model. Children born to women who drew their drinking water from wells had a 2.2 higher chance of fatality compared to those born to women who drew their water from piped sources. Maternal education, wealth index, type of place of mother's residence, birth order and preceding/succeeding birth interval and type toilet facility were not significantly associated with the risk of childhood death. Note that with the inclusion of environmental factors, the significant association between maternal education and risk of childhood death vanished.

In model IV (full model), there was a significant association between maternal education and childhood deaths in Kenya. Children born to mothers with secondary and higher education experienced 0.4 times lower deaths compared to those born to women with no education. Mothers who drew their drinking water from wells had children with twice the risk of death compared to those who drew it from piped sources. With regards to ethnicity of these Kenyan mothers, those who were Kamba, Luhya or Luo had children with a 2.6, 9.0 and 17.7 higher risk of death respectively compared to mothers who were Kikuyu, Embu and Meru. The impact on the Luo children was highest in this model. The association of maternal age with risk of childhood death disappeared. Marital status, type of toilet facility, succeeding/preceding birth interval, birth order and wealth index were also not significantly linked to the risk of childhood death.

On examining model I in table 5.1.2 (Ghana), mothers with secondary and higher education had children with a 0.4 lower chance of dying compared to mothers with no education in Ghana. Wealth index was significantly associated with the risk of child deaths here with children born to mothers in the medium wealth index having a 1.7 higher chance of dying compared to those born to mothers in the low wealth index. With regards to the mother's current marital status, children born to mothers who had never been married had a 3.0 higher chance of dying compared to those born to mothers who were currently married. There was no significant association between type of place of mother's residence and ethnicity and risk of childhood death in this model.

In model II, on examining bio-demographic against socio-cultural factors, mothers with a succeeding birth interval of 36 months and over, compared to those with an interval of

between 24 and 36 months, had children with a 4.0 higher chance of death. Again, mothers who had never been married had children with a 2.8 higher chance of death with reference to those who were currently married. Maternal age at birth, birth order, preceding birth interval and ethnicity were not found significantly associated with risk of childhood death here.

Looking at model III, the significant association of education with risk of death still existed. Mothers with secondary and higher education had children with a 0.5 times less chance of dying compared to those with no education. Children born to mothers in the medium wealth index experienced 1.7 times higher deaths compared to those born to women in the low wealth index. Children who had a succeeding birth interval of 36 months or more had a 3.8 higher chance of death among these Ghanaian women compared to those who had a 24 to 36 months interval. Children born to women who drew their drinking water from 'other' source experienced 3 times the deaths experienced by those born to women who drew their water from piped sources. Mothers in households with no toilet facilities had children who experienced 1.6 times the deaths experienced by mothers in households with toilet facilities. No significant association was found between type of place of mother's residence, maternal age at birth, birth order or preceding birth interval and risk of childhood death in this model.

Considering model IV, children born to mothers with secondary and higher education experienced half the deaths of those born to mothers with no education. Again as in the other models, mothers in the medium wealth index had children with a 1.8 higher chance of dying compared to those in the low wealth index. Succeeding birth interval of 36 months and over provided Ghanaian children with a 3.8 higher risk of dying compared to a 24 to 36 months interval. Mothers who sourced their drinking water from 'other' category had children with a 3.0 higher risk of dying compared to those who drew it from piped sources. Children born in households with no toilet facilities had a 1.7 higher risk of dying compared to those born in households with them. As regards the mother's current marital status, women who had never been married had children with a 3.1 higher chance of death compared to those who were currently married. There was no significant association between childhood death risk and type of place of mother's residence, maternal age at birth, birth order, preceding birth interval and ethnicity in this model.

5.3 Discussion of the results

Infant Mortality

Results on infant mortality in Kenya and Ghana were both similar and contrasting in many aspects. Some results were also as expected while others were contrary to expectation. Looking at maternal education in Kenya, women with secondary and higher education were seen to reduce the risk of their infants dying. It is important to note that education per se does not contribute to child survival but rather other proximate determinants associated with it which include quality of healthcare, sanitation and hygienic conditions surrounding the mother, her nutritional status and quality of housing among others (Ocholla-Ayayo et al., 2000).

In Ghana on the other hand, infants born to mothers with at least primary education had higher chances of death. This was consistent with other findings in Ghana including Gyimah (2002, 2003) even though the results were not statistically significant. In a community study of child deaths in Guinea-Bissau, Sodermann et al (1997) found out that despite timely health seeking behaviour by mothers of sick children, infant and child mortality was still high in the study community due to poor health care management in health institutions. In such cases maternal education does not influence survival chances but rather acts to enhance the ability to pay for the services and the interaction with healthcare providers in the community. Education also does not influence child survival at all ages. Boerma and Bicego (1991) using data from 17 DHS studies carried out between 1987 and 1990 found out that there was significantly elevated risk of death throughout the first two years of life associated with low levels of maternal education. Association was more manifested in the post neonatal stage where education is more associated with death risk than neonatal period that is more affected by biological processes.

Mothers in Kenya in the high wealth index had infants with the highest chances of fatality. This was contrary to expectation since women in this wealth index are considered to be having the highest resources at their disposal to ensure their children have the highest chances of survival. These results could be attributed to sampling since women in this group were very few in the 2003 KDHS sample. Also wealth index was calculated using household possessions and may have not sufficiently illuminated the current economic status of households. Household economic status influences child survival mainly through access to goods and services that affect the health of the child which include nutrition i.e. food supply, access to health and medical services, clothing, good shelter and proper

hygiene and sanitation. Wealth index was not statistically associated with risk of infant death in Ghana.

Although rural and urban differentials in infant mortality were expected in both countries, this variable was not significant in both. Only about 26 per cent of women in both samples lived in the urban areas and these could have contributed to this insignificance. The small samples may have not been sufficient to bring out the differences in the countries rural and urban areas although in the full models, both countries exhibit slightly lowered risks of infant death in the urban areas though not significant. Also, rural problems are fast becoming urban ones with rural-urban migration becoming higher than ever before. Poverty has dug its roots in most urban centres leading to the mushrooming of slums that are overcrowded and lack clean water and sanitation. With the urban poor unable to afford clean fuels, they rely instead on crude fuels for cooking and heating. Inside their smoky dwellings, air pollution is often higher than it is outdoors in the world's most congested cities. Risks are compounded in these periphery urban settlements, where garbage collection is often nonexistent and drainage tends to be poor, creating ideal conditions for insects and other disease vectors. Overcrowding also increases the risk of disease transmission (Mutunga, 2004).

Maternal age at birth was expected to be a major contributor to the risk of infant death but this was not so according to both the Kenya and Ghana findings. Although not statistically significant, mothers over the age of 30 exhibited slightly heightened infant deaths in Kenya and Ghana. In addition, mothers below the age of 20 in Ghana exhibited higher infant deaths although this was also not statistically significant. This could be explained by the physiological immaturity plus the social and psychological stress that accompanies giving birth. Although most adolescent women are physiologically mature enough to become pregnant, their bodies are often not sufficiently developed to carry a pregnancy to term safely. They are at particular risk for pre-eclampsia and obstructed labour due to cephalopelvic disproportion. Skeletal growth in women is not complete until the age of 18 and the birth canal is not mature until approximately 20 to 21 years of age although these ages vary substantially with nutritional levels among individuals and between populations (Hobcraft, 1997).

Birth order and preceding birth interval were found to be significantly associated with the risk of infant death in both countries. Infants with a preceding birth interval of less than

24 months were seen to exhibit higher risk of death. This could be attributed to maternal depletion syndrome which leads to deterioration of the mother's capacity to adequately host a fetus and to facilitate its normal growth process. It could also impair the mother's ability to produce milk. Also the mother may not have fully restored her nutritional reserves or recovered from previous pregnancy and birth trauma. As a result she may not be physiologically or emotionally ready for another child. The index child may suffer intrauterine retardation which may result in premature delivery or low birth weight which increase risk of death (Ikamari, 1996). The increase of children of almost similar age in the household increases their physical proximity hence their susceptibility to infectious diseases as well as sibling competition for household resources including individual maternal attention (Boerma and Bicego, 1992). In addition, women with closely spaced births may perhaps still have very young children hence are less likely to attend prenatal care services (Gyimah, 2002). Depleted physiological system of mothers due to repeated births make them susceptible to pregnancy complications (Alam, 2000) hence increasing the risk of their infants' mortality.

Considering the source of drinking water, it was found to be significantly associated with infant death risk in Kenya but not in Ghana. This could partly be explained by the different categorization of both countries of these water sources. Kenyan women obtaining theirs from 'other' category seemed to exhibit higher incidences of infant deaths. This category includes water from bottles, trucks and the rain among others. The quality of this water especially from trucks and the rain could be compromised by the method of fetching, transporting and storing and could be highly contaminated with harmful pathogens. Most women do not boil rain water and hence expose their infants to germs by using it directly to clean their feeding bottles and so on. Studies done elsewhere have confirmed that the risk of infant and child mortality is associated with water supply and sanitation facilities (Woldemicael, 2000; Mutunga, 2004).

On examining toilet facilities, they were significantly associated with risk of infant death in Kenya in the full model but not at all in Ghana. Type of toilet facility in Kenya became significant with the inclusion of the mother's ethnicity and her current marital status. Higher risk of death associated with lack of toilet facilities could be explained by unhygienic disposal of excreta and contamination caused by open air defecation (Gyimah, 2003). It seems that the use or misuse of toilet facilities varies by ethnic affiliation and current marital status of these women which could be indirectly attributed to their

socioeconomic status which tends to vary with ethnicity and marital status. A better status would mean better hygienic conditions which would include proper facilities for sanitation.

Additionally, Brockerhoff and Hewett (2000), in their descriptive statistics from households suggested a close correspondence of child mortality differentials with ethnic inequalities in household economic status, education of women, access to and use of health services and degree of concentration to the largest city. This was also confirmed by Gyimah in his 2003 study of Ghana where the Mole-Dagbani exhibited higher rates of death due to diarrhoea in comparison to the Akan, an effect which disappeared once the socioeconomic factors were controlled and hence suggested that ethnic differences in Ghana were mainly due to socioeconomic disparities. Gyimah (2002) also concluded that since ethnic differentials mainly reflect socioeconomic disparities, improvements in the survival of children can be achieved through bridging these inequalities among ethnic groups, especially through formal education.

Ethnicity by itself did not seem to affect the risk of infant mortality in Ghana. In Kenya however, a great disparity was seen among the different ethnicities. This was not attributable to the ethnic groups per se but rather to the geographical areas that they tend to inhabit. In general, acute respiratory infections cause most child deaths in Kenya highland areas while diarrhoea, malaria and malnutrition are the major causes of death in low lying areas of the Coast Province and around Lake Victoria in Nyanza Province (UNICEF, 1992). The highland areas are inhabited by the Kisii and Kalenjin while the low lying areas are inhabited by the Luo and Mijikenda/Swahili and this could explain the higher risk of death exhibited for their infants. The findings for the Mijikenda/Swahili were only significant in the full model which could be attributed to their reliance on the environment plus other socioeconomic and bio-demographic factors. In Ghana, the lack of significant association of ethnicity with risk of infant fatality was attributed to the lack of major geographical differences in the country with common diseases being almost fairly distributed throughout.

Marital status of the mother was not significant in Kenya but in Ghana, infants of formerly married women are seen to exhibit lowered death risks which was consistent in all models. This could be partially explained by the sampling in the 2003 GDHS where this category had very few subjects.

Child mortality

In the examination of the association of the risk of childhood mortality with socioeconomic, bio-demographic and socio-cultural factors in Kenya and Ghana, it was observed that some results were as hypothesized while others were contrary to common belief. In both countries, highly educated mothers were seen to reduce the risk of their children's death. Child mortality is highest among children born to illiterate parents; it decreases as mothers' and fathers' education increases (Kiros, 2001). This could be attributed to higher economic status and improvement of basic maternal childcare skills like effective use of modern health care services, preventive care strategies as well as domestic management of child illnesses (Caldwell, 1994). Also, mothers with education have a greater say in childcare issues unlike traditionally hence are more likely to make decisions regarding childcare like nutrition and seeking medical care without waiting for their spouses. However, Basu (2002) has suggested in his research that effect of maternal education could be less important with the adequate provision of safe water and sanitation and health facilities since these would benefit everyone.

Regarding the wealth index, it had no significant association with the risk of childhood death in Kenya but in Ghana, mothers in the medium wealth index had children with a higher risk of death. This could be linked to the sampling of those in this category in the 2003 GDHS. Also, wealth index is calculated using the household possessions and although these may be present in a household, they may not depict the current economic status of that household as they could have been acquired when the status was good.

Type of place of mother's residence showed no significant association with the risk of childhood death in both Kenya and Ghana. This could be attributed to the sampling of the 2003 KDHS and GDHS where only 26 percent of them are seen to live in the urban areas. This sample may not have explicitly brought out the rural and urban differences for both countries with regard to childhood deaths. Also both countries are in the sub-Saharan Africa which is rapidly acquiring very poor urban population due to rapid rural-urban migration with the situation in the urban areas steadily deteriorating to that of most rural areas (or worse) in terms of hygiene and sanitation (Mutunga, 2004).

Mother's age at birth was seen to be significantly associated with the risk of childhood mortality in Kenya. Children born to mothers who were less than 20 years of age were seen to exhibit higher risk of death in model II and III. Higher risk among younger

mothers could be due to physical immaturity, lack of money, childcare skills, access to health services and experience which are associated with age. In the full model however, this effect disappeared with the introduction of ethnicity and mother's current marital status in the model. Apparently these factors contributed more to the welfare of the child and erase the effect of the mother's age which could be indirectly linked to socioeconomic situation of the mother of the child. In Ghana, maternal age at birth had no significant association with the risk of childhood death although the coefficients for mothers below the age of 20 showed that their children had a higher risk of death.

Birth order and preceding birth interval were not significantly associated with the risk of childhood death in both countries. According to Omariba (2005), bio-demographic factors are more important in infancy while socioeconomic, socio-cultural and environmental factors are more important in childhood. This could explain the situation here. Succeeding birth interval had a significant association with childhood death in Ghana with an interval of 36+ months raising it. This was in contrast to expectation and could be explained by the sampling of the 2003 GDHS. Also, most women seemed not to have had children experiencing the succeeding birth interval since they were last births.

Drinking water source was seen to be associated with the risk of infant and child deaths in both countries. Children born of mothers who drew their drinking water from sources other than piped facilities had higher risk of death. In Kenya, highest risk was exhibited by those who draw their water from wells which can be contaminated due to a variety of factors like fetching and storage. Although not statistically significant, women who fetched their water from stream, rivers or lakes and 'other' category also seemed to exhibit high childhood deaths. The 'other' category includes water from bottles, trucks and the rain among others.

In Ghana, the women who obtained their drinking water from 'other' category exhibited higher childhood deaths. Water from trucks and rain is especially susceptible to contamination due to the methods of fetching, transport and storage. This phenomenon could also be partially explained by the sampling in the 2003 GDHS where this category had just 2.6 per cent of the sample population and hence may not have provided an explicit view of the situation. Children born in households with no toilet facilities experienced higher risk of death in Ghana but this was not the case in Kenya. According to WHO (2004), in sub-Saharan Africa sanitation coverage was a mere 36 percent. The

availability of safe drinking water and modern sanitary conditions protects against disease and infections which go a long way in reducing child mortality (Gyimah, 2002).

Type of toilet measures the faecal contamination (Omariba, 2005). According to Ikamari (1996), the effect of toilet facility is greater after, than during infancy. Infants spend more their time crawling on the ground putting everything into their mouth and although they may not use toilets they are handled by people who do. As they grow older they have more access to toilets and will be more exposed to hazards associated with poor sanitation. The effect of toilet facility here increased with addition of ethnicity and marital status which do not elevate the death risk per se but rather the socioeconomic situation associated with them.

On examination of ethnicity and its association with the risk child deaths in Kenya, children born to mothers of Kikuyu, Embu and Meru ethnicity exhibited the lowest risk. The results on the higher mortality among the Luo compared to other ethnicities was particularly worth mentioning. High mortality of children among Luo mothers could be explained by the high incidence of HIV/AIDS in this ethnic group (MoH, 2001). According to the 2003 KDHS, Nyanza, Coast and Western Provinces are Malaria-prone areas and had among the highest ownership and use of insect treated nets. These Provinces are dominantly inhabited by the Luo, Swahili and Luhya respectively. It could explain the higher risk of death among the Luo and Luhya ethnic groups since just about 16.5 and 11.6 per cent of children under-5 had slept under nets the night before the 2003 survey. Kamba children also exhibited high deaths which could be explained by the drought experienced in a vast area of Eastern Province within which the Kamba reside.

Again, referring to 2003 KDHS report, only 32.4, 41.6 and 57.7 per cent respectively of children aged 12-23 months in Nyanza, Western and Eastern Province received all the immunization required. Immunization against childhood diseases contributes to reductions in morbidity, mortality and permanent disability among children. Compared to Nairobi where 77.2 per cent of births are delivered in health facilities, in Nyanza, Western and Eastern respectively, only 38.2, 28.1 and 35.0 per cent of babies are delivered in health facilities. This increases the chances of child deaths since it is only in proper health facilities that one can receive the care required incase of complications during delivery that often take place. In Ghana on the other hand, ethnicity did not seem to play a

major role in the risk of childhood deaths. Ghana has few distinct geographical climatic regions hence most of the people experience almost the same type of weather.

Turning our attention to mother's current marital status, in Ghana the mothers who had never been married exhibited the highest risk of death. This could be explained by poverty, economic hardships and young age at birth experienced by these women (Alam, 2000). In a Kenyan study by Hakansson (1994), he pointed out that the level of kin and social support shaped cultural attitudes for unwed mothers and their children consequently impacting on the mother's physiological and economic well being. Among the Gusii for example, single mothers were socially and economically side-lined with respect to kin group. Unmarried mothers were seen as an embarrassment to the clan and were regarded as prostitutes especially if living alone. Among the Luhya however, unwed mothers were able to obtain childbearing assistance and economic support from parents and brothers because they maintained lifelong memberships in their birth lineages. In Kenya, this variable was not statistically associated with childhood risk of death.

5.4 Summary

Following the analysis of the factors associated with infant and child deaths in Kenya and Ghana, it is safe to say that maternal education, wealth index, birth order, preceding birth interval, source of drinking water, type of toilet facility, ethnicity and mother's current marital status were significantly associated with the risk of infant mortality in Kenya and/or Ghana. Wealth index in Kenya and maternal education in Ghana had an association with risk of infant death that was unique to common findings or hypotheses. While increased years of maternal education were associated with reduced risk of infant death in Kenya, mothers with primary education in Ghana had infants with increased risk of death.

In both countries, short preceding birth intervals and higher order births had a greater association with increased infant mortality. Environmental factors had an association with risk of infant death in Kenya but not in Ghana. Ethnic affiliation was strongly associated with risk of infant death in Kenya but not in Ghana and vice versa for marital status where women formerly married women in Ghana had infants with decreased chances of death. Maternal age at birth and type of place of mother's residence were not significantly associated with the phenomenon although they're hypothetically supposed to. It seems

that the other biological factors i.e. birth order and preceding birth interval, were of more importance than the age of the mothers at birth.

Maternal education, wealth index, maternal age at birth, succeeding birth interval, source of drinking water, type of toilet facility, ethnicity and mother's current marital status were significantly associated with the risk of childhood mortality in Kenya and/or Ghana. In both countries, higher education was associated with decreased chances of childhood death. Maternal age at birth was associated with risk of childhood death in Kenya in model II and III, disappearing in the full model while it was not at all associated with childhood death risk in Ghana. In Kenya, children of mothers sourcing their drinking water from wells had higher chances of death while in Ghana, mothers fetching their water from 'other' source and those with no toilets had children with higher chances of death. Again, ethnic affiliation was strongly associated with the risk of childhood death in Kenya unlike in Ghana while in Ghana; never married women had children with increased chances of death.

Johnson-Hanks (2005) in her study on sexual stigma and infant mortality in sub-Saharan Africa which included data from Ghana among other countries, found out that children out of wedlock in stigmatized societies had increased risk of death. Again, younger mothers may not be able to get adequate antenatal care and provide sufficient postnatal care due to lack of money, childcare skills and experience associated with age. Many societies disapprove of childbearing in unsanctioned unions and the fear of banishment or school expulsion may deter young pregnant single women from seeking prenatal care (Hakansson, 1994). Inadequate prenatal care is associated with poor pregnancy outcomes, including high rates of infant and neonatal deaths, premature birth or low birth weight, complications of pregnancy and birth defects (Wright, 1990).

A study by Gage (1998) in her study on premarital childbearing, unwanted fertility and maternity care in Kenya and Namibia, confirmed that premarital childbearing was an important risk factor for the under utilization of maternity care. In Kenya women were less likely to deliver at a health facility if they were dissatisfied by pregnancy timing. She concluded that ethnicity played an important role in conditioning the premarital birth effect on prenatal and delivery care. Cultures also define who is entitled to access reproductive health services, sometimes by social control and sometimes by laws, policy restrictions or other measures. In many African societies only married women have access

to family planning and other health services, and unmarried pregnant adolescents are particularly affected (Bledsoe and Cohen, 1993). Succeeding birth interval and wealth index in Ghana were uniquely associated with the risk of childhood death. This could be explained by problems with the 2003 GDHS sampling. Birth order, preceding birth interval and type of place of mother's residence were not significantly associated with risk of childhood death.

CHAPTER SIX

SUMMARY, CONCLUSIONS & RECOMMENDATIONS

6.0 Introduction

This chapter highlights the summary of the study, conclusions made with regard to it and recommendations made with reference to its findings. The general objective of the study was to carry out a comparative study of the determinants of infant and child mortality in Kenya and Ghana. The specific objectives were to estimate the major socio-economic determinants of infant and child mortality in Kenya and Ghana while controlling for the bio-demographic and socio-cultural factors as well as to compare the effects of the determinants of infant and child mortality in Kenya and Ghana. In order to achieve the objectives of the study, the appropriate variables from the 2003 KDHS and GDHS were sought in order to carry out the necessary analysis. Variables were recoded and combined as required. For the socioeconomic factors the variables used were maternal education, wealth index and type of place of residence. The bio-demographic factors included the variables of maternal age, birth order, preceding birth interval and succeeding birth interval for childhood analysis. The socio-cultural factors included the ethnicity and marital status variables.

6.1 Summary

The 2003 KDHS sample had 5949 women with 502 infant and child deaths while the 2003 GDHS sample had 3844 women with 314 infant and child deaths. Majority of the deaths for both countries were found to have taken place within the first year of life at 80.4 and 74.8 percent for Kenya and Ghana respectively. Regarding data quality, sex ratios at birth, reporting of age among women, omission of dead children and heaping of children's ages were examined. Sex ratios revealed that male children were over reported in Ghana. Women in Ghana also had a higher tendency for age heaping and women in both countries exhibited inappropriately higher numbers in the 25-29 age group. These phenomena could have affected the end results of the study.

The analysis targeted the under-5 group of children and was divided into infancy for those aged between 0 and 11 months and childhood for those aged between 12 and 59 months.

This was done in order to make the study more comprehensive and also because different biological and physical aspects affect death of children at these two stages of life. The mode of analysis was survival analysis. In the case of an outcome such as death this is known as Cox regression for survival analysis. It's a method for investigating the effect of several variables on the time a specified event takes to happen. Since not all children had had the chance to survive to the oldest age under investigation by the time of the interview, Cox's proportional hazard model was used to account for censoring in the estimation of exposure time. 100, 95 and 90 percent levels of statistical significance were used in the study analysis results.

Some of the findings of the analysis were as hypothetically expected while other were unique in character. For infant mortality, Kenyan mothers with secondary and higher education had infants with lowered chances of death while Ghanaian mothers with primary education had infants with increased chances of mortality. Women in the high wealth index in Kenya had infants with higher chances of fatality while in Ghana wealth index was not significantly associated with risk of infant death. Type of place of mother's residence was not significantly associated with risk of infant death in both countries although in the full model, it shows slightly lowered chances of infant death. For both Kenya and Ghana, maternal age at birth was not a significant determinant of risk of infant death.

Regarding birth order and preceding birth interval, in both countries, preceding birth intervals of less than 24 months and high birth order were associated with increased risk of infant death more so in Ghana than in Kenya. Mothers sourcing their water from 'other' source had infants with increased mortality risk in Kenya but this variable was not significant for Ghana. In the full model, infants born to Kenyan mothers in households with no toilet facilities had higher risk of dying. Again this variable was not significantly associated with risk of infant death in Ghana. Mother's ethnic affiliation was strongly associated with risk of infant death in Kenya with the Luo mothers exhibiting the highest risks while this was not so in Ghana where ethnic affiliation was insignificant. Infants born to formerly married mothers in Ghana had higher chances of survival according to the findings but this variable was insignificant in Kenya.

Looking at childhood mortality, in both Kenya and Ghana, children born to mothers with secondary and higher education had higher chances of survival. Mothers in the medium

wealth index in Ghana had higher risk of childhood death while wealth index was insignificant in Kenya although the medium wealth index exhibits higher risk of childhood death as well. For both countries, type of place of mother's residence is insignificant with regards to risk of childhood death although in the full model the risk is lower in Kenyan and higher in Ghanaian urban areas. Maternal age at birth is partly associated with increased risk of childhood death in Kenya but it disappears with the introduction of socio-cultural variables. In Ghana it is statistically insignificant although in the full model for both countries, mothers under the age of 20 exhibit higher risk of childhood death. Birth order and preceding birth interval are not associated with risk of childhood death in both countries.

Children with a succeeding birth interval of more than 36 months exhibit a heightened risk of death in Ghana. This variable is not significant in Kenya. Regarding source of drinking water, there was increased risk of childhood death among Kenyan women who fetch it from wells and Ghanaian women who source it from 'other' source. Children had higher risk of dying in household with no toilet in Ghana and although not significant in Kenya, the same phenomenon prevailed. Again, ethnic affiliation is strongly associated with risk of childhood death in Kenya with the Luo exhibiting the highest risk. This variable was statistically insignificant in Ghana. For marital status, Ghanaian women who have never been married exhibited higher risk of childhood death; the variable being insignificant in Kenya.

Overall, the factors that seemed to most importantly influence the risk of infant mortality for both Kenya and/or Ghana included maternal level of education, birth order and preceding birth interval, presence of toilet facilities and ethnicity. Those that crucially influenced the risk of childhood mortality for both Ghana and/or Kenya were maternal education as well, drinking water source, presence of toilet facilities and once more ethnicity.

6.2 Conclusions

The link between level of maternal education and risk of infant and child mortality cannot be stressed enough. As has been confirmed by many other studies (Rutstein, 2000, Gyimah, 2002; Ikamari, 1996; Omariba, 2005; e.t.c), higher educated women have children with increased survival chances. Education is today recognized worldwide as a

basic prerequisite for development. As stated by the UN Secretary General in the Millennium Report, "Short-changing girls is not only a matter of gender discrimination; it is bad economics and bad social policy. Experience has shown, over and over again, that investments in girls' education translate directly and quickly into better nutrition for the whole family, better health care, declining fertility, poverty reduction and better overall economic performance." Children do not necessarily become sick because their mothers are less educated but mainly because such mothers rarely practice better hygiene and nutrition.

Throughout their years in school, educated women are regularly exposed to the importance of hygiene and nutrition. Consequently, they become more aware of causes of disease and hence indulge in good sanitary practices and other preventive measures to reduce the risk among their children (Gyimah, 2003). Basu (2002) emphasizes that availability of these facilities to all could render maternal education less important since they would benefit everyone. Highly educated women are also likely to have jobs that improve their household standard of living hence provide their children with better healthcare and increase their chances of survival. Mortality rates improve when mothers are educated as this ensures that families avail themselves of improved health technologies and are more open to preventive health practices. As pointed out earlier however, maternal education does not influence risk of children's death at all ages; low levels of maternal education actually significantly raise the risk of death throughout the first two years of life as depicted in Ghana. Here the women with primary education had infants with higher risk of death.

Preceding birth intervals of less than 24 months were seen to be strongly linked to elevated risk of infant deaths. As has been found in other studies, the maternal factor of having children 'too' quickly has grave consequences for both the child and mother. Gyimah (2002) clearly points out that closely-spaced births may physiologically deplete the mother of energy and nutrition which may lead to premature births or pregnancy related complications. This could elevate the risk of infant or maternal death or impair the mother's ability to nurture her children. This is among other issues brought about by close births like less attendance of prenatal care services, premature weaning of the previous child and competition for household resources and mother's attention. Not only is there higher risk of death for the newly born child but also for the previous child who could be

exposed to malnutrition hence increasing the child's vulnerability to infectious and parasitic diseases.

A factor that is closely linked to short birth intervals is the birth order of the children. Risk of death is higher for first order (irrespective of the age of the mother) and higher order births. Higher order births are mostly associated with older mothers. The higher risk of death among children born to older mothers could be due to a decline in the efficiency of the reproductive system with age and repeated child births combined with economic pressure in the family (Da Vanzo et al., 1983). First order births are often linked to younger mothers and children born to them exhibit higher risk of death due to a certain extent to physical immaturity, lack of child care skills and lack of access (and use) of healthcare services. As the number of children in a household increases, they are less likely to receive quality care and attention hence are more likely to come into contact with disease pathogens hence increasing their risk of death.

Regarding the environmental factors of drinking water and toilet facilities utilized in this study, the results authenticate other findings regarding the same. It is a well known fact that removing contaminants from the living space of children is an important means of preventing deterioration of health that may lead to death (Rutstein, 2000). Children born in homes that obtain their drinking water from other sources other than piped facilities had higher chances of dying more so in childhood than in infancy. Infants are less exposed to the environment than children who can get around on their own thus exposing themselves to harmful pathogens in and around the household. There is need therefore to practice good hygiene and provide proper sanitation in the household in order to especially prevent diarrhoea which is one of the five most main causes of death for children under the age of five in sub-Saharan Africa.

Ethnicity in Kenya has revealed itself to be fervently associated with the risk of infant and child deaths. Brockerhoff and Hewett (2000) in their study on Inequality of Child Mortality Among Ethnic Groups in sub-Saharan Africa concluded that ethnic mortality differences were in fact closely linked to economic inequality in many countries. They found large disparities in schooling among ethnic groups, the favored ethnic groups had better dwellings and men with better occupations and immunization coverage was found to be higher among the most dominant ethnic communities. These factors play a great role

in the association with infant and child deaths with higher schooling, better housing and occupation and immunization increases the chances of children's survival.

Geographical setting in which an ethnic group is primarily centred strongly influences the health and survival chances of children. Location of communities in favorable epidemiological and/or cash crop environments affects the survival status of their children. In this study the Luo, Luhya and Kamba exhibit higher risk of child deaths which could be attributed to their geographical setting that favors disease pathogens like Malaria, measles and diarrhoea as well as their location in rural environments that are not well supplied with healthcare services. The Kamba are further plagued by drought in a vast area of the occupancy hence have children who are more vulnerable to malnutrition and hence ill health. The elevated risk of child deaths among the Luo could be attributed to the high rate of HIV/AIDS in the area. This could be due to the death of frequent illness of the caregiver or breadwinner, unexplained trauma and depletion of economic and non economic resources in the household. Furthermore, the time, energy and financial resources needed to take care of children may be diverted to caring for sick adults. Loss of income due to illness of the breadwinner can lead to poverty and deprivation and adult death may result in single parenthood. These scenarios could result in negative health outcomes for the children hence elevating their risk of death (Adentuji, 2000).

Single parenthood heightens the death risk of children through poverty and the harsh economic situations that follow. Single mothers are often young and inexperienced in taking proper care of their children as well as attendance of pre and post natal care. In some communities getting children out of wedlock is frowned upon and such mothers are ostracized hence exposing them to poverty, psychological trauma from rejection and they are thus less able to properly take care of their children. In her study of sexual stigma and infant mortality in sub-Saharan Africa Johnson-Hanks (2005) found out that children conceived outside of marriage suffer a greater mortality disadvantage in African societies where premarital sexuality is more stigmatized. Infants depend on their mothers' advocacy; when their mothers occupy socially disadvantageous positions in the household, infants suffer. That is, cultural norms influence social structure, and social structure influences mortality rates.

Apart from the factors associated with the risk of infant and child death analyzed in this study, others like nutritional status, breastfeeding and infant feeding, maternal care, immunization and care of sick children are important in determining their survival status. Rutstein (2000) noted that improvement in the nutritional status of children was associated with decreases in mortality rates. Also a rise in children aged 7-9 months who were both breastfed and getting solid foods was associated with decreases in both post natal and infant mortality rates. Increased use of births receiving medical care reduced mortality rates as well as use of prenatal care services. Immunization of children was also linked to improved chances of children's survival in the post neonatal period and those below the age of 1 year. Children who received medical attention for diarrhoea, acute respiratory illness and fever had higher chances of survival.

Besides diarrhoea as a major cause of infant and child deaths, Malaria is also making a comeback elevating the risk of children's deaths. Malaria is on the rise due to insecticide resistance, antimalarial drug resistance, and environmental changes. Inspite of the resistance the parasite has developed to the cheap and commonly used antimalarial drug chloroquine, ministries of health are slow to change policy to use the second line drug Fansidar. Resistance to Fansidar is also developing due to improper use of antimalarial drugs. Low maternal hemoglobin is strongly associated with preterm delivery and low birth weight. Infants with low birth weight are significantly more susceptible to other infections and have a higher risk of dying during infancy. Those who survive are at greater risk for poor growth and development.

Anaemia is another major cause of child morbidity and mortality in Africa. Severe anaemia is the most common complication of Malaria in children ages 6 months to 2 years living in Malaria-endemic regions of Africa. Malaria infection affects weight gain and stunts growth. In three malaria intervention trials in Africa that measured the protective effect of insecticide impregnated bed nets (ITBNs), malaria mortality decreased along with all causes of child mortality. Weight gain was significantly higher among infants who slept under ITBNs (Egan, 2001).

Some important conclusions of this study are that birth intervals of three years or longer can substantially decrease the risk of newborn death, infants are twice as likely to survive if the previous birth interval is at least two years, avoiding short birth intervals would lower both fertility and infant and child mortality and enabling women to realize their birth interval preferences would result in substantial decreases in both infant and child

mortality and fertility (WHO/AFRO, 2004). Also immunization is a crucial way to improve survival chances for children as well as the use of prenatal, hospital delivery and postnatal care services.

6.3 Recommendations

6.3.1 For policy

Just as better incomes lower the possibility of a child's death, higher income alone is ineffectual in the absence of immunization and other intervening factors. Reductions in child mortality in many countries are at any rate partly driven by socioeconomic development: improvements in women's education and literacy, household income, environmental conditions (safe water supply, sanitation and housing), along with improvements in health services and child nutrition (Rutstein, 2000; Cornia and Mwabu, 1997).

Therefore, in order for Kenya and Ghana to achieve the 4th Millennium Development Goal for the improvement of child health the following policies should be considered. First, their governments should invest in the provision of water and sanitation services and education for women. Secondly, preventive healthcare should be emphasized and particularly immunization programmes. Immunization of children should be provided on a free-of-charge basis as this would help improve the population's health. Another preventive service needed is that from Malaria which is endemic in many sub-Saharan countries. 90 percent of global Malaria deaths occur here among the children under the age of five. This service should be made more available and affordable to majority of the countries' people. Prevention of unwanted and unplanned pregnancies should also be intensified with birth control being made readily available, affordable, accessible and user friendly.

Thirdly, single mothers are on the increase and effort to make them an acceptable part of the society should be stepped up in order to allow their children to have the same privileges to increase their survival chances as those of any other family setting. Lastly, proper resource allocation, availability of resources at the local level, commitment and enthusiasm can all help accelerate effort and achievement of the desired goal.

6.3.2 For further research

Some of this study's findings were contrary to expectation and no valid explanations could be found for them. For instance, Kenyan mothers in the high wealth index had infants with the highest risk of death. Also Ghanaian mothers with primary education had infants with an elevated risk of death, higher than that of mothers with no education. Infants of formerly married Ghanaian mothers exhibited lowered risk of death which is also a confounding. Children of mothers in the medium wealth index in Ghana also exhibited higher risk of death than those in the low wealth index. Ethnicity in Ghana and type of place of residence in both countries have, in previous studies, been found to be associated with infant and child mortality in Ghana but not in this study, why? Further research needs to be carried out with emphasis on these factors in order to find out the circumstances under which they elevate or reduce the risk of infant and/or child deaths in both Kenya and Ghana. Qualitative analysis should be a beginning in the examination of the various confounding elements in this study.

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APPENDICES

APPENDIX A: Hazard models of infant mortality associated with socioeconomic, bio-demographic and socio-cultural variables in Kenya

Model I

Variables	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	-0.143	0.163	0.866
Secondary education	-0.407	0.201	0.666
Wealth index			
Low	-	-	-
Medium	0.118	0.124	1.125
High	1.240	0.199	3.456
Type of place of residence			
Rural	-	-	-
Urban	0.028	0.120	1.029
Ethnicity			
Kikuyu/Embu/Meru	-	-	-
Kamba	0.320	0.234	1.376
Kisii/Kalenjin	0.605	0.196	1.832
Luhya	0.592	0.191	1.808
Luo	1.111	0.185	3.037
Mijikenda/Swahili	0.314	0.255	1.369
Others	0.651	0.215	1.917
Current marital status			
Currently married	-	-	-
Never married	-0.064	0.209	0.938
Formerly married	0.035	0.183	1.036

Model II

Variables	β	SE	Exp(β)
Maternal age at birth (years)			
20-29	-	-	-
<20	-0.059	0.164	0.943
30-34	0.009	0.168	1.009
35+	0.176	0.154	1.193
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	0.347	0.177	1.415
4+ and 25+	-0.089	0.166	0.915
4+ and <24	0.633	0.169	1.883
First birth	-0.030	0.171	0.970
Ethnicity			
Kikuyu/Embu/Meru	-	-	-
Kamba	0.328	0.234	1.389
Kisii/Kalenjin	0.580	0.196	1.787
Luhya	0.562	0.192	1.754
Luo	1.091	0.187	2.977
Mijikenda/Swahili	0.394	0.247	1.484
Others	0.737	0.183	2.090
Current marital status			
Currently married	-	-	-
Never married	0.040	0.207	1.041
Formerly married	0.041	0.183	1.042

Model III

Variables	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	-0.177	0.138	0.838
Secondary education	-0.462	0.186	0.630
Wealth index			
Low	-	-	-
Medium	0.075	0.123	1.078
High	1.199	0.199	3.316
Type of place of residence			
Rural	-	-	-
Urban	0.077	0.136	1.080
Maternal age at birth (years)			
20-29	-	-	-
<20	-0.029	0.167	0.972
30-34	-0.024	0.169	0.976
35+	0.110	0.154	1.117
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	0.412	0.177	1.510
4+ and 25+	-0.040	0.167	0.961
4+ and <24	0.694	0.171	2.002
First birth	-0.037	0.174	0.964
Drinking water			
Piped	-	-	-
Well	0.080	0.165	1.083
Stream/river/lake	0.085	0.149	1.089
Other	0.446	0.188	1.561
Toilet facility			
Have toilet	-	-	-
No toilet	0.146	0.134	1.157

Model IV

Variables	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	-0.188	0.170	0.829
Secondary education	-0.451	0.212	0.637
Wealth index			
Low	-	-	-
Medium	0.084	0.124	1.088
High	1.175	0.201	3.238
Type of place of residence			
Rural	-	-	-
Urban	-0.019	0.142	0.981
Maternal age at birth (years)			
20-29	-	-	-
<20	-0.134	0.168	0.875
30-34	0.043	0.170	1.044
35+	0.179	0.156	1.196
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	0.344	0.177	1.411
4+ and 25+	-0.137	0.169	0.872
4+ and <24	0.543	0.174	1.722
First birth	0.008	0.173	1.008
Drinking water			
Piped	-	-	-
Well	0.093	0.169	1.098
Stream/river/lake	0.074	0.157	1.077
Other	0.568	0.193	1.765
Toilet facility			
Have toilet	-	-	-
No toilet	0.305	0.140	1.356
Ethnicity			
Kikuyu/Embu/Meru	-	-	-
Kamba	0.329	0.236	1.389
Kisii/Kalenjin	0.646	0.201	1.907
Luhya	0.577	0.196	1.780
Luo	1.170	0.191	3.222
Mijikenda/Swahili	0.510	0.264	1.666
Others	0.690	0.222	1.994
Current marital status			
Currently married	-	-	-
Never married	-0.068	0.209	0.934
Formerly married	0.006	0.183	1.006

APPENDIX B: Hazard models of infant mortality associated with socioeconomic, bio-demographic and socio-cultural variables in Ghana

Model I

Variables	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	0.303	0.179	1.354
Secondary education	-0.088	0.193	0.915
Wealth index			
Low	-	-	-
Medium	0.058	0.133	1.060
High	-0.009	0.457	0.991
Type of place of residence			
Rural	-	-	-
Urban	-0.230	0.162	0.794
Ethnicity			
Akan	-	-	-
Ga-adangbe	-0.266	0.297	0.767
Ewe	-0.150	0.226	0.861
Mole-dagbani	-0.194	0.199	0.824
Others	-0.002	0.198	0.998
Current marital status			
Currently married	-	-	-
Never married	0.510	0.324	1.665
Formerly married	-0.893	0.415	0.409

Model II

	β	SE	Exp(β)
Maternal age at birth (years)			
20-29	-	-	-
<20	0.234	0.234	1.264
30-34	0.074	0.211	1.076
35+	0.028	0.199	1.028
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	0.925	0.259	2.523
4+ and 25+	0.238	0.209	1.268
4+ and <24	1.004	0.250	2.728
First birth	0.303	0.224	1.354
Ethnicity			
Akan	-	-	-
Ga-adangbe	-0.218	0.296	0.804
Ewe	-0.059	0.225	0.942
Mole-dagbani	-0.127	0.174	0.881
Others	0.055	0.175	1.057
Current marital status			
Currently married	-	-	-
Never married	0.508	0.324	1.662
Formerly married	-0.912	0.414	0.402

Model III

	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	0.302	0.172	1.353
Secondary education	-0.034	0.185	0.966
Wealth index			
Low	-	-	-
Medium	0.080	0.133	1.083
High	0.015	0.457	1.015
Type of place of residence			
Rural	-	-	-
Urban	-0.168	0.210	0.845
Maternal age at birth (years)			
20-29	-	-	-
<20	0.185	0.237	1.204
30-34	0.082	0.212	1.086
35+	0.038	0.199	1.039
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	0.907	0.259	2.476
4+ and 25+	0.202	0.212	1.224
4+ and <24	0.949	0.253	2.582
First birth	0.326	0.227	1.385
Drinking water			
Piped	-	-	-
Well	-0.025	0.219	0.975
Stream/river/lake	0.080	0.246	1.084
Other	0.356	0.392	1.428
Toilet facility			
Have toilet	-	-	-
No toilet	0.059	0.153	1.061

Model IV

	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	0.303	0.184	1.354
Secondary education	-0.047	0.202	0.954
Wealth index			
Low	-	-	-
Medium	0.044	0.133	1.045
High	0.001	0.458	1.001
Type of place of residence			
Rural	-	-	-
Urban	-0.178	0.210	0.837
Maternal age at birth (years)			
20-29	-	-	-
<20	0.182	0.236	1.199
30-34	0.088	0.212	1.092
35+	0.049	0.200	1.050
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	0.904	0.259	2.471
4+ and 25+	0.205	0.212	1.227
4+ and <24	0.946	0.254	2.575
First birth	0.331	0.227	1.393
Drinking water			
Piped	-	-	-
Well	-0.027	0.221	0.973
Stream/river/lake	0.085	0.246	1.088
Other	0.378	0.394	1.459
Toilet facility			
Have toilet	-	-	-
No toilet	0.083	0.171	1.086
Ethnicity			
Akan	-	-	-
Ga-adangbe	-0.264	0.300	0.768
Ewe	-0.149	0.229	0.861
Mole-dagbani	-0.162	0.220	0.850
Others	0.024	0.213	1.025
Current marital status			
Currently married	-	-	-
Never married	0.525	0.325	1.691
Formerly married	-0.903	0.415	0.405

APPENDIX C: Hazard models of child mortality associated with socioeconomic, bio-demographic and socio-cultural variables in Kenya

Model I

	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	-0.425	0.345	0.654
Secondary education	-0.946	0.442	0.388
Wealth index			
Low	-	-	-
Medium	0.354	0.228	1.425
High	-0.488	1.008	0.614
Type of place of residence			
Rural	-	-	-
Urban	-0.397	0.254	0.673
Ethnicity			
Kikuyu/Embu/Meru	-	-	-
Kamba	1.665	0.592	5.284
Kisii/Kalenjin	0.028	0.765	1.028
Luhya	2.259	0.533	9.575
Luo	2.813	0.531	16.656
Mijikenda/Swahili	0.709	0.728	2.032
Others	1.003	0.629	2.727
Current marital status			
Currently married	-	-	-
Never married	-0.508	0.512	0.602
Formerly married	-0.406	0.461	0.666

Model II

	β	SE	Exp(β)
Maternal age at birth (years)			
20-29	-	-	-
<20	0.519	0.296	1.681
30-34	-0.180	0.385	0.835
35+	0.150	0.340	1.162
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	-0.248	0.400	0.780
4+ and 25+	0.005	0.341	1.005
4+ and <24	0.105	0.397	1.111
First birth	-0.058	0.320	0.943
Succeeding birth interval (months)			
24-36	-	-	-
Under 24	-0.335	0.399	0.715
36+	-0.390	0.627	0.677
Last birth	-0.055	0.272	0.946
Ethnicity			
Kikuyu/Embu/Meru	-	-	-
Kamba	1.766	0.593	5.847
Kisii/Kalenjin	0.122	0.765	1.130
Luhya	2.290	0.535	9.877
Luo	2.765	0.534	15.879
Mijikenda/Swahili	1.004	0.710	2.729
Others	1.443	0.572	4.231
Current marital status			
Currently married	-	-	-
Never married	-0.440	0.512	0.644
Formerly married	-0.434	0.461	0.648

Model III

	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	0.132	0.298	1.141
Secondary education	-0.435	0.419	0.647
Wealth index			
Low	-	-	-
Medium	0.359	0.228	1.432
High	-0.525	1.009	0.591
Type of place of residence			
Rural	-	-	-
Urban	0.060	0.289	1.061
Maternal age at birth (years)			
20-29	-	-	-
<20	0.596	0.301	1.815
30-34	-0.171	0.386	0.843
35+	0.075	0.340	1.078
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	-0.120	0.401	0.887
4+ and 25+	0.049	0.344	1.050
4+ and <24	0.246	0.397	1.279
First birth	-0.009	0.326	0.991
Succeeding birth interval (months)			
24-36	-	-	-
Under 24	-0.334	0.399	0.716
36+	-0.398	0.627	0.672
Last birth	-0.094	0.272	0.910
Drinking water			
Piped	-	-	-
Well	0.805	0.335	2.236
Stream/river/lake	0.461	0.328	1.586
Other	0.414	0.445	1.513
Toilet facility			
Have toilet	-	-	-
No toilet	0.089	0.272	1.093

Model IV

	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	-0.475	0.356	0.622
Secondary education	-0.949	0.459	0.387
Wealth index			
Low	-	-	-
Medium	0.373	0.229	1.452
High	-0.503	1.011	0.605
Type of place of residence			
Rural	-	-	-
Urban	-0.225	0.315	0.798
Maternal age at birth (years)			
20-29	-	-	-
<20	0.326	0.304	1.385
30-34	-0.113	0.395	0.894
35+	0.174	0.351	1.190
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	-0.236	0.401	0.790
4+ and 25+	-0.193	0.354	0.825
4+ and <24	-0.101	0.406	0.904
First birth	0.086	0.324	1.090
Succeeding birth interval (months)			
24-36	-	-	-
Under 24	-0.357	0.400	0.700
36+	-0.371	0.628	0.690
Last birth	-0.088	0.273	0.915
Drinking water			
Piped	-	-	-
Well	0.715	0.362	2.044
Stream/river/lake	0.426	0.358	1.531
Other	0.641	0.463	1.899
Toilet facility			
Have toilet	-	-	-
No toilet	0.139	0.287	1.149
Ethnicity			
Kikuyu/Embu/Meru	-	-	-
Kamba	1.720	0.595	5.585
Kisii/Kalenjin	0.069	0.771	1.072
Luhya	2.202	0.540	9.046
Luo	2.873	0.542	17.695
Mijikenda/Swahili	0.837	0.753	2.309
Others	1.029	0.650	2.799
Current marital status			
Currently married	-	-	-
Never married	-0.464	0.514	0.629
Formerly married	-0.433	0.462	0.649

APPENDIX D: Hazard models of child mortality associated with socioeconomic, bio-demographic and socio-cultural variables in Ghana

Model I

	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	-0.238	0.319	0.788
Secondary education	-0.836	0.359	0.433
Wealth index			
Low	-	-	-
Medium	0.535	0.229	1.707
High	-10.815	182.573	0.000
Type of place of residence			
Rural	-	-	-
Urban	0.154	0.273	1.166
Ethnicity			
Akan	-	-	-
Ga-adangbe	-0.172	0.543	0.842
Ewe	0.173	0.394	1.189
Mole-dagbani	0.128	0.329	1.136
Others	-0.022	0.354	0.978
Current marital status			
Currently married	-	-	-
Never married	1.088	0.465	2.968
Formerly married	0.544	0.401	1.723

Model II

	β	SE	Exp(β)
Maternal age at birth (years)			
20-29	-	-	-
<20	0.377	0.433	1.458
30-34	-0.179	0.372	0.836
35+	-0.091	0.333	0.913
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	-0.576	0.742	0.562
4+ and 25+	0.259	0.330	1.295
4+ and <24	0.453	0.490	1.573
First birth	-0.140	0.392	0.870
Succeeding birth interval (months)			
24-36	-	-	-
Under 24	0.531	0.671	1.701
36+	1.390	0.549	4.015
Last birth	0.716	0.467	2.047
Ethnicity			
Akan	-	-	-
Ga-adangbe	-0.064	0.541	0.938
Ewe	0.251	0.392	1.285
Mole-dagbani	0.459	0.288	1.582
Others	0.356	0.319	1.428
Current marital status			
Currently married	-	-	-
Never married	1.010	0.467	2.745
Formerly married	0.435	0.399	1.544

Model III

	β	SE	Exp(β)
Maternal education			
No education	-	-	-
Primary education	-0.101	0.308	0.904
Secondary education	-0.652	0.347	0.521
Wealth index			
Low	-	-	-
Medium	0.514	0.229	1.672
High	-10.909	191.888	0.000
Type of place of residence			
Rural	-	-	-
Urban	0.242	0.352	1.274
Maternal age at birth (years)			
20-29	-	-	-
<20	0.319	0.435	1.375
30-34	-0.187	0.370	0.830
35+	-0.055	0.332	0.946
Birth order and Preceding birth interval (months)			
2-3 and 25+	-	-	-
2-3 and <24	-0.508	0.742	0.602
4+ and 25+	0.235	0.334	1.264
4+ and <24	0.480	0.493	1.616
First birth	-0.044	0.395	0.957
Succeeding birth interval (months)			
24-36	-	-	-
Under 24	0.627	0.672	1.872
36+	1.344	0.549	3.836
Last birth	0.777	0.466	2.176
Drinking water			
Piped	-	-	-
Well	0.144	0.382	1.155
Stream/river/lake	-0.232	0.456	0.793
Other	1.088	0.540	2.967
Toilet facility			
Have toilet	-	-	-
No toilet	0.467	0.265	1.595