THE STALLING CHILD MORTALITY IN GHANA: THE CASE OF THE THREE NORTHERN REGIONS

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Abstract**:**

The study examined the levels of, and trends in infant and child mortality in the three northern regions of Ghana over 1993-2003 period. The 1993, 1998 and 2003 Ghana Demographic and Health Survey (GDHS) data were used for the study. Indirect techniques were used to estimate the mortality levels. From the analysis, the East family of Coale-Demeny Model Life Tables was found to conform to the mortality patterns in the three regions. The average mortality levels for Northern, Upper West and Upper East regions were estimated as 15.7, 13.4 and 19.1 respectively. The implied expectation of life at birth for both males and females based on the average mortality levels has also been estimated. Multivariate logistic regression was used to fit the models. Education of mother, birth order of child and marital status of mother are significant determinants of the incidence of child mortality in the three northern regions of Ghana.

1.1 Introduction

The last decade (1990s) has seen a remarkable decline in infant and child mortality (probability of dying between birth and 11 months old and the probability of dying between age 1 and age four respectively) in most of the less developed countries in the world. In some countries, particularly in sub-Saharan Africa, these declines in mortality among children had slowed down and are now rising again. Internationally comparable data derived from survey programmes, such as the Demographic and Health Surveys (DHS), are available both to document the changes that have occurred in mortality and to provide insight into some of the factors that may explain these trends in mortality. Rates of infant and child mortality estimated from the birth histories recorded by the surveys show that a range of changes occurred in the 1990s. While most countries with comparable data from the DHS have had declines in mortality over time, (some rates have fallen by as much as 63 deaths per 1000 live births among children aged under 5 years), some have seen this trend reversed, and still others have been increases in mortality by up to 25 deaths per 1000 live births (Shea, 2000).

There are significant variations in child mortality among the various regions of the world. For instance, it is estimated that, about 10.5 million children aged 0-4 years died in 1999 throughout the world. Out of this, about 36 percent died in World Health Organisation's (WHO) Africa region, 33 percent in South-East Asia, 14 percent in the Eastern Mediterranean, 11 percent in the Western Pacific, 4 percent in the Americas and 2 percent in Europe. It was further found that, the risk of child not reaching his or her fifth birthday is nearly eight times greater in Africa than in Europe (Ahmad et al., 2000).

However, some regions have made impressive progress towards achieving the MDG 4 by experiencing steep declines in child mortality within 1990-2003. Child mortality rate in North Africa, Latin America and the Caribbean, and South- Eastern Asia has dropped by 40%, clearly putting them on the track of meeting the MDG target by 2015. However, sub-Saharan Africa, the region with the highest level of child mortality, made the smallest reduction (<1%) in child mortality over the period (UN, 1990-2005).

The infant, child and under-five mortality rates have steadily declined in Ghana over 1990-2003 period, however, regional disparities between the north and south of the country still exist. In northern Ghana for instance, infant mortality rate is twice as high as in the nation's capital(Greater Accra region) and under-five mortality rate is also three times as high as that in the Greater Accra region and at the same time the fertility figures for the regions in the northern Ghana are the highest in the country. Northern region has the highest Total fertility rate (TFR) in the country of 7.0 births per woman followed by Upper West region of 5.5. The TFR for the Upper East region (4.7) is only lower than the rates for Central (5.0) and Brong Ahafo (4.8) regions that are far above the national average of 4.4 births per woman (GSS, 2004). The situation presents a picture of serious lack of health facilities and poor access to health services in northern Ghana, thus justifying the high mortality rates in the regions.

1.2 STATEMENT OF THE PROBLEM

Every year in Ghana, about 80,000 children do not live to celebrate their fifth birthday. Most of these children die from preventable causes. Malaria is hyper-endemic in Ghana and claims one-quarter of all under-five deaths every year – 20,000 young lives. Acute respiratory infection is responsible for 18 per cent of under-five deaths, and diarrhoea for another 18 per cent. Malnutrition is the underlying cause of death in half of all under-five deaths. Over the last five years, national infant mortality and under-five mortality rates in Ghana have not improved – startling evidence that children continue to die needlessly (MOH, 2006).

Although there has been a decline in infant ,child and under five mortality rates in Ghana for the past two decades, recent Demographic and Health Survey findings reveal a reversal in these declines especially in the infant and under-five mortality rates. This has attracted a lot of attention by both policy makers and the academia. The major causes of infant mortality are attributable to vaccine preventable diseases. It is also worth noting that the high infant mortality rate might be a driving force for Ghana's high but stalled fertility rate over the last decade. This is because as security against the possible losses of their children, women tend to replace ex post their children who die (Benefo and Schultz, 1996).

A cursory look at the trend of both infant and under-five mortality rates in Ghana for the past fifteen years (2003-1988) revealed a recent rise in both infant and under-five mortality in the 2003 GDHS. The trend in infant mortality rate is: 77 infant deaths per 1000 live births for 1988, 66, for 1993, 57, for 1998 and 64, for 2003. And that of Child mortality rate is 84 child deaths for 1000 live births for 1988, this rate dropped to 57 in 1993 and further to 54 in 1998 and finally to 50 in 2003. For Under-five mortality rate for the same period we had; 155 child deaths per 1000 live births for 1988, 119 for 1993, 108 for 1998 and finally 111 for 2003.

Figure 1.0 Trend of Child Mortality in Ghana

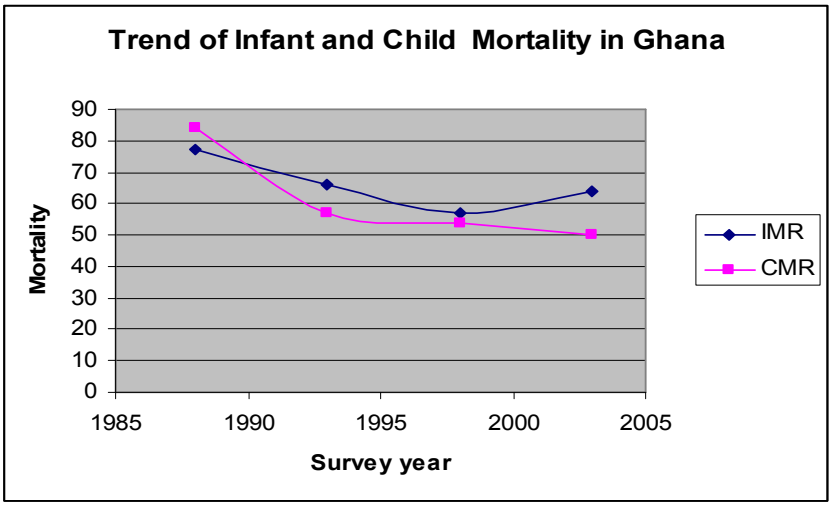
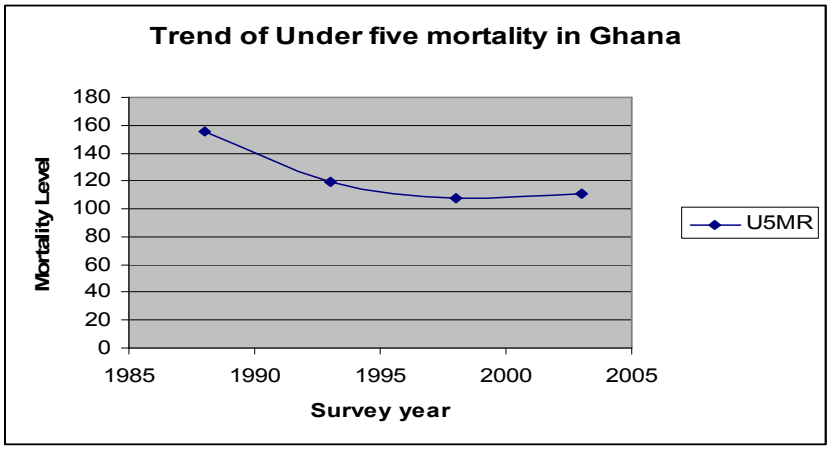


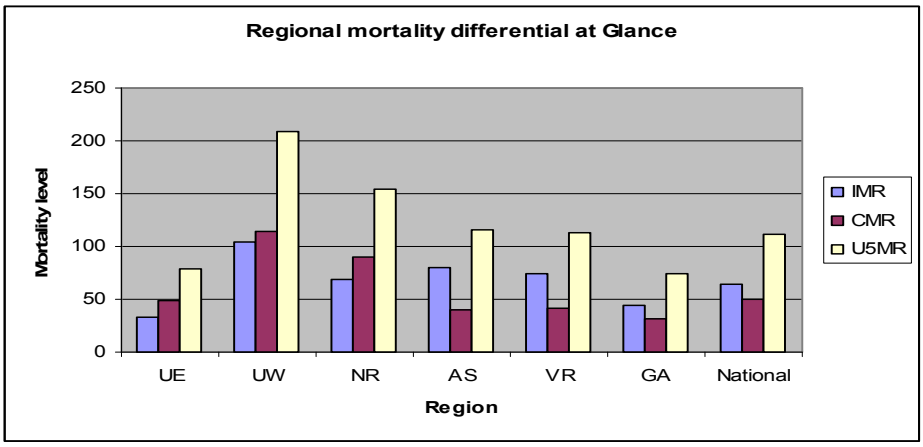
Figure 2.0 Trend of Under-five mortality in Ghana



When data from four Ghana Demographic and Health Surveys-GDHS (1988, 1993, 1998 and 2003) are compared, for the most recent five years period, the marked decline in both infant and under-five mortality rates observed in the three earlier surveys (1988-1998) appears to have halted during the period (1999-2003). The under-five mortality rate of 111 deaths per 1000 live births in Ghana means that, one in every nine Ghanaian children dies before reaching age five and nearly three in five of these deaths occur in the first year of life (GSS, 2004).

The apparent slow down in under five mortality decline, which serves as an indicator of well being, signifies the difficulties that the socio-economic situation in general and the health system in particular are faced in achieving the Ghana Poverty Reduction Strategy, which had a target of an infant mortality rate of 50 per 1000 live births and under five mortality rate of 95 per 1000 live births by the year 2005 (World Bank, 2003). This even has a greater implication for the country in achieving the MDG target of reducing child mortality by two-third by 2015. The question that borders the mind of the researcher is; what could be responsible for these reversal trends in the infant and under five mortality between 1998 and 2003

Figure 3.0 Regional Mortality Differentials at Glance



The disparities within countries in infant and child mortality observed in Africa are equally experienced in Ghana. As with any averages, the national statistics has masked the disparities among the regions and among the various socioeconomic groups within the country. According to Ghana Statistical Service (2004), there is striking differential in infant mortality rates among the study regions. Upper East region has the lowest infant mortality rate of 33 per 1000 live births in the country, with Upper West region having the highest infant mortality rate of 105 per 1000 live births followed by Ashanti region of 80 per 1000 live births, 75 for Volta region and 69 per 1000 live births for Northern region. With regards to child mortality rate, there is sharp difference between the three northern regions on one hand and the rest of the regions on the other hand. Upper West region has the highest child mortality rate of 115 per 1000 live births in the country, followed by Northern region with 90 child deaths per 1000 live births and Upper East region having the third largest child mortality rate of 48 per 1000 live births in country. In addition, marked regional differentials in under-five mortality are also observed. The Under five mortality rate ranges from a low of 75 per 1000 live births in the Greater Accra region to as high as 208 per 1000 live births in Upper West region followed by 116 in the Ashanti region and 154 per 1000 live births in Northern region, However Upper East region ranked second to Greater Accra region with 79 deaths per 1000 live births (GSS, 2004). It is noticed from the above that Upper West region has the highest rates for all the three levels of mortality in the country.

From the above analysis, the following questions are worth raising; Could these extremity in child mortality in the three northern regions in Ghana be due to low levels of education of the women in the regions, since it is established from demographic literature that, there is strong negative correlation between women educational level and child survival?, or, to the uneven distribution of national resources including health facilities and

services?, or, the overall literacy level of women in those regions?. This paper, among other objectives, seeks plausible answers to these questions.

In order to implement effective child survival programmes, there is the need to identify the factors that contribute to child deaths and assess their effects. It is also important to take note of sharp mortality differentials among various regions in the same country as different intervention strategies may be required to arrest the situation. It is against this background that the study seeks to estimate and compare the levels of, and trends in infant and child mortality over the ten-year period (1993-2003) among the three northern and contrasting that with Southern regions of Ghana.

1.3 RATIONALE OF THE STUDY

For those who might be wondering why levels and trends of child mortality, levels of child mortality provide an index of health and vigour of a population whiles trends give an indication of changes in mortality over time. They also help in answering questions such as why has mortality fallen or why has it not fallen? And to what extent has particular health intervention scheme(s) reduced mortality? (Trussell and Menken, 1984).

Children are important national assets and therefore, investment in them lays the foundation for a just society, a strong economy and a world free from poverty, hunger and disease. This study is therefore not just analysis of children but also, analysis of future leaders of Ghana. Infant and Child mortality rates are regarded as important indicators of living standards and health status of a people, therefore the high rates of infant and child mortality in the three northern regions of Ghana are indications of the poor living standards and poor health situation in the regions. Studies of characteristics such as; age pattern and socio-economic and demographic differentials of child mortality are used to highlight factors that promote child survival as well as those that are detrimental to it. Consequently, mortality analyses are helpful in identifying promising directions for health programmes and advancing child survival efforts (GSS, 2004), as demonstrated by Navrongo Health Research Institute, a DSS site in Ghana, through their health care programmes such as; Community-based Health Planning and Services (CHPS) initiative. Analysis of the first three years of Navrongo project exposure shows that child-health interventions have had a pronounced impact on child mortality (Pence et al, 2005). The combined effect of various intervention programmes reduced the child mortality in the study district (where the DSS site is located) below the level set by the MDG for 2015 and reached the goal in 2004, 11 years before the MDG target year of 2015 (Philips, et al, 2005).

The big change in mortality occurring across the world in recent decades does not involve extending lives to unimaginable lengths but relate to saving of premature mortality of infants, children and young middle aged adults. There can be no doubt that living long is a much-shared aspiration, even though it is clearly not the only thing we seek, a long life is inter alia fairly universally valued –valued very strongly(Sen, 1998).

Research has shown that, infant and child mortality deaths are influenced by socio-economic, cultural, biological as well as environmental factors. Therefore, for any government to succeed in prolonging the live of its people, a full understanding of the levels of, and trends in infant and child mortality as well as the socio-economic and demographic factors that influence the incidence of their occurrence in the various sectors of a country, is necessary.

Several studies have been carried out on infant, child and under five mortality in the three northern regions in particular and the Ghana at large, but very few or no research has specifically considered the levels of, and trends in child mortality in the three northern regions over time using these data sets and contrasting that with the other regions in Ghana. It is in the light of this, that the study is designed to investigate the levels of, and trends in infant and child mortality as well as the socio-economic factors that contribute to the high infant and child mortality rates in the three northern regions of Ghana over a ten-year period compared with other regions in the country.

It is hoped that, the findings of this study will help shape government policies and programmes in bringing down the high rates of the infant and child mortality in the three northern regions and the whole nation at large. This will first reduce the striking regional mortality differentials and accelerate the nation's progress towards achieving the MDG target of reducing the national child mortality rate by two-thirds by the year 2015.

1.40 RESEARCH OBJECTIVES

The ultimate goal of the study is to examine the levels of, and trends in infant and child mortality in the three northern regions of Ghana and to determine the socio-economic factors that influence them.

1.41 SPECIFIC OBJECTIVES

(i) To estimate and compare the levels of infant and child mortality among the three northern regions of Ghana for 1993-2003 period.

(ii) To examine the trends in infant and child mortality in the three northern regions of Ghana over the same period.

(iii) To determine how the selected factors affect the changing pattern of mortality overtime in the three northern regions of Ghana.

(iv) To make recommendations based on the findings for appropriate intervention measures to reduce the incidence of infant and child mortality in the three northern regions of Ghana.

1.5 LITERATURE REVIEW

Several research works have been carried out at different levels and different places across the developing world in an attempt to find out how the socio-economic and demographic factors in a population affect the infant and child mortality. The factors, according to Mosley and Chen and Schulzt (1984) are categorised into two; exogenous (socio-economic) and endogenous (biomedical factors). The former consist of cultural, social, economic, community and regional factors and the latter, (endogenous) comprise; breastfeeding patterns, hygiene, sanitary measures, and nutrition. The effects of the exogenous variables are considered indirect because they operate through the endogenous biomedical factors. Likewise, the bio-medical factors are called intermediate variables or proximate determinants because they constitute the middle step between the exogenous variables and child mortality (Mosley and Chen, 1984; Schultz, 1984; UN, 1985).

This paper considered some selected variables belonging to both categories in discussing the child mortality determinants.

The socio-economic factors usually considered for study of child survival include but not limited to the following; maternal and paternal levels of education, type of place of residence, marital status, religion, household income and wealth, ethnicity, occupation or economic activity of the mother, region of residence and access to and use of health facilities and services, to mention just a few. The demographic factors also include age of mother, sex of child, birth spacing or interval, and birth order. The number and type of factors selected for a study depends on the resources available to the researcher, the capacity of the researcher as well as the scope of the research and time available.

This study considered maternal factors (age of mother at birth of child, sex and birth order of child), mother's education, type of place of residence, marital status and region of residence.

In a study of factors associated with trends in infant and child mortality in developing countries during the 1990s, Shea (2000) considered type of place of residence, mother's

education, and household electricity supply. Using the available Demographic Health Survey data across Africa, the study found that during the 1990s, the two most important groups of factors explaining the decrease in mortality among children under the age of five years were the decline in the proportions of children who were malnourished and those who were living in poor environmental conditions such as; poor water supply, poor sanitation and housing conditions. Socio-economic factors such as electricity and the mother's educational level follow in importance.

Twum-Baah et al. (1994), in a study of infant, child and maternal mortality in Ghana; a nationwide survey conducted using nationally representative probability sampling of 15000 households in 650 enumeration areas(EAs) found some evidence of differentials in the rates of mortality(Infant, Child and Maternal) with respect to region of residence, place of residence, religion and marital status. In respect of region of residence, there were significant differences between the rates for all the three northern regions and those of the regions in the southern part of Ghana. On the regional differentials, northern region appears to have the highest mortality rates, recording an infant mortality rate of 128 infant deaths per 1000 live births and under five mortality rates of 217 per 1000 live births. The lowest rate of infant mortality of 55 per 1000 live births and under five mortality of 82 per 1000 live births were recorded in Greater Accra which is the most developed region in the country as it encompasses the capital city of Ghana. The Northern, Upper East and Upper West regions are the least developed in terms of infrastructure and availability of essential facilities like water, hospitals, and schools among others. The variation could also be due to low literacy rates in the regions.

Wang (2003), using the results of 2000 Ethiopian DHS examines the environmental determinants of child mortality. She run three hazards models, the Weibull, the Piece-wise Weibull and the Cox's model to examine three age-specific mortality rates: neonatal (under one month), infant (under one year), and under-five mortality by location (urban/rural), female educational attainment, religious affiliation, income quintile, and access to basic environmental services (water, sanitation and electricity). The estimation results show that children born in rural areas face much higher mortality risk compared with those born in urban areas. Ethiopia is characterized by severe lack of access to basic environmental resources and strong statistical association is found between child mortality rates and poor environmental conditions. Safe water, sanitation and electricity are mainly accessible to households living in urban areas (accounting for less than 20% of the total population)

There is strong evidence in demographic literature on the inverse relationship between the mother's education and the survival of her children. For instance, Ngang (1995), in a study of under-five mortality differentials in Cameroun, observed that the findings from both the bivariate and multivariate analysis showed a strong negative correlation between mother's education and under-five mortality. The study indicated that primary education was not as strong as secondary education in alleviating under-five mortality. It was further revealed that, maternal education contributed about 95 percent of the total variation in under-five mortality in Cameroun, while other variables explained only 4.8 percent of the variation. In nation wide study in Ghana, Twum-Baah et al. (1994) observed that children born to women with higher education were found to have relatively lower childhood mortality rates. The study found evidence to support the presence of a real difference between the indices for women with primary education and those with middle school/JSS education. Results of the study indicate that about half (47%) of the respondents who were female had never been to school while the highest educational level attained by the majority of those who had ever been to school was middle/Junior Secondary School.

Mother's age at birth is also found to have great impact on the survival of her children. Lowest and highest parity births are found to have the highest risk of death. Tawiah (1979) in a study of some demographic and social differentials in infant and early childhood mortality in Ghana observed that the youngest and oldest mothers registered higher infant death rates of 14 percent and 95 percent respectively than mothers aged 20-24 years. The death rates rise monotonically after the 20-24 age group until an infant death rate of 145 infant deaths per 1000 live births is attained in the 45-49 age group. In other words, children born to youngest and oldest mothers are more likely to die than children born to mothers aged 20-24 years.

Gaisie (1979) examined mortality differentials by rural-urban residence in some African cities. His study found that, all the available mortality statistics compiled by international organisation and agencies, national institutions and individuals researchers showed quite clearly that urban dwellers have a higher life expectancy at birth than their rural counterparts. The study further revealed that most African cities have infant mortality rates of the order of 100 per 1000 live births whereas in the rural areas the rate often exceeds 200 per 1000 live births. In Ethiopia, child mortality as measured by ($_4q_1$) is higher in rural than in urban areas, although the difference is not as large as that observed among the Ghanaian population. Gyamfi (2002) observed that the type of place of residence is another socio-economic variable that maintained its significance as an independent determinant of infant mortality in the multivariate analysis. The analysis showed that children living in rural areas

are more likely to die in infancy than those in urban areas. The odds of experiencing infant death are 42 percent lower for urban dwellers compared to rural dwellers.

Twum-Baah et al. (1994) in an analysis of a nationwide survey for infant, child and maternal mortality found that infant and under-five mortality rates are significantly lower for urban areas than for rural areas. Whereas the urban areas in Ghana in 1992 recorded an infant mortality rate of 70 infant deaths per 1000 live births and an under-five mortality rate of 109 deaths per 1000 live births, rural areas had 86 and 138 deaths per 1000 live births for infant and under five mortality respectively. The differentials can be attributed to the disparities in favour of urban areas in the distribution of facilities necessary for maintaining adequate health. Gyimah (2004), in a study in Zambia on maternal education and infant mortality, found that the mortality risk of infants in the rural areas is different from that in the urban areas. Mothers who live in urban areas are 11 percent less likely to record infant deaths compared to rural mothers. Tettey (2003) in a study in Ghana and Nigeria observed that place of residence has a significant relationship with infant and child mortality in Ghana. The study showed that both infant and child mortality rates are higher in the rural areas; that is 67 deaths per 1000 live births than in the urban areas of Ghana – 43 deaths per 1000 live births. Apart from lack of medical care facilities for infants and children in rural areas, certain cultural practices, beliefs and norms also militate against infant and child survival.

In general, one can say that child survival is dependent on combination of several factors. It is certainly true that mortality rates are affected by poverty and economic deprivation. Personal income is unquestionably a basic determinant of survival and death. However, the quality of life of a person depends not merely on his or her personal income but also, on various physical and social conditions. For example the epidemiological atmosphere in which one lives can have a very substantial impact on morbidity and mortality. The availability of health care services, the educational level of the mother and access to modern medical knowledge to a very large extent determines child survival (Sen, 1998).

The Stalling Child Mortality in Ghana

The consistent decline in childhood mortality in Ghana in the 1990s has been halted and appeared to have been reversed. However, a comprehensive analysis and evaluation of Ghana DHS data for the four surveys (1988, 1993, 1998 and 2003) by Kiesrten and his colleagues (2005) exposed problems with the quality of data especially for 1998 data. Clear evidenced of heaping was noticed at reported age of 12 months, displacement of births and omission of births particularly in 1998. Heaping on age at death of 12 months was worse for 2003 than in

1998 data, which may have resulted in a slight underestimation of infant mortality in 2003. However, a correct estimation of childhood mortality levels in 2003 under these conditions would lead to false impression of an increase in mortality which appeared to be the case for in infant and under five mortality in 2003 GDHS report.

After analysis of trend of factors associated with the childhood mortality in Ghana, they found evidence to conclude that the apparent upturn in mortality seen in 2003 GDHS is largely a function of underestimated mortality in 1998 survey. On the basis of the above, they found no solid evidence of increase in mortality and therefore concluded that, "the past three GDHS surveys provide substantial evidence that mortality in Ghana has stagnated at very high levels" (Kiesrten et al ,2005).

Following the preceding analysis, it is convincingly established that, the increase in infant and under-five mortality in Ghana in the 2003 survey is not a real increase but due to the underestimation in 1998 DHS. However, the same cannot be said for the three northern regions of Ghana, which, though exhibit common socioeconomic and demographic features, show striking childhood mortality levels at least for 2003 GDHS.

1.6 HYPOTHESES

The study is to test the following hypotheses;

1. Mother's educational level is directly related to the survival of her children.
2. Children born to women in the rural areas have higher risk of mortality than children born to women in the urban areas.
3. Children born to women currently in union women have a higher survival rate than children born to women currently not in union.

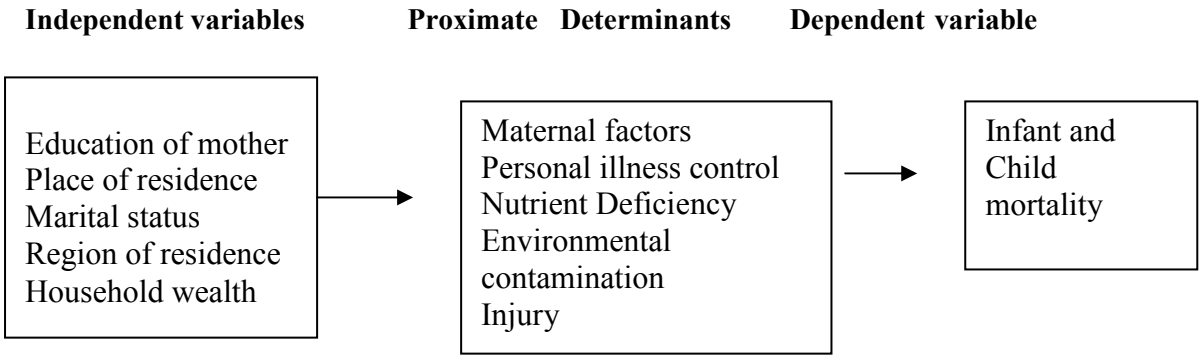
1.7 CONCEPTUAL FRAMEWORK

The study adapted the Mosley and Chen's conceptual framework for the analysis of how the selected socio-economic variables impact on infant and child mortality. And since the GDHS data upon which this study is based were not collected with the Mosley and Chen's framework in mind, modification of the original framework to suit the scope of the data is necessary, hence the modified version of the original framework.

The purpose of analytical framework in the study of child survival is to clarify our understanding of the many factors involved in the family's production of healthy children in order to provide a foundation for formulating health policies and strategies. The framework is based on the premise that all social and economic determinants of child mortality necessarily

operate through a common set of proximate determinants to exert an impact on child mortality

Figure 1.0: A modified form of Mosley and Chen's Conceptual Framework for Child Survival



Independent variables for the study are; mother's educational level, type of place of residence, the marital status of women, household wealth and region of residence. The proximate determinants through which these independent variables operate to impact on the infant and child mortality are; Maternal factors, Personal illness control, Environmental contamination, Nutrients Deficiency in both the mother and the child. However, only maternal the factors are considered in this study. The dependent variables are infant and child mortality.

1.80 METHODOLOGY

1.81 Data Source

Data obtained from the complete registration of births and deaths provide the best basis for the direct estimation of child mortality. Unfortunately, most African countries lack functioning vital registration systems. Estimates of childhood mortality in these countries are therefore largely based on cross-sectional surveys that collect complete birth histories from respondents. In a few cases, Longitudinal Demographic Surveillance Systems provide routine data for such estimations. Such systems typically track and record all vital events in a well-defined sample (geographic area) of a national population, they are however very expensive to establish and maintain and often cover a non-representative sample of nations which limits their usefulness. In the absence of such sources of data, indirect estimates of infant and child mortality levels and trends may be obtained from information on children ever-born and proportion surviving classified by five age of mother. This information has been widely

collected in censuses and surveys. The source of data for this study is Ghana Demographic and Health Surveys (GDHS, 1993-2003).

The Demographic and Health Surveys (DHS) programme is the world's largest survey, collecting information on mortality among infants and children and on health status and health service indicators. All the three surveys are nationally representative surveys comprising women age 15-49 and men 15-59. In the 1993 GDHS, 4,562 women and 1,302 men were interviewed. For 1998, 4,843 women and 1,546 men were interviewed while 5,691 women and 5,015 men were interviewed for 2003 survey. The 1998 and 2003 surveys used a two-stage stratified nationally representative sample of households for the data collection. With the exception of 1998 survey, the 1993 and 2003 surveys used the frame for Ghana Population Census as their sampling frame. Number of households interviewed for the respective surveys are; 5822, 6003 and 6251 for 1993, 1998 and 2003. All the three surveys (1993, 1998 and 2003) are consecutively the second, third and fourth surveys in the series of national level population and health survey, conducted as part of the global DHS programme. They are designed to provide data to monitor the population and health situation in Ghana (Ghana Statistical Service, 2004).

1.81 **Limitation**

1.82 **Data**

The infant and child mortality rates and demographic facts are derived from birth histories obtained from the mothers interviewed (women respondents). The DHS is however characterised with several limitations. Four types of errors can affect period's mortality rates such as those produced by DHS surveys: there can be omissions of births and or deaths, incomplete information on the date of birth or death, displacement of events in time due to misconception of the reference period, and misreporting of age at death. It is sometimes possible to detect these errors if they are systematic (Kiersten et al. , 2005). Omission of vital events is probably the most serious error occurring most frequently for children not living with their biological mothers and for children who have died, especially those who died many years before the survey date. Since women of reproductive age (15-49 years) are the basic sampling unit in these surveys, their premature death exclude their children from the survey.
Due to limited resources and capacity of the researcher, the study is focussed on only the three northern regions of Ghana and considered the selected socioeconomic and demographic determinants for the analysis. It did not analysed environmental, cultural and biological determinants of child mortality in Ghana.

1.82 Method of Data Analysis

The Brass and Trussell Technique, a variant of the original Brass technique for estimating levels of infant and child mortality were employed. Information required; data on children ever born and surviving classified by five age group of mother. Specific information for the computation: five-year age group of women, average number of children born alive ($P_{i\ t}$) to women (classified by five-year age group), average number of children dead, proportion of children dead ($D_{i)}$, multipliers for adjusting for the effects of age pattern of childbearing(K_i). The technique seeks to convert the proportion of children dead into life table probability of dying by multiplying the proportion dead by the adjustment factors K(i) as follows.

The basic Brass equation is given as:

$$q(x) = K(i) \times D(i)$$

Equation for the adjustment

$$k(i) = a(i) + b(i) \times \frac{p_2}{p_3}$$

Where "a" and "b" are constants and P_2 and P_3 are the mean parity for the age groups 20-24 and 25-29 respectively. The implied mortality levels and the expectation of life at birth for each of the study regions were determined using the Coale-Demeny model life tables. Bivariate and multivariate logistic regression analyses were used. The rationale for using the logistic regression is that, the dependent variables (Infant and Child mortality) are categorical variables, thus a child either dies or lives

PROFILE OF THE STUDY AREA AND BACKGROUND CHARACTERISTICS

2.1 INTRODUCTION

The study area is the savannah zone of northern Ghana and comprises Northern, Upper East, and Upper West regions. The zone covers 41 percent of the total land area of Ghana and makes an important contribution to the food supply of the country. It has a prolonged dry season and one rainfall season with average temperatures between 21^0C and 32^0C. The zone

is also characterised with low population density and the prevailing farming system in the sector can be described generally as subsistence farming with low or minimum external input. Despite the subsistence nature of its farming systems, it still accounts for 14 percent of the agricultural production in the country (GSS, 1995)

2.11 NORTHERN REGION

Northern region has the largest land area of the 10 regions in Ghana, (40%). About 70 percent of the working population are employed in subsistent agriculture whiles 10 percent are underemployed. The remaining 20 percent are economically inactive. Sixty percent of the male population are with little or no formal education and working in the agricultural sector. Access to health facilities in the region is 18 percent and being among the poorest in the country (CWIQ, 1997).

The population of the region, from 2000 National Population Census stands at 1,820,806 and represents about 10 percent of the national population of 18,912,079. Fifty percent (50%) of the population consist of females and 46 percent are under the age of 15 years. The gross primary enrolment rate for male is 73.7 percent and that of female is 57.2 percent. (GSS, 2000). The percent of women who can read and write in the region is 14 percent compared with the national literacy rates for men and women of 73 percent and 55 percent respectively. Northern region has the highest total fertility rate (TFR) in the country of 7.0, compared to the national figure of 4.4 (GDHS, 2003).

2.12 UPPER EAST REGION

The region is sparsely populated and has a total population of 920,089 with 52 percent of its population being females and 43 percent are under 15 years. The region has gross primary enrolment rate of 75 percent for male and 75 percent females. The population per doctor ratio in the region is 1:23,592, thus one doctor to about 24000 people compares with the national average of one doctor to about 9000 people (GSS, 2000).

The findings of 2003 GDHS indicate that 83 percent of women and 63 percent of men in the region cannot read and write while 17 percent and 37 percent of women and men are respectively literate. This compares with national literacy rates for men and women of 73 percent and 55 respectively. The TFR in the region is little above the national average of 4.4 that is 4.7

2.13 UPPER WEST REGION

The Upper West region is last of the three northern regions under study. It has population of 576,583 with 53 percent being females and 41 percent are under 15. The region has gross primary enrolment rate of 68 percent for male and 70 percent for females while enrolment at junior secondary school for males and females are 49 percent and 44 percent respectively (GSS, 2000).

The region has the highest TFR value of 5.5 after northern region in the country. It has the highest literacy rate among the three northern regions, thus 42 percent of men in the region are literate while only 24 percent of women are literate and the corresponding percentages that cannot read at all in the region are 58 percent and 76 percent respectively. About 75 percent of men in the active work force are employed in the agricultural sector. (GSS, 2004)

2.2 DATA EVALUATION

Data evaluation is an essential and fundamental step in any serious demographic analysis. It becomes even more indispensable when one is dealing with retrospective data from a developing country, which lacks compulsory and complete civil and vital registration systems. The evaluation provides analysts with the statistical basis for adjusting the observed or raw data and constructing plausible demographic parameters. The demographic data such as GDHS (1993, 1998 and 2003) on which this study is based, are not without errors. The presence of these errors make data from such surveys less effective for analysis and in order to overcome this limitation, it is important to identify these errors and their sources in order to make the data useful for the purpose for which they were collected. Knowledge on the type of errors guides the researcher to make appropriate adjustments to contain them, however in making the adjustment, care should be taken to ensure that only reported errors are minimised leaving any peculiarities in the data unaffected. In the sections that follow, the age data of respondents, data on children ever born, mean number of children surviving and average proportion of children dead shall be discussed. The evaluation is done separately for each of the three data sets (1993, 1998 and 2003).

Age Distribution of Respondents

2.22 Single Years

The evaluation of the age data is done in single years for all the three data sets using graphical method. The percentage distribution of respondents in 1993, 1998 and 2003 shows

a pattern of irregularities in age reporting in 1993 and 1998 data and an improvement of that in 2003 data. There is however evidence of more digit preference for ages ending in '0' and '5' and marked deficiencies for digits ending in '1', '7' and '9' in the 1993 and1998 survey data than in 2003. These findings confirm earlier findings by Kiesrten et al., (2005) of poor data quality with the 1998 survey data in their publication of "The Stall in Mortality Decline in Ghana". Thus, there is evidence of women reporting their ages ending in digits of "0" and "5". This reveals the extent of age misreporting and age heaping on ages ending in "0" and "5" such as ages; 20, 25, 30, 35, 40 etc instead of ages; 21, 27, 33 etc. See the appendix for graphs of the percent distribution of women on figure I.

2.23 Mean Children Ever Born

Generally, there is a positive relation between parity and age of mother, thus parity increases with the age of mother. Also, the proportion of male children borne by each group of women should be close to the proportion of females borne by the same group of women. It is therefore expected that the mean children ever born to women in this study follow this pattern. In order to determine whether the data for the study conform to the expected pattern, the mean number of children ever born by five-year age group of mother and sex of child has been computed by regions as shown in table 2.11(see Appendix).

A close observation of the data across the regions and for the three years shows that, the average parities for the three regions follow the expected pattern for parity and age more so, the proportion of male children borne by each group of women is almost the same as proportion of female borne by the same women across the three data sets and by the three regions. However, a closer look at the 1998 data for Upper East region revealed some irregularities at age groups 40-44 and 45-49 for average parities for females. The same irregular pattern occurred in 2003 data set for the same age groups 40-44 and 45-49.

Upper East region for the same 1993 and 1998 data sets. For instance in 1993, there has been heaping of female dead at age group 30-34 and at age group 40-44 in the 1998 data set. Evidence of heaping on reported age at death on month 12 is established in the further analysis of GDHS data. it is found that there are 2-3 times more reported deaths at the age of 12 months than expected (Kiesrten et al, 2005). Thus, suggesting an under reporting of infant mortality rate.

PATTERNS AND LEVELS OF MORTALITY

3.1 Determination of Age Pattern of Mortality

Accurate measurement of mortality levels is important to demography not only because mortality is one of the three population dynamics, but also because erroneous mortality measures will lead to wrong policy recommendations and inappropriate intervention strategies. There are two basic ways of obtaining infant and child mortality rates: direct and indirect methods. The direct methods are based on either vital registration or dated vital events from retrospective birth histories, and the indirect method uses number of children ever born and the proportion dead, classified by five-year age groups of mother. Although based on two different forms of data and although the assumptions underlying them differ, both direct and indirect methods are expected to give estimates of infant and child mortality that approximates the true level, given accurate data. Even if the data available were not very good, indirect methods are expected to work well in, situations where data are defective. With no complete vital registration system in Ghana, studies on child mortality in Ghana make use of the indirect techniques to estimate the mortality levels. This paper therefore used the indirect techniques to estimate child mortality in the study area.

The use of indirect techniques for estimating levels of mortality in countries that lack accurate demographic data requires that appropriate age patterns of mortality be chosen among a set of model life tables. This is based on the assumption that the unknown pattern of mortality of the population under study is similar to one of the tabulated patterns of model life tables. The commonly used model life tables include; Coale –Demeny (1983), the United Nations (1982) and the Brass Logit System (1971) and recently, the INDEPTH (International Network for continuous Demographic Evaluation of Population's Health) model life tables. These are developed from empirical mortality life tables from 19 Demographic Surveillance Systems (DSS) sites in Africa and Asia (INDEPTH, 2002). However, in terms of application, perhaps the most widely used model life table system has been the Coale–Demeny regional

model life tables (Coale and Demeny 1966). First published in 1966, they were derived from a set of 326 life tables for both sexes from actual populations. Four typical age patterns of mortality were identified, determined largely by the shape of their mortality schedules (corresponding to the geographical location of the population), but also on the basis of their patterns of deviations from previously estimated regression equations. Those patterns were called: North, South, East, and West (Murray et al, 2003 p: 167). The Coale-Demeny Model life tables are the widely used in estimating mortality levels in developing countries because of the flexibility and relative simplicity in entering the life tables, although non of these life tables, except the INDEPTH, fairly represent the African population. The characteristics of the four families are described in the next paragraph.

The North family is characterised by relative low infant mortality, high child and low old age mortality rates beyond age 50. The South model has high mortality pattern characterised by (a) high child mortality rate in relation to infant mortality at high overall mortality,(b) low child relative to infant mortality at low overall mortality. The East family model is characterised by high child mortality in relation to infant mortality. The last family model, which is the West model, is characterised by a pattern intermediate between the North and the East patterns. Because this model is derived from the largest number and broadest variety of cases, it is believed to represent the most general mortality pattern (Murray et al nd). Coale-Demeny recommends its use when no information on the age pattern of mortality is available for the population under study.

The North family of the Coale-Demeny model life tables has been identified as most appropriate for the mortality situation in sub Saharan Africa and has therefore been widely used. The choice of the north family for sub-Saharan Africa stems from two considerations. First, information from hospital records on infant and childhood mortality in this area indicates very high infant and childhood mortality, with childhood mortality being relatively higher than infant mortality. The second reason is that, because of the universal duration of more than one year breastfeeding practices, the expectation was that the contribution of malnutrition and infectious diseases to infant mortality would be reduced but the effect of these would be significant after weaning, leading to relatively high childhood mortality (Gyamfi, 2002). Ramachandran et al. (1979) have also lent support to the North model pattern as the best fit for countries in sub-Saharan Africa. To them, available information on the age distribution of death and causes of death tended to suggest the North pattern for most of the countries of sub-Saharan Africa.

The Coale–Demeny models life tables has been found to be more suitable and employed in most infant, child and under five mortality estimation studies. For instance, Bawa (1995) and Gaisie (1976) confirmed that the north family model was best suited for Ghana. However, Gyamfi (2002), using GDHS 1998, found that contrary to the above confirmation, the East family model best suits Ghana. This study attempts to determine the appropriate family model from the four families that suits the mortality patterns of each of the three northern regions (Northern, Upper East and Upper West) of Ghana.

The study used a 3-stage procedure to select the mortality pattern that best suits the mortality pattern of each of the study regions. The stages are:

(i) Mortality Levels Implied by l_x values method

(ii) Expectation of life at Birth method

(iii) The Absolute Mean Deviation methods using a selected entry point.

If any of the four families of the Coale-Demeny model life tables is identified by at least any two of these stages, that family is deemed appropriate to represent the mortality patterns of the population (region) under study.

3.2 Adjustment for Declining Fertility

The application of Brass method of indirect mortality estimation is on the assumption that fertility and mortality is constant in the recent past. Fertility in the Ghanaian population and the study area in particular, has not been constant for the past decade, making the Brass indirect mortality estimation method inappropriate. This calls for adjustment in the changing fertility situation to be able to accurately estimate the multipliers. If fertility has been changing in the recent past, the observed parity ratios used as independent variables when estimating the multipliers (ki) may not reflect adequately the true experience of cohorts in the population, and hence the resulting multipliers may not be suitable for mortality estimation. A method proposed to address this problem of declining fertility is the Coale- Trussell method of mortality estimation. The method takes into account the experience of true cohorts when estimating the multipliers.

In this method, child survival data from two surveys, five-years apart, are used to determine the parity ratios for true cohorts. The study makes use of data on the children ever born and children dead by five-year age groups of mother. Child survivorship data for GDHS 1998 and 2003 have been used in calculating the parity ratios for adjusting for changes in fertility. The calculations are done for each of the regions as shown on Table 3.2. Since the two surveys are five-years apart, parity ratios have been computed using $P_1(1998)/ P_2(2003)$. The table 3.2 (see

Appendix) shows the procedure for calculating the parity ratios for the two successive surveys for age groups 20-24 to 35-39.

As observed from the formula used in calculating the parity ratios, it does not permit the calculation of parity ratio for age group 15-19. Therefore, the only parameters that can be estimated using this method are q_2, q_3, q_5 and q_{10}. Thus parity ratios can only be calculated for age groups 20-39 when the Coale-Trussell variant method is used. These parity ratios are then used in calculating the multipliers, ki using the relation;

$$Ki = ai + bi\frac{P(i-1,1)}{P(i,2)}$$

where a_i and bi are appropriate coefficients and P(i-1, 1)/P(i, 2) are the parity ratios. The multipliers are then employed to adjust the proportion dead of children ever born, to obtain the probabilities of dying at specified ages and consequently, the implied levels of mortality.

3.3 Determination of Mortality Pattern

3.31 Mortality Levels Implied by l_x values Method

The application of this method requires computation of q_x values using the cohort parity ratios and the proportion dead of children ever born corresponding to the four families of the Coale-Demeny Model Life Tables. It must be noted that, the probabilities of dying were based on the adjusted multipliers (ki). The level of mortality implied by the probabilities of dying at ages 2, 3, 5, and 10 are then derived for each of the four families of the Coale-Demeny Model Life Table System. The range is calculated for the implied level and the family with the least range is considered suitable for representing the mortality pattern of the regions concern. The computations are shown on table 3.3(Appendix). The East family mortality pattern is found to best fit all the three regions with the least range of mortality levels of 1.5 for Northern region, 3.2 for Upper West region and 3.9 for Upper East region.

3.32 Expectation of life at Birth Method

The expectation of life at birth (e_0^0) implied by the probabilities of dying from birth to exact ages 2, 3, 5, and 10 are computed for each of the four families of the Coale-Demeny Model life tables by regions. The range of the implied expectation of life at birth is found for each of the four families and also, by the regions. The family with the minimum range is considered suitable for the population of the region under study. The result of the computation is presented on table 3.4 (see Appendix). East family mortality pattern is again

identified as being the best fit for all the three regions with minimum range of 3.6, 7.9 and 9.4 respectively for Northern, Upper West and Upper East regions.

3.33 Selection of Mortality Pattern by Mean Absolute Deviation Method.

The method is based on the selection of an appropriate entry point into the four families of model life tables. The implied probabilities of dying at exact ages 2, 3, 5 and 10 are divided by the Coale-Trussell multipliers derived from the average of the multipliers for age groups 25-29 and 30-34 to get the expected children dead. The procedure is repeated for each of the four families and then for each of the three regions. The results are then subtracted from the observed proportion dead of children for each age group of mother to derive the absolute deviation of the proportion of children dead. Finally, the mean absolute deviation is then calculated for each of the Coale-Demeny families. The family with the least range of mortality level fits the mortality pattern of the region concerned(See Excel sheet 3).

The East family model has a consistent least range of implied mortality level, expectation of life at birth, and mean absolute deviation method for all the three regions. This implies that, the actual mortality pattern in the three regions are similar to that of the Coale–Demeny East family model. This confirms findings by Gyamfi(2002) for the East family mortality pattern for Ghana. Therefore, all other estimates that will be done for all three regions will be based on the East family Model.

3.4 Levels of Child Mortality

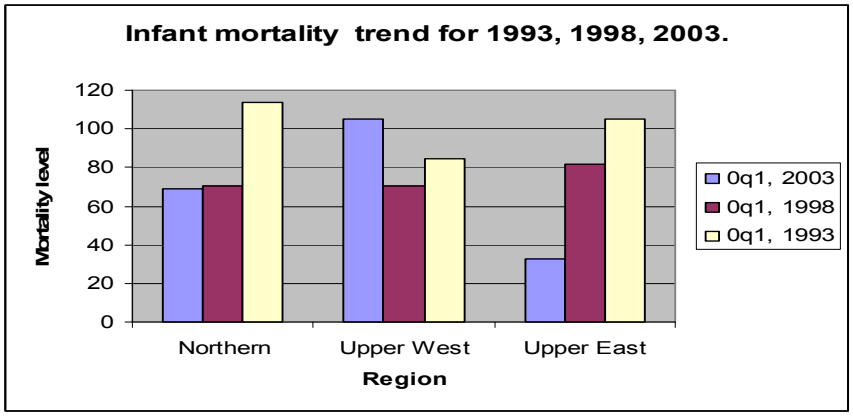
As stated earlier, the Coale–Demeny Model life tables suggested by the three methods for selecting the age pattern of mortality for all the three regions is the East family. Table 3.8 (see Appendix B) shows the mortality levels, expectation of live at birth and the reference dates for the corresponding probability of dying at exact age x, q(x) values.

The implied Mortality level for the East family for each age group and for each region is shown in column 5 of Tables 3.8. The average mortality levels for the population in the regions are 15.7, 13.4 and 20.1 and it is based on the age groups 20-39 since the reporting of children ever born and children dead were found to be slightly better for ages under 40 years during the evaluation. Upper West had the lowest expectation of life at birth of 49.2 years over the study period, with Upper East having the highest of 65.5, followed by Northern region. The reference dates to the age specific mortality levels are indicated on column 8 of the table.

3.31 Trend Analysis of Infant and Child Mortality by Regions.

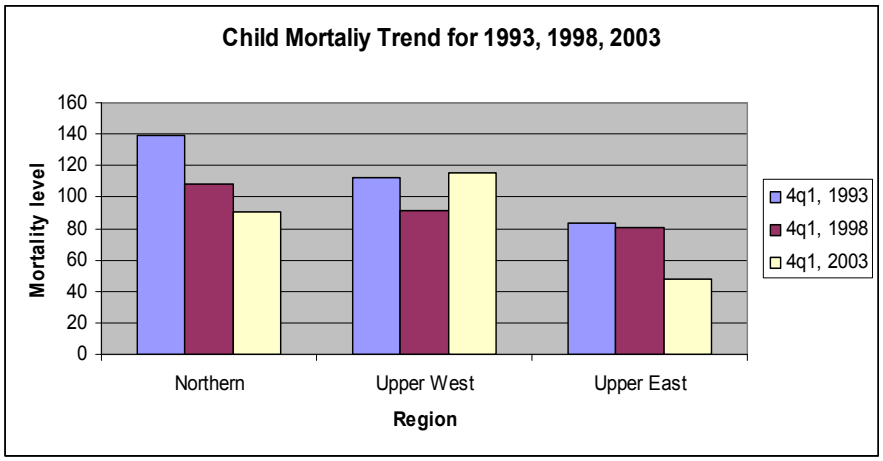
Figure 4.0 presents direct estimates of infant and child mortality for the three regions from the Ghana Demographic and Health Surveys (1993, 1998 and 2003).

Figure 4.0 DHS estimates of infant mortality by region



Infant mortality rate for Northern region for the three surveys 1993, 1998 and 2003 years are 113.7, 70.1 and 69 infant deaths respectively per 1000 live births. The mortality rate declined by 38.3 percent between 1993 and 1998 and further declined by 1.6 percent to 69 in the period 1998 - 2003. The overall declined for the 10-year (1993-2003) period is 39.3 percent. For the Upper West region, the rate was 84.5 infant deaths per 1000 live births in 1993 and declined to 70.6 by 16.4 percent in 1998. There was however a sharp rise in the mortality rate from 70.6 in 1998 to 105 per 1000 live births in 2003 by 48.7 percent as shown in figure 4.0. For the period 1993 – 2003, there has been an over all rise in mortality rate by 24.3 percent. Unlike the Upper West, there has been a general declined in infant mortality over the 10-year period in the Upper East region. The infant mortality rate of 105.1 per 1000 live births in 1993 declined to 81.5 in 1998 by 22.5 percent and further declined to 33 percent in 2003 by 59.5 percent. The overall percentage decline for the 10-year period is 68.6 percent. The region recorded the highest decline in infant mortality among the three regions for the period of study.

Figure 5.0 **DHS estimates of Child mortality by region**

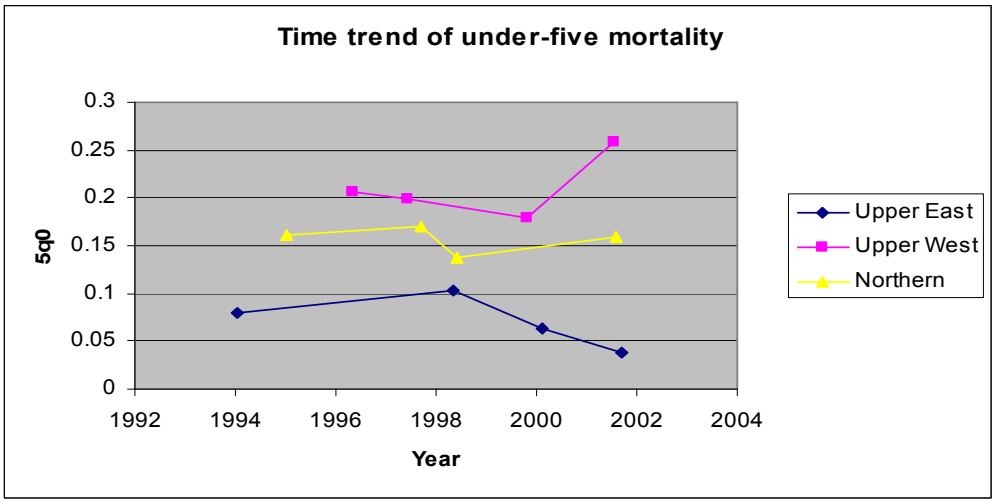


With regards to child mortality, there has been a general decline in both Northern and Upper East regions. In the Northern, for 1993, the child mortality rate was 139.1 per 1000 live births and declined to 108.8 in 1998 by 21.8 percent and further declined to 90 in 2003 by 17.3 percent as shown on figure 5.0. The overall percentage decline for the last decade (1993-2003) is 35.3 percent. The child mortality rate for the Upper East region in 1993 is 83.9 child deaths per 1000 live births and declined to 80.8 per 1000 live births in 1998 by 3.7 percent. There was a significant further decline in 2003 by 40.6 percent to 33 per 1000 live births. Similar pattern of mortality as indicated earlier is observed in the Upper West region in the period 1993-1998. The mortality rate of 112.7 in 1993 declined to 91.5 in 1998 by 18.8 percent. There was however, a sharp rise in mortality in 2003 by 23.5 percent as shown in figure 5.0.

The general decline in both infant and child mortality in the Northern and Upper East regions could be attributed to increased number of health interventions programmes by non-governmental organisations (NGOs) as well as the district assemblies in the respective regions. The presence of child health intervention programmes by Navrongo Health Research Institute (Demographic Surveillance System) site in Kasena Nankana District of the Upper East region is an additional and most important reason for the significant fall in both infant and child mortality in the region and its being the lowest among the three regions. The sharp rise in both infant and child mortality in Upper West region could be attributed to the smaller number of NGOs running health intervention programmes in the region. Another reason and perhaps the most important is the fact the region remained the poorest in the country, where, 9 out every 10 persons in the region are poor.

Direct estimates from all the three regions show a higher child mortality rates relative to infant mortality rates as shown on figures 4 and 5, thus conforming to the mortality pattern of the East model of Coal-Demeny model life tables as identified earlier.

Figure 6.0 Indirect Estimates of Infant, Child and Under-five Mortality rates



The time- trend of under-five mortality estimates on figure 6, are computed on the assumption that, the estimated implied mortality levels for each region is applicable to all ages. Upper West region shows a steep rise in probability of dying for children between birth and age five in the region after 2000. This is closely followed by a relatively gentle rise in probability of dying under age five in Northern region, where the rise in the probability of dying started 2 years earlier(ie. 1998). Upper East is experiencing a dramatic fall in probability of dying by children under the age of five years after 1998. Besides Upper East region, the estimates for Northern and Upper West 2001 are more than the DHS estimates in 2003, this suggest an evidence of under estimation in the DHS since there is evidence that there is rising trend in under-five in these regions. The under-five mortality estimates from DHS 2003 for Northern and Upper West regions are 154 and 208 per 1000 live births respectively and 79 for Upper East. However, the indirect estimates of probability of dying before age five in mid 2001 for the three regions are 158, 258 and 37.

ANALYSIS OF THE SELECTED SOCIO-ECONOMIC DETERMINANTS OF INFANT AND CHILD MORTALITY

4.1 Introduction

Differences in infant and child mortality are always observed among different social groups of women. These differences could be attributed to differences in socio-economic characteristics. The study considered the following socio-economic factors: type of place of residence, marital status, level of education of the mother and region of residence. According to Mosley and Chen(1984), these socio-economic determinants operate through proximate determinants to influence the incidence of both the infant and child mortality. This section examines the impact of the selected socio-economic factors on the infant and child mortality by regions (Northern, Upper East and Upper West). Demographic variables such as sex of child, age of mother at birth of the child and birth order of child are also examined as confounding factors to the socio economic determinants. The unit of analysis in this study is the child and it is based on ten-year birth cohort (1993-2003).

4.2 BIVARIATE ANALYSIS

In this section, both infant and child mortality rates have been tabulated according to the selected socio-economic characteristics of interest to the study as well as the confounders. This is aimed at examining differentials, if any, in both infant and child mortality among the selected socio-economic variables and to ascertain the relative importance of the variables as the determinants of infant and child mortality.

Tables 4.1 and 4.2(see Appendix)

4.21 Level of Education of Mother

Mothers' educational attainment have been categorised into two for this study, namely no education and primary and higher education. As generally expected, there is considerable decline in infant mortality as mother's educational attainment increases. However there exist marked differentials among the regions. The greatest differential is shown in the Northern region. Infants born to women with no education are almost three times more likely to die (71 per 1000 live births) before age one than infants born to women

with primary and higher education (28 per 1000 live births). This could be due to the fact that as earlier stated; about 80 percent of the women in the childbearing age in the Northern region have no education. Children born to women in the Upper West region are two times more likely to die (70 per 1000 live births) before attaining age one than their counterparts born to women with primary and higher education (36 per 1000 live births). There is a small difference in mortality between women with no education and women with primary and higher education in this region.

On the child mortality, the Northern region still registered a remarkable differential between children born to women with no education and children born to women with primary and higher education. From table 4.2, children born to women with no education in the Northern region, are six times more likely to die than children born to women with primary and higher education, (87 per 1000 live births compared to 14 per 1000 live births). The implications are that, lack of improvement in the level of educational attainment for women accompanied by improvement in the survival chances of infants. This is because educated mothers tend to have a better understanding of diseases and health processes and are able to seek medical attention in time and on regular basis. Also educated mothers are more likely to have a steady source of income since high education is associated with good and well-paid employment.

In the Upper West region, children born to women with no education are more than two times likely to die (73 per 1000 live births) than children born to women with primary and higher education. In the Upper East region, the differential in the child mortality is still small thus (58 per 1000 live births) for women with no education as compared to (46 per 1000 live births) for women with primary and higher education.

4.22 Type of Place of Residence

Type of place of residence is considered as one of the important factors in infant as well as in child mortality. The results from table 4.1 show some level of significance in the rural-urban factor in determining the infant mortality across the regions. For instance, the region that shows the greatest significance is Upper East region, where infant mortality in the rural areas is almost twice (83 per 1000 live births) as high as in the urban areas (49 per 1000 live births). This confirms the observation made by Gyamfi (2002) that infant mortality in the rural areas is almost twice as high as in the urban areas in Ghana.

Almost the same pattern is observed in the Upper West region where infant mortality in the urban areas is 45 per 1000 live births as compared to 70 per 1000 live births in rural areas.

Northern region shows the least of such differences with infant mortality of 52 per 1000 live births in the urban areas and 69 per 1000 live births in the rural areas in the region.

On child mortality, Upper East region still shows similar patterns in urban-rural settings. The child mortality in the rural area is twice (58 per 1000 live births) as high as in the urban area (26 per 1000 live births). However, different pattern of mortality is indicated in the Northern region where child mortality in the urban areas is higher (83 per 1000 live births) than in the rural areas (78 per 1000 live births). This could be attributed to higher nutritional deficiencies in the children as well as increased environmental contaminations.

4.23 Marital Status

The marital status in this study is categorised into currently in union and currently not in union due to the fact that the cases for the respective categories as captured in the GDHS were so small. The results from table 4.1 indicate that infant mortality with women not in union is almost twice as high as women currently in union in both the Northern and the Upper East regions. However in the Upper West region, the reverse is the case. Children born to women currently in union have higher chances of dying (69 per 1000 live births) than their counterparts born to women currently not in union (48 per 1000 live births) before reaching age one.

Concerning child mortality, the pattern in the Northern region is not different from that in the infant mortality. Children born to women who are currently not in union are almost two times more likely (115 per 1000 live births) to die than children born to women who are currently in union (77 per 1000 live births) in the region. These results are consistent with findings from a study in Ghana by the UN (1983). The possible explanations for these results according to the UN are that; socio-economic status is higher among married women than any marital category as a result of higher family income. Widowhood and divorce are associated with substantial stress both economic and social, which in turn affect infant health and survival. However, in both Upper West and Upper East regions, the pattern of child mortality is different. Children born to women currently in union have higher chances of dying than children born to women currently not in union in the Upper West region. This means that marital status is not a determinant of child mortality in the two regions from the results. The determinant of the child mortality in these regions could be attributed to other factors not investigated by this study.

4.24 Demographic Characteristics

Three demographic factors have been considered in this study. They are; the age of mother at birth of child, sex of child and birth order of child. These variables have some relationship with infant survival and could confound the relationship between infant and child mortality and the selected socio-economic characteristics. For these reasons, they have been controlled for. Due to the few cases of infant mortality rates, for other sub categories of the age of mother, the age of mother at birth of child is collapsed into less than 20 years and 20 years and above.

The result from the table 4.1 shows a similar pattern of infant mortality in both Upper West and Upper East regions. In the Upper West region, children born to women less than 20 years old at birth are almost three times (156 per 1000 live births) more likely to die than children born to women 20 years and above (63 per 1000 live births). While in the Upper East region, children born to the former are two times (143 per 1000 live births) more likely to die than children born to the latter. However in the Northern region, the opposite is the case. Children born to women 20 years and above at birth are more likely to die (68 per 1000 live births) than children born to women less than 20 years (48 per 1000 live births). In all, Upper West has the highest infant mortality for children born to women less than 20 years at births.

Regarding child mortality, the Upper West and Upper East regions still exhibit the same earlier pattern of mortality, thus children born to women less than 20 years old are several times more likely to die than children born to women 20 years and over. In the Upper West region, the ratio is 4:1 whereas in the Upper East, it is 2:1.

On the sex of child, male children generally experience slightly higher mortality during infancy and childhood than the female children. Evidence from demographic literature attributes the excess mortality among male children mostly to their higher biological risks during the first year of life. From the table, the infant mortality for males in the Upper East region is higher (84 per 1000 live births) than females (74 per 1000 live births). This confirms the above observation. However in the Northern and Upper West regions, the pattern is different. In these regions, infant mortality for females is higher than for males. With reference to child mortality, in all the three regions, there is higher mortality for males than for females thus, conforming to the earlier observation that male children have higher biological risk of dying than the female children. For instance, in the Upper East region, male children have higher risks of dying than the female children (69 per 1000 life births) against (42 per 1000 live births).

With birth order, generally the first and higher order births (7^{+}) experience high mortality than the middle order births. From table 4.1, Upper East region has the highest infant mortality for birth order 1 among the three regions, suggesting an early chid bearing, while the Upper West region has the highest infant mortality for the seventh order births. Northern region however has the highest infant mortality at the second and third order births.

4.3 MULTIVARIATE ANALYSIS

Logistic regression model is used for the multivariate analysis. It is an appropriate model for multivariate analysis when the dependent variable is dichotomous. The dependent variables in this study are infant and child mortality. The dichotomous nature of the dependent variables is; for the infant, the child either dies before attaining age one or not. For the child, a child dies between ages 1 and 4 or survives. As a probability, it must lie between 0 and 1. The standard logit model used is of the form:

$$\log_e\left(\frac{p_i}{1-p_i}\right) = x_i\beta_i$$

where P_i represents the logit transformation of survivorship status, x_i represents the independent variables and B_i is a vector co-efficient related to specific independent variables. In short, the logistic regression estimates the log of the odds of the outcome occurring, in terms of a vector of independent variables and an error term.

The Statistical Package for Social Sciences (SPSS for windows) was used for the analysis. The summary results of the logistic regression analysis are presented in Tables 4.3 and Table 4.4 for infant and child mortality respectively. From the multivariate logistic regression, the most statistically significant determinant of infant mortality is birth order, followed by marital status. The rest of the variables are not statistically significant. The marital status of the respondents shows some degree of statistical significance in determining infant mortality. Women currently not in union are the reference category. From the table, children born to women currently not in union have higher chances of dying before age 1. The odds ratio for women currently in union is 1.8. This means that, children born to women currently not in union are 1.8 times more likely to die before age 1 than children born to women currently in union.

The reference category with for the birth order variable is birth order 1. The results show that children born at birth order of 4-6 are 42 percent less likely to die than children born at birth order of 1. This finding confirmed the earlier observation at the bivariate

analysis that revealed that first order birth experience higher infant mortality than the other births categories.

The results from the regression show higher infant mortality of children born to women living in the rural areas than for women living in the urban areas. The odds of dying in the rural area are 1.4 times higher than in the urban areas. This finding, though not statistically significant, has proved the second hypothesis of the study that children born to women in the rural areas have higher risk of mortality than children born to women in the urban areas.

Table 4.3 Parameter Estimates for Infant Mortality Using logistic Regression(Based on ten-year birth Cohort)

Variable Category	B	S. E.	Sig. Level	Odds Ratio	95% C.I. for Exp (B)	
Birth order of Child					**Lower**	**Upper**
1(R)						
2nd-3rd	-0.384	0.241	0.111	0.681	0.425	1.092
4th-6th	-0.546*	0.252	0.03	0.579	0.354	0.95
7+	-0.259	0.298	0.385	0.772	0.43	1.385
Sex of Child						
Male (R)						
Female	-0.041	0.169	0.807	0.96	0.689	1.337
Level of Education of Women						
No education (R)						
Primary and higher	-0.424	0.294	0.149	0.654	0.368	1.163
Marital Status						
Currently in union (R)						
Currently not in union	0.591*	0.305	0.052	1.805	0.994	3.279
Type of Place of Residence						
Urban (R)						
Rural	0.307	0.352	0.383	1.359	0.682	2.709
Age of Mother at Birth of child						
<20 yrs (R)						
20+ yrs	-0.225	0.313	0.472	0.799	0.433	1.474
Region of Residence						
Upper East (R)						
Northern	0.04	0.23	0.863	1.041	0.551	1.23
Upper West	0.195	0.205	0.342	1.215	0.567	1.293

*P<0.05 R= reference category

The level of maternal education is the only significant determinant of child survival for this study. The reference category for the level of education is no education. The odds

ratio from Table 4.4 shows that children born to women with primary or higher education are 46 percent more likely to survive than children born to women with no education in the three regions under study. This conforms to the bivariate analysis across the three regions.

Table 4.4 Parameter Estimates for Child Mortality Using logistic Regression (Based on ten-year birth Cohort)

Variable Category	B	S.E.	Sig. Level	Odds Ratio	95% C.I. for Exp (B)	
Birth order of Child					**Lower**	**Upper**
1(R)						
2nd-3rd	-0.109	0.288	0.704	0.896	0.51	1.577
4th-6th	0.07	0.292	0.809	1.073	0.605	1.902
7+	0.218	0.338	0.518	1.244	0.641	2.413
Sex of Child						
Male (R)						
Female	-0.26	0.184	0.156	0.771	0.538	1.105
Level of Education of Women						
No education (R)						
Primary and higher	-0.787*	0.363	0.03	0.455	0.224	0.926
Respondents Marital Status						
Currently in union (R)						
Currently not in union	-0.045	0.437	0.918	0.956	0.406	2.252
Type of Place of Residence						
Urban (R)						
Rural	0.064	0.34	0.852	1.066	0.547	2.076
Age of Mother at Birth of child						
<20 yrs (R)						
20+ yrs	-0.604	0.347	0.082	0.547	0.277	1.079
Region of Residence						
Upper East (R)						
Northern	0.32	0.221	0.149	1.377	0.892	2.125
Upper West	0.202	0.234	0.388	1.224	0.774	1.937

* = P <0.05 R= reference category

From the multivariate analysis, only few socio-economic variables showed some level of statistical significance in measuring both infant and the child mortality. Regarding infant mortality, marital status and birth order came out as significant determinants in all the three northern regions, while with respect to child mortality, only the level of education of mother appeared as the most significant determinant of child mortality in the study area. This finding has confirmed the findings by Das Gupta (1997) in her study of socio-economic status and clustering of Child deaths in rural Punjab. She found that Mother's education is a powerful factor that affects the clustering of child deaths. Significant heterogeneity in child mortality was found among uneducated women but not among the educated women.

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The evaluation of the age data revealed preference for digits ending in '0' and '5' resulting in noticeable age heaping at such ages. The Data also showed avoidance for digits ending '1', '7' and '9' resulting in age shifting at such ages. These preference for and avoidance of digits was more noticeable in the 1993 and 1998 data sets than in 2003. The data was grouped into five years age groups of women in order to contain the errors.

East family of the Coale-Demeny Model life tables was found to best represent the mortality experience of all the three regions. The average mortality levels for Northern, Upper West and Upper East regions are 15.7, 13.4 and 20.1 respectively. The implied expectation of life at birth for both males and females based on the average mortality levels in all the three regions are 54.5, 49.2 and 65.5 years. The estimates of the under-five mortality from the indirect techniques are higher than the direct estimates from the DHS, suggesting an under estimation by the DHS. This is not unusual since most indirect estimates are lower than the direct estimates.

From the bivariate analysis, among the selected socio-economic variables, type of place of residence across the regions consistently showed the highest differentials in both infant and child mortality. On the level of education of the women, Northern region consistently showed the highest differentials in both infant and child mortality among the three regions. Children born to women age less than 20 showed the highest differentials in both Upper East and Upper West regions. From the multivariate analysis, variables such as; educational level of mother, marital status, birth order of child and to some extent, type of place of residence are found to be statistically significant determinants of child survival in the three northern regions.

5.2 Recommendations

In line with the findings, a number of recommendations aimed at further reducing both infant and child mortality in the three Northern regions in particular and the country at large are made. The relationship between socio-economic factors and infant and child mortality in the three Northern regions suggest that children are more likely to die if their mothers are living in the rural areas, born to women currently not in union or if they happened to be first births or the seven and higher births of their mothers.

The problem of high child mortality in the rural areas of the three northern regions is a reflection of the lack of health facilities and personnel. To improve on the health facilities in the rural areas as a way of reducing infant and child mortality, the policy makers must ensure that there is equitable and proportional distribution of resources to all geographical locations whether urban or rural in the country. These could include maternal and child health services to be rendered by qualified personnel. Information on basic good health practices should be communicated to rural women in their local dialects.

Girls should be encouraged to go to school up to at least secondary level. This will first of all increase age at first birth and therefore reduce child deaths at first birth order. It will also increase the survival of their children since child survival is found to increase with maternal age and level of education in the study area.

Finally, for further studies, looking at the gap between the direct and indirect estimates, the researcher recommends the use of more appropriate life tables such as model life tables from the INDEPTH in such analysis. This is likely to yield more plausible estimates since they are constructed from empirical life tables from Africa and Asia populations. It is also recommended that larger samples of primary data on infant and child mortality be collected in the three northern regions to be able to measure the impact of socio-economic factors on both infant and child mortality. This will guide the policy makers in adopting the appropriate strategies to reduce the infant and child mortalities in the northern regions and the whole country at large.

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APPENDIX

Figure I. Percent Distribution of women in 1993, 1998 and 2003 surveys.

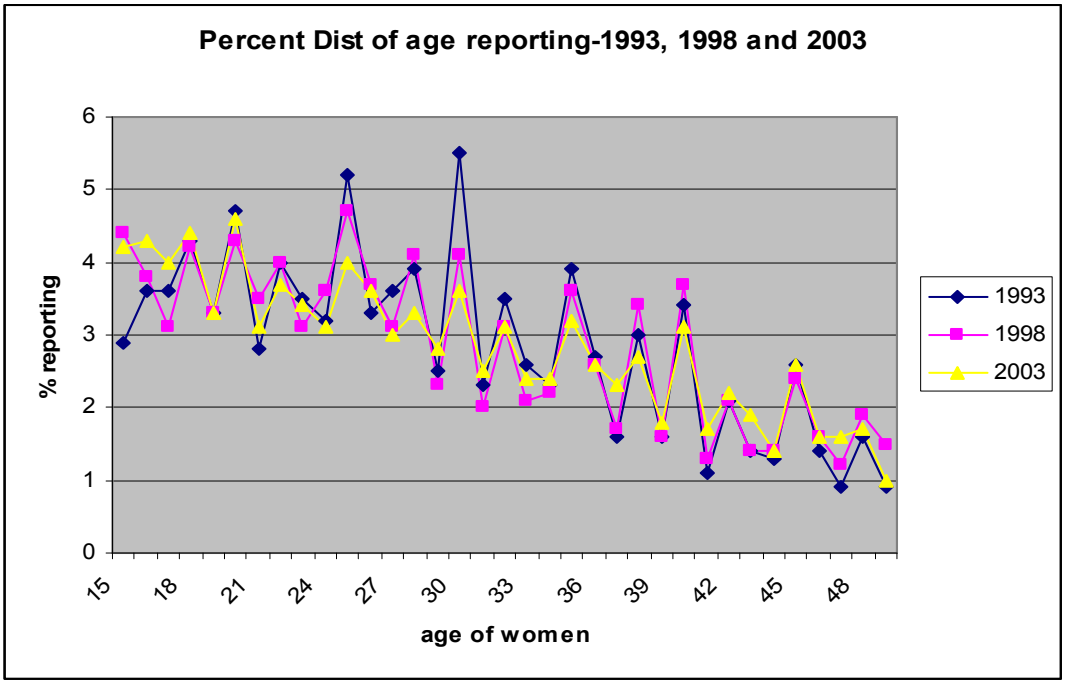

Table 3.2 Calculation of Parity Ratios Using 2 Surveys, Five Years Apart.

Age Groups Region	Exact Age x	Parity ratios for two successive surveys P(i-1,1)/P(i,2)*	Actual Parity Ratios**
Northern			
20-24	2	P(1,1)/P(2,2)	0.0960
25-29	3	P(2,1)/P(3,2)	0.6102
30-34	5	P(3,1)/P(4,2)	0.6177
35-39	10	P(4,1)/P(5,2)	0.7693
Upper West			
20-24	2	P(1,1)/P(2,2)	0.0999
25-29	3	P(2,1)/P(3,2)	0.3990
30-34	5	P(3,1)/P(4,2)	0.6439
35-39	10	P(4,1)/P(5,2)	0.6802
Upper East			
20-24	2	P(1,1)/P(2,2)	0.0723
25-29	3	P(2,1)/P(3,2)	0.3497
30-34	5	P(3,1)/P(4,2)	0.5551
35-39	10	P(4,1)/P(5,2)	0.8381

*UN Manual X. **Computed by Author from GDHS 1998 and 2003 data files

Table 2.11 Mean Number of Children Ever Born by Age of Mother, Region and Sex of Child: 1993, 1998 and 2003

	1993				1998				2003			
Age group	Total Children Ever Born	Average Parities		Total	Total Children Ever Born	Average Parities		Total	Total Children Ever Born	Average Parities		Total
Region	**TCEB**	**Male**	**Female**		**TCEB**	**Male**	**Female**		**TCEB**	**Male**	**Female**	
Northern												
15-19	66	0.1061	0.0758	0.23	32	0.1037	0	0.12	76	0.036	0.0896	0.17
20-24	68	0.5735	0.04118	1.19	42	0.6704	0.6407	1.44	75	0.5327	0.567	1.26
25-29	88	1.0455	1.1023	2.67	42	1.0689	0.9932	2.42	104	1.0686	0.9726	2.36
30-34	77	1.5455	1.5325	3.96	45	1.617	1.6387	4.08	90	1.7641	1.5058	3.92
35-39	60	2.0833	2.15	5.57	22	2.3956	2.0634	5.28	84	2.2494	2.1726	5.3
40-44	47	2.5745	2.5957	6.91	25	2.1041	2.4334	6.26	37	2.6055	2.2741	6.34
45-49	38	2.8158	2.9211	8.08	26	2.69	2.4033	7.03	34	2.91	2.4885	7.08
Total	444	1.3739	1.3739	3.61	234	1.3818	1.3244	3.43	499	1.3962	1.2766	3.26
Upper West												
15-19	24	0	0.0833	0.08	20	0.0173	0.052	0.1	29	0.034	0.0508	0.08
20-24	14	0.2857	0.7143	1.21	19	0.3393	0.4813	1	22	0.3333	0.4594	1
25-29	30	1.0667	0.9	2.5	16	1.0237	1.1758	2.46	23	1.0831	1.0128	2.51
30-34	33	1.7576	1.6061	4.06	15	1.4651	1.7116	3.69	25	1.536	1.5333	3.82
35-39	21	2.381	1.8095	5.29	17	2.1451	2.021	5.01	24	2.1067	2.2006	5.42
40-44	17	2.7059	2.2353	5.94	17	2.6351	2.3889	6.52	13	2.2893	2.3177	6.17
45-49	20	2.3	2.4	6.25	16	3.0967	2.4181	7.13	16	2.3713	2.5465	6.56
Total	159	1.4843	1.3585	3.65	120	1.4623	1.4012	3.54	153	1.2586	1.305	3.27
Upper East												
15-19	28	0.0714	0.0714	0.18	48	0.0324	0.0216	0.05	62	0.0806	0.0102	0.1
20-24	56	0.6429	0.5536	1.32	48	0.2609	0.391	0.88	46	0.4588	0.2641	0.75
25-29	56	1	0.9821	2.61	53	0.9504	0.8118	2.04	56	1.3546	1.0144	2.52
30-34	43	1.814	1.4884	4.26	39	1.3775	1.7156	3.8	43	1.9114	1.4015	3.68
35-39	35	2.0857	1.6286	4.51	42	2.2956	1.925	5.06	34	2.275	1.8831	4.53
40-44	27	2.2963	2.1111	5.56	26	2.2982	2.5987	5.92	37	2.3158	2.5549	5.29
45-49	31	2.4516	2.5161	6.16	32	2.483	1.9029	5.4	33	3.2003	2.1457	6.24
Total	276	1.3877	1.2464	3.29	288	1.2291	1.1768	2.92	310	1.4553	1.1538	2.88

Table 3.8 Estimating the Mortality Level for Northern, Upper West and Upper East regions.

Age group / Region	Age	Parity ratios for two successive surveys P(i-1,1)/P(i,2)*	East Model ki	D(i)	q(i)=K(i)*D(i)	ML	e_0^0	t(x)	Ref. Date
		1	2	3	4	5	6	7	8
Northern									
20-24	2	0.096	1.09134	0.1293	0.14111	15.6	54.6	1.97	2001.57
25-29	3	0.6102	0.95964	0.1351	0.12965	16.6	57	5.11	1998.43
30-34	5	0.6177	1.02732	0.1654	0.16992	15.1	53.4	5.84	1997.70
35-39	10	0.7693	1.04204	0.1661	0.17308	15.5	54.4	8.50	1995.04
Upper West									
20-24	2	0.0999	1.08849	0.2074	0.22575	11.4	44.5	1.99	2001.55
25-29	3	0.399	1.02636	0.1637	0.16801	14.7	52.4	3.74	1999.79
30-34	5	0.6439	1.01898	0.1967	0.20043	13.8	50.2	6.10	1997.44
35-39	10	0.6802	1.07485	0.206	0.22142	13.5	49.5	7.20	1996.34
Upper East									
20-24	2	0.0723	1.10864	0.0315	0.03492	22.2	70.6	1.83	2001.71
25-29	3	0.3497	1.04193	0.0586	0.06106	20.4	66.2	3.43	2000.11
30-34	5	0.5551	1.04726	0.0986	0.10326	18.3	61.1	5.20	1998.34
35-39	10	0.8381	1.01671	0.0829	0.08429	19.5	64.2	9.51	1994.03

*Source: computed from 1998 and 2003 data files

Table 4.1 Background Characteristics, Infant Mortality Rates and Number of Births

Socio-economic characteristics	Infant Mortality: Northern IMR/1000	Northern Births	Upper West IMR/1000	Upper West Births	Upper East IMR/1000	Upper East Births
Level of Education of Mother						
No education	71	595	70	498	83	733
Primary & higher	28	72	56	89	68	117
Marital Status						
Currently in Union	63	637	69	566	77	778
Currently not in Union	133	30	48	21	125	72
Place of Residence						
Urban	62	115	45	44	49	41
Rural	69	552	70	543	83	809
Demographic Factors						
Age of Mother at Birth						
< 20	48	62	156	32	143	56
20+	68	605	63	555	77	794
Birth Order of Child						
1	75	133	77	104	138	160
2-3	77	222	57	176	70	302
4-6	49	225	63	189	66	305
7+	69	87	85	118	72	83
Sex of Child						
Male	65	340	63	269	88	442
Female	67	327	72	318	74	408

Table 4.2 Background Characteristics, Child Mortality Rates and Number of Births

Socio-economic Characteristics	Child Mortality					
	Northern		Upper West		Upper East	
	CMR/1000	Births	CMR/1000	Births	CMR/1000	Births
Level of Education of Mother						
No education	87	553	70	498	83	733
Primary & higher	14	70	56	89	68	117
Marital Status						
Currently in Union	77	597	69	566	77	778
Currently not in Union	115	26	48	21	125	72
Place of Residence						
Urban	83	109	45	44	49	41
Rural	78	514	70	543	83	809
Demographic factors						
Age of Mother at Birth						
< 20	34	59	222	27	125	48
20+	83	564	60	520	52	733
Birth Order of Child						
1	73	133	77	104	138	160
2-3	63	222	57	176	70	302
4-6	84	225	63	189	66	305
7+	111	87	85	118	72	83
Sex of Child						
Male	82	340	63	269	88	442
Female	75	327	72	318	74	408