2010
POPULATION & HOUSING CENSUS REPORT

MORTALITY

UN POPULATION FUND

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PREFACE AND ACKNOWLEDGEMENTS

The mandate of the Ghana Statistical Service (GSS) includes data collection, compilation and analysis as well as dissemination of statistical information in an accessible and user-friendly manner. In order to satisfy the needs of users, GSS is required to analyse and interpret statistics in a form that makes it easily understood for people to appreciate the value of the statistical information. There is also the need to disseminate widely all the statistics produced by GSS so that all data users including potential data users can have access to it.

Ghana, like many other developing countries, relies mainly on survey and population census data for planning at the national and the sub-national levels. Detailed analysis of such data provides users with a wealth of information for planning and policy formulation. Analysis of the 2010 Population and Housing Census data on topical issues, therefore, provides information for effective planning at all levels.

Several reports, including six monographs, were prepared using the 2010 Census data and published in 2012 and 2013. The published reports from the census data was a collaborative effort between the GSS and Local consultants from research institutions and universities in Ghana with funding from the Government of Ghana and various Development Partners (DPs). In order to strengthen the report writing capacities of the Ghana Statistical Service (GSS) and Ministries, Departments and Agencies (MDAs) which are engaged in population-related activities, professional staff of GSS and these MDAs were paired up with consultant writers to prepare the reports.

The monograph on 'Mortality in Ghana' is one of the additional eight monographs that has been prepared from the 2010 Population and Housing Census data and is meant to inform policy makers on issues relating to mortality in Ghana. The report discusses the quality of mortality data in Ghana, identifies methodological approaches for the estimation of key indicators of mortality in Ghana. The report further provides estimates of mortality indicators using the 2010 Population and Housing Census data. It also examines trends, levels, and age patterns of infant and under-five mortality and derives population life expectancies disaggregated by sex, locality of residence and region.

The Ghana Statistical Service wishes to thank the United Nations Children's Fund (UNICEF) and the United Nations Population Fund (UNFPA) for providing funds for the preparation of this monograph and the lead role UNFPA played in mobilizing resources from the UN System and from other DPs for the 2010 PHC. Our appreciation also goes to Dr. Fiifi Amoako Johnson and Prof. Sabu S. Padmadas for the dedication and competence they demonstrated during the preparation of this report.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

This report presents an overview of patterns, trends and differentials in mortality and life expectancy in Ghana based on the analysis of the 2010 Population and Housing Census (PHC) data. The 2010 Ghana PHC was the fifth post-independence national census conducted on 26th September 2010. Previous censuses were held in 1960, 1970, 1984 and 2000 respectively. The 2010 PHC collected a range of household and population information including fertility, mortality, migration, and related demographic, geographic and socio-economic data including educational attainment, literacy, ethnicity, religious affiliation and economic activity. In addition, the 2010 PHC introduced five new modules to collect data on disability, emigration, Information Communication Technologies (ICT), maternal mortality and agriculture.

The specific objectives of the mortality report of the 2010 PHC were to:

a) evaluate and discuss the quality of mortality data collected by the 2010 PHC;
b) identify methodological approaches for the direct and indirect estimation of key indicators that would provide an accurate description of mortality in the population;
c) estimate key mortality indicators in the population using direct and indirect estimation methods
d) examine the trends, levels and age patterns of infant and under-five mortality and derive the population life expectancies disaggregated by sex, residence and region
e) assess the demographic and socio-economic differentials of infant and under-five mortality within the broader context, reflecting on recent social and economic changes in the population, and
f) highlight, where appropriate, the implications of the results for policy and programme interventions.

The 2010 PHC recorded data on deaths in the household in the 12 months preceding the census date. This included data on females aged 12-54 who died while pregnant, during delivery or within six weeks after the end of a pregnancy or childbirth. The analysis was preceded by a systematic evaluation of the quality of the census data on mortality by age and sex. The analysis considered both direct and indirect estimation techniques to estimate key mortality indicators, where appropriate addressing potential biases and discrepancies associated with reporting of deaths in the census. Data on age and sex distribution of the population, children ever-born and surviving were evaluated for quality, reliability and consistency. Due to severe under-reporting of deaths in very young ages, infant and child mortality levels were estimated using indirect techniques based on the Brass method comparing the Trussell version of the Coale-Demeny model life tables and the Palloni-Heligman version of the United Nations model life tables.

The 2010 Population and Housing Census (PHC) estimated Ghana's total population to be 24.7 million. Ghana's population increased by almost thrice since the 1980s, and by about one-third between 2000 and 2010. Assuming the current trends in population growth, the country will add another 21 million people by 2050. The high fertility rates in Ghana observed during the 1980s continued till the end of last century. The 2010 PHC estimated a total fertility of 4 children per woman. Between 2000 and 2010, total fertility declined by about 20%. However, the 2010 estimates were consistent to those from the national surveys such as the Ghana Demographic and Health Surveys. The increase in population life expectancy had been either stagnant or slow for over the last three decades. This was primarily due to high rates of HIV and related opportunistic infections such as TB among men and women of adult ages. Children were also adversely affected by the HIV epidemic.

On the other hand, about one in two deaths in Ghana was attributed to non-communicable diseases.
The 2010 PHC data showed remarkable mix in the pattern and distribution of deaths across different geographical areas of Ghana. The age-standardised crude death rate of Ghana was 7.7 deaths per 1000 mid-year population. This was 20% higher than the unadjusted crude death rate, which highlighted the potential influence of young age structure of the Ghana population.

Overall mortality levels varied considerably by region and residence: rural mortality was the highest in the Upper Eastern, Upper Western, Volta and Eastern regions whereas mortality in urban areas was above the national average in six regions including Upper Eastern, Eastern, Central, Volta, Western and Brong Ahafo regions. Mortality was also consistently higher among males, especially in the younger and older ages, in all geographic regions, particularly the Upper Eastern and Upper Western regions. Female mortality levels were slightly higher in the 15-39 age range and thereafter remained stable till age 60. On the other hand, the gender difference in mortality was highly pronounced after age 55. Mortality levels were considerably higher for older males than females.

Maternal mortality ratio was estimated at 485 deaths per 100,000 births. Although this was higher than that estimated by the WHO, the ratio was within the 95% confidence interval range of the WHO estimate. One in ten female deaths in the age group 10-54 was pregnancy-related. Maternal mortality ratio was generally higher in rural areas when compared to urban areas. In both rural and urban areas, the ratio was considerably higher among younger (10-19) and older women aged 40 and above.

Infant mortality rate (IMR) was estimated at 59 deaths per 1000 live births and the under-five mortality rate (U5MR) was 90 deaths per 1000 live births. These estimates were slightly higher than those from the 2008 DHS data. The rates were higher among males than females. However, male IMR and U5MR were slightly higher in urban areas when compared to rural areas, whereas the corresponding mortality rates for females were higher in rural areas. The observed difference could be partly attributed to possible high under-reporting of deaths in rural areas.

Both infant and under-five mortality rates were consistently higher in the Upper West and Upper East regions and the lowest in the Eastern and Ashanti regions. The difference between IMR and U5MR was also the highest in the Upper West and Upper East regions when compared to other regions. Infant and under-five mortality rates in the Central, Northern, Upper East and Upper West regions were above the national average. The mortality rates in urban areas were the highest in the Upper West, Northern and Upper East regions respectively. Never-married and widowed women, those belonging to Mole-Dagbani ethnic community and Traditionalist and Islam religion experienced high infant and child mortality rates. The estimates of infant and child mortality by literacy and educational attainment of the mother did not show consistent results, for which further investigation is needed. Mothers who were not in employment or economically non-active had relatively higher mortality rates than their counterparts.

The levels and patterns of mortality were clearly reflected in the population life expectancy. The age patterns of mortality confirmed the general expected shape, however with some fluctuations and elevated mortality risks for especially rural males in the adult ages. Based on the estimation from model life tables, population life expectancy for males and females was

59.4 years and 64.4 years respectively. At age 60, an average male in Ghana would be expected to live an additional 16.6 years whereas his female counterpart would an additional 18.2 years. Females had relatively longer life than males in all ages in both urban and rural areas. The gap between male and female life expectancy was 5.9 years in urban areas and the difference in rural areas was 4 years.

The findings demonstrate evidence of considerable differences in mortality and life expectancy by geographic and socioeconomic characteristics. The findings also reflect the efforts needed to accelerate Ghana's progress towards the Millennium Development Goals, particularly goals 4 and 5. There is an urgent need to strengthen and reorient existing safe motherhood and new-born healthcare systems and related community-based intervention programmes in Ghana. Programme efforts, for example health insurance and community health interventions, should be directed more towards poorly developed rural areas of the Upper Eastern, Upper Western, Volta and Eastern regions, as well as the urban areas of Upper Eastern, Eastern, Central, Volta, Western and Brong Ahafo regions. On the other hand, it is important to accelerate and sustain communicable and non-communicable disease prevention programmes in both urban and rural areas.

Given the increase in population migration and mobility, health systems, local authority and vital registration systems should ensure systematic monitoring and recording of the number and causes of death. Also, it is imperative to promote HIV/TB, malaria and injury prevention programmes in vulnerable and disadvantaged communities across Ghana. Finally, to systematically monitor the disease and mortality burden, new data collection on mortality and morbidity indicators should be implemented on a routine basi

CHAPTER ONE
INTRODUCTION

1.1 Background

Ghana is located in the west-African region to the north of the equator along the Gulf of Guinea. In 2012, Ghana was listed as one of the top five countries in the medium human development category for making rapid progress in human development with its overall Human Development Index ranking better than the Gross National Income (UNDP 2013).

1.2 Overview of the 2010 Population and Housing Census

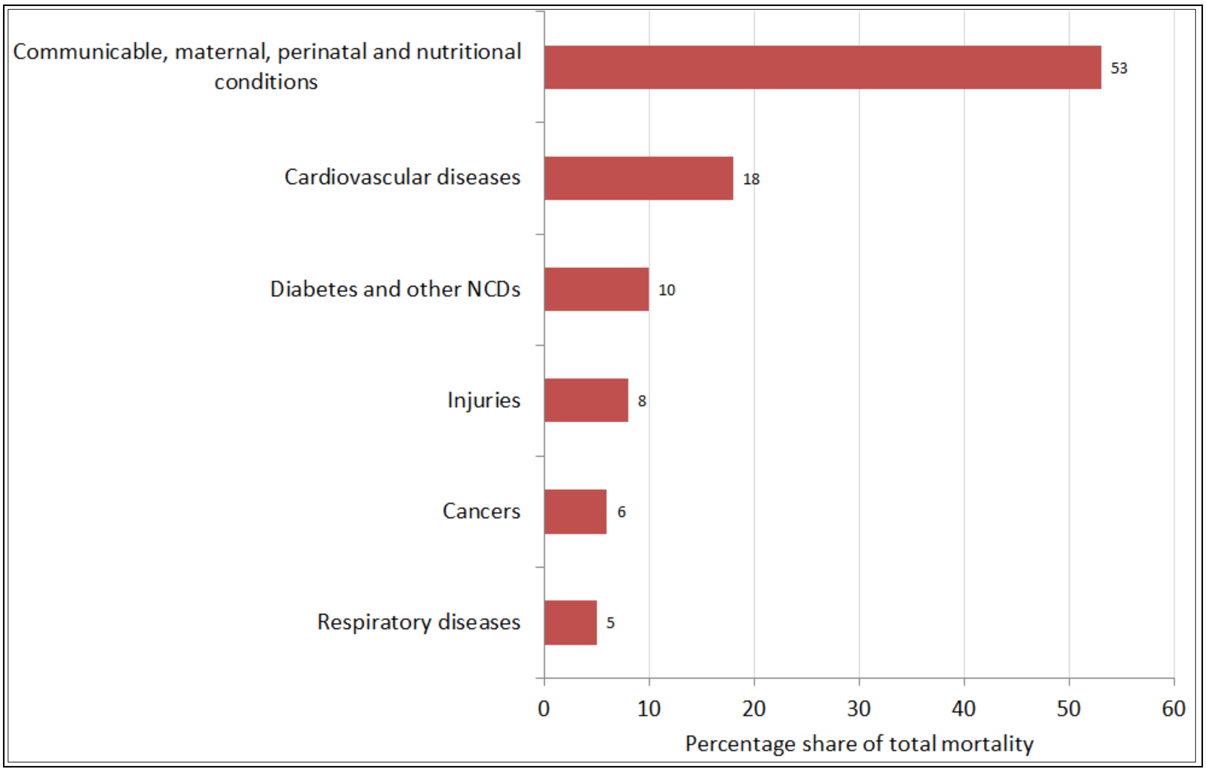
Ghana has a young population structure with about 38% of its total population aged below 15 years. Since independence, Ghana's population grew almost thrice its size until the 1980s, and between 2000 and 2010 the total population increased by about 29%. The 2010 Population and Housing Census (PHC) estimates Ghana's total population to be 24.7 million. Assuming the current trends in population growth, the country will add another 21 million people by 2050 (UN 2013a). One of the explanations for this trend is the high fertility in the past which remained persistently high at about 6-7 children per woman until the mid-1980s. The total fertility rate declined to about 5 children by 2000 and further to about 4 children by the end of last decade (GSS, GHS and ICF Macro 2009).

On the other hand, the increase in population life expectancy since 1990s has been either stagnant or slow, adding an average of only 0.11 years every year (UN 2013a). In fact, life expectancy at birth remained low within the mid-50 range for over the last three decades. During this period, both infant and child mortality showed consistent decline. For example, the infant mortality rate was close to 100 deaths per 1000 live births in the late 1970s and towards the end of the 1990s, the infant mortality declined to 70 per 1000 live births and further to 50 per 1000 live births in 2008 (GSS, GHS and ICF Macro 2009; UN 2013).

The slow improvement or reversal of life expectancy in the late 1990s is explained by the high incidence of HIV and related opportunistic infections, including Tuberculosis which affected primarily men and women of adult ages and children. In 2012, the incidence of HIV and Tuberculosis was estimated at 72 per 100,000 and the death rate was about 7 per 100,000 persons (WHO 2013). Ghana has a generalised HIV epidemic with the national level prevalence fluctuating in the last decade with estimates ranging between 2.9% and 1.9% (Ghana AIDS Commission 2012). The prevalence varied considerably across different geographical regions from 0.4% to 9.6% with some regions including Greater Accra showing an increase in the prevalence. The population incidence of malaria also remained very high and Ghana has been identified as one of the high risk countries with inadequate coverage of essential interventions (WHO 2012a).

In 2008, about 53% of total deaths in Ghana were attributed to communicable diseases, maternal, perinatal and nutrition conditions (WHO 2010). Equally challenging is the high burden of Non-Communicable Diseases which constitute about 40% of overall mortality burden in Ghana (Figure 1.1).

Figure 1.1: Percentage share of mortality attributed to different causes of death, 2008



Adapted from WHO (2010)

1.3 Objectives

The objectives of this report are to:

g) evaluate and discuss the quality of mortality data collected by the 2010 PHC;
h) identify methodological approaches for the direct and indirect estimation of key indicators that would provide an accurate description of mortality in the population;
i) estimate key mortality indicators in the population using direct and indirect estimation methods
j) examine the trends, levels and age patterns of infant and under-five mortality and derive the population life expectancies disaggregated by sex, residence and region
k) assess the demographic and socioeconomic differentials of infant and under-five mortality within the broader context, reflecting on recent social and economic changes in the population, and
l) highlight, where appropriate, the implications of the results for policy and programme interventions.

1.4 Organisation of the Report

This report is organised into 5 sections. This section provided an overview of the 2010 Population and Housing Census of Ghana, introduced the background and context and outlined the objectives of this report. Section 2 introduces the definition and concepts of mortality measures and conducts an evaluation of the quality of mortality and related data collected by the 2010 PHC. Section 3 presents the main results from the direct and indirect estimation of mortality indicators. This includes a direct measurement of crude death rate, age-sex specific death rates, maternal mortality and an indirect estimation of infant and under-five mortality based on children ever-born and children surviving data, and life expectancies based on the Coale and Demeny North Model Life Tables. Section 4 discusses the demographic and socioeconomic differentials of infant and under-five mortality. The concluding section presents a summary of the key findings reflecting on potential data limitations and highlights relevant policy implications reflecting on Ghana's progress towards the health-related UN Millennium Development Goals.

CHAPTER TWO
METHODOLOGY

This section provides an overview of the definition and concepts of mortality measures and makes an attempt to evaluate the quality of mortality and related data collected by the 2010 PHC.

2.1 Definition and concepts

Mortality is generally defined as the number of deaths that occur within a population. This section introduces the concepts and definitions of mortality measures.

Crude Death Rate (CDR) is defined as the number of deaths over a given period divided by the mid-year population in a given year.

Age-specific Death Rate (ASDR) is the number of deaths in a specific age group over a given period divided by the mid-year population in a given year.

Infant Mortality Rate (IMR) is the probability of dying of children below age one expressed per 1000 live births in a given year. The indirect estimation of IMR is based on Brass P/F Ratio method using data on children ever-born and children surviving at the time of the census.

Child Mortality Rate (CMR) is the probability of dying of children between exact age one and four years of age, expressed per 1000 live births in a given year.

Under-five Mortality Rate (U5MR) is the probability of dying of children between birth and exact age five, expressed per 1000 live births in a given year.

Maternal mortality is defined as the death of a woman either during pregnancy and childbirth or within 42 days of termination of pregnancy, from any cause related to pregnancy or its management, excluding accidental or incidental causes.

Maternal Mortality Ratio (MMR) is the number of maternal and pregnancy-related deaths in a population divided by the number of live births, expressed per 100,000 live births. Maternal Mortality Rate is the number of maternal deaths in a population in a given year divided by the number of women aged 15–49 years or woman-years of risk exposure, expressed per 100,000 women aged 15-49 years.

Life Expectancy at Birth is the average number of years a hypothetical cohort of people born in a specific year could expect to live if current mortality at each age remains constant in the future. Life expectancy at a specific age is the number of additional years a person could expect to live if current mortality at each age remains constant in the future.

Life Table is an organised tabular display of probabilities of dying and life expectancies at each age or age group for a given population based on the ASDRs prevailing at that time.

UN Model Life Tables are a series of life tables illustrating standard mortality patterns by age and the changes in those patterns at different overall levels of mortality. The five commonly used patterns of standard life tables, based on data from less developed countries, are Latin American, Chilean, South Asian, Far Eastern and General. Other related models widely used include the Brass logit life table and Coale-Demeny model life table systems.

Estimation of basic functions of life tables

The input data for the direct estimation of life tables are mid-year population and the number of deaths at each age expressed in single years or in age intervals.

Column 1 (x) is the age in single years or abridged usually in 5 year age intervals

Column 2 ($_na_x$) is the average number of person years lived by those who die between age x and x+n. It is derived from a set of empirical values to account for deaths at young ages skewed towards the beginning of the interval (also referred to as Chiang's a). The general assumption is that a death is uniformly distributed through the interval [x, x+n], where n is the width of the interval.

Column 3 ($_nm_x$) is the age-specific death rate between ages x and x+n, estimated by dividing the number of deaths by the mid-year population.

Column 4 ($_nq_x$) is the probability of dying between ages x and x+n, which is estimated using the equation:

$$\frac{n \times {}_nm_x}{1+(n-{}_na_x)\times {}_nm_x}$$

Column 5 ($_np_x$) is the probability of surviving between ages x and x+n, which is estimated by subtracting 1 from $_nq_x$.

Column 6 (l_x) is the number of survivors alive at exact age x.

$$l_o = 100{,}000$$

$$l_{x+n} = l_x \times {}_np_x$$

Column 7 ($_nd_x$) is the number of deaths between ages x and x+n.

$$_nd_x = l_x - l_{x+n}$$

Column 7 ($_nL_x$) is the person years lived between ages x and x+n.

$$_nL_x = n \times l_{x+n} + {}_na_x \times {}_nd_x$$

For the open interval at the end of the life table:

$$_\infty L_x = \frac{lx}{_\infty m_x}$$

Column 8 (T_x) is the total number of person years lived beyond exact age x, estimated as the cumulative sum of the person years lived in each age interval.

Column 9 (e_x) is the expectation of life at exact age x.

$$e_x = \frac{T_x}{l_x}$$

2.2 Data Evaluation and Quality Assurance

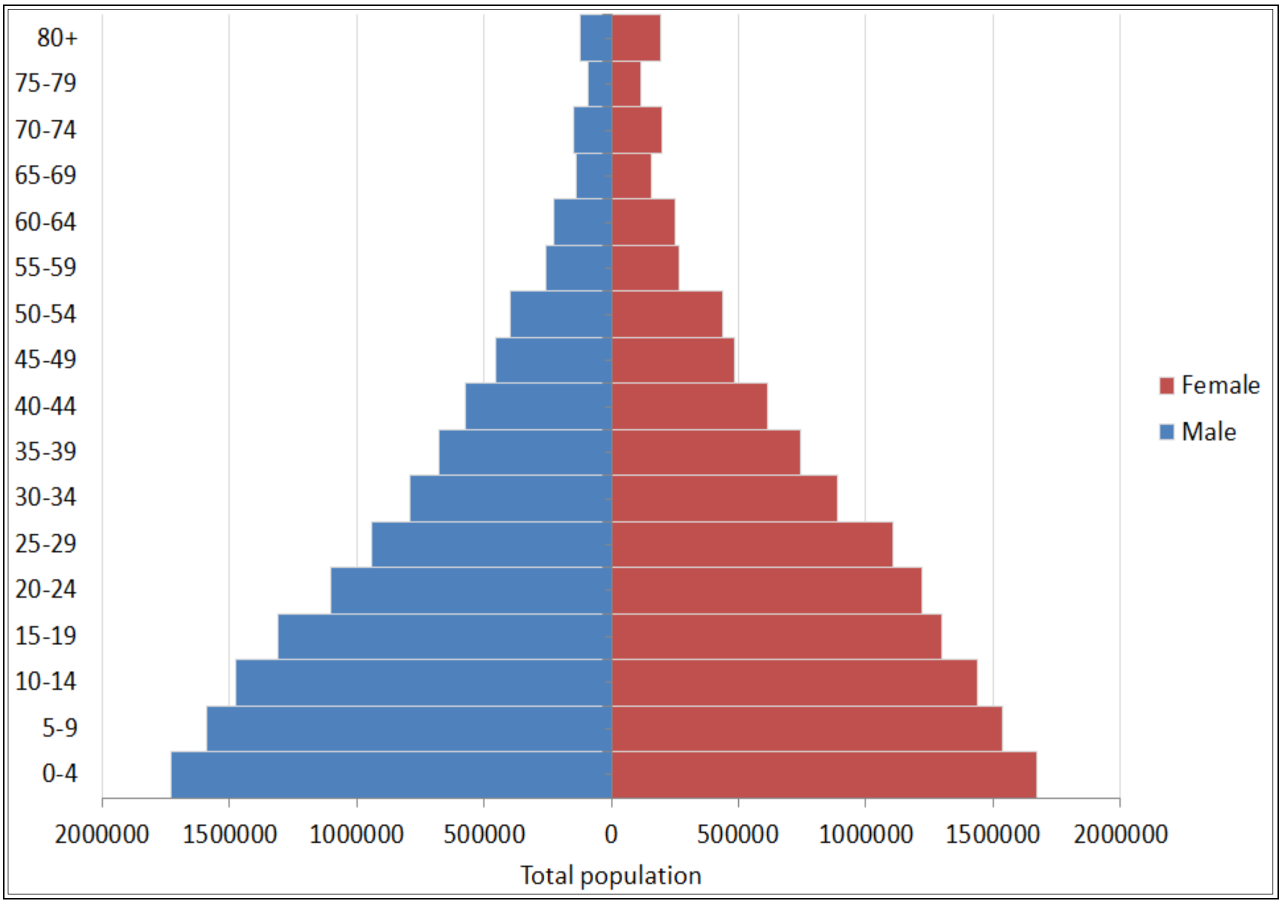
Age-sex structure

Age structure and sex composition are fundamental attributes to evaluating the changes in a population. The best approach to illustrate the components of demographic change including fertility, mortality and migration is to construct population pyramids. Figure 2.1 presents the population pyramid for Ghana based on data from the 2010 Population and Housing Census (PHC). The wide base of the pyramid illustrates that Ghana has a relatively young population with about 38% of the population below 15 years (Figure 2.1a). The sex ratio of the population below 15 years is 103 males for every 100 females which is almost the same as the sex ratio at birth. However, the sex ratio for the total population is 95 males per 100 females which suggest potential relatively high male mortality in the overall population. This is further illustrated in the absolute number of people alive at age 80 and above.

The age-sex pattern varies between urban and rural areas. Females are slightly over represented in urban areas in all ages except 0-10 years whereas in rural areas males are slightly under represented in all ages except 0-20 years; and hence an overall population sex ratio in favour of females. Further assessment of the population age-sex structure in single years can provide insights of potential heaping on reported ages. Readers are referred to Chapter 3 of the National Analytical Report which provides a detailed evaluation of the age and sex data from the 2010 census (GSS 2013).

Figure 2.1: Population pyramids illustrating the age-sex structure, Ghana

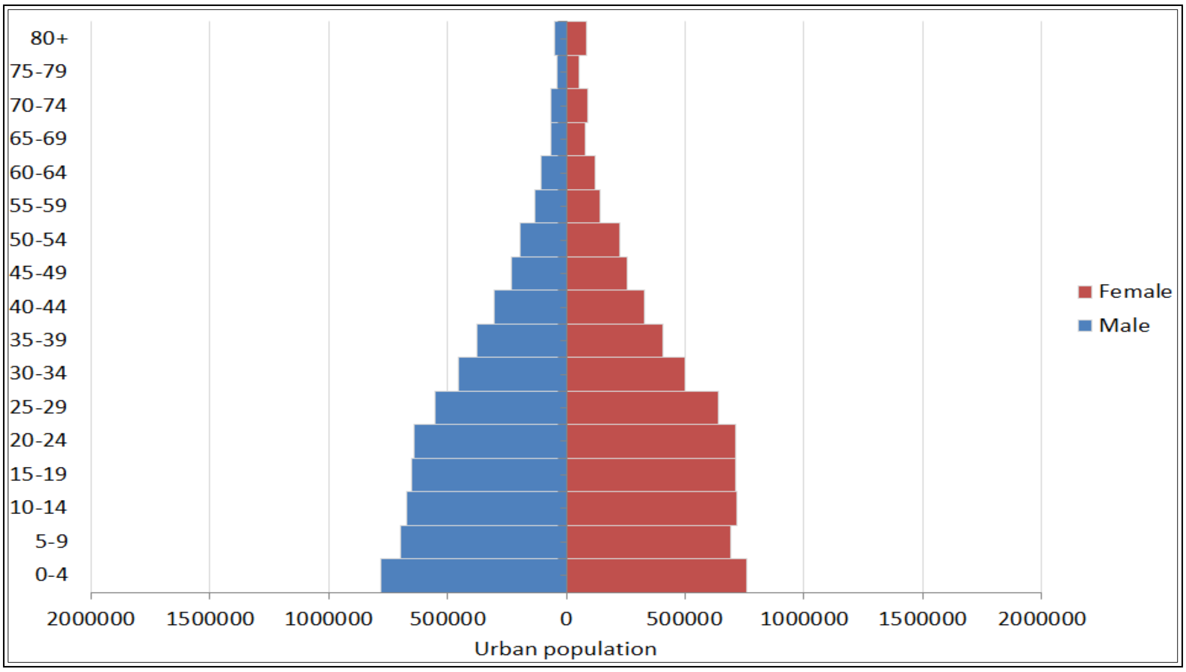
(a) Total population



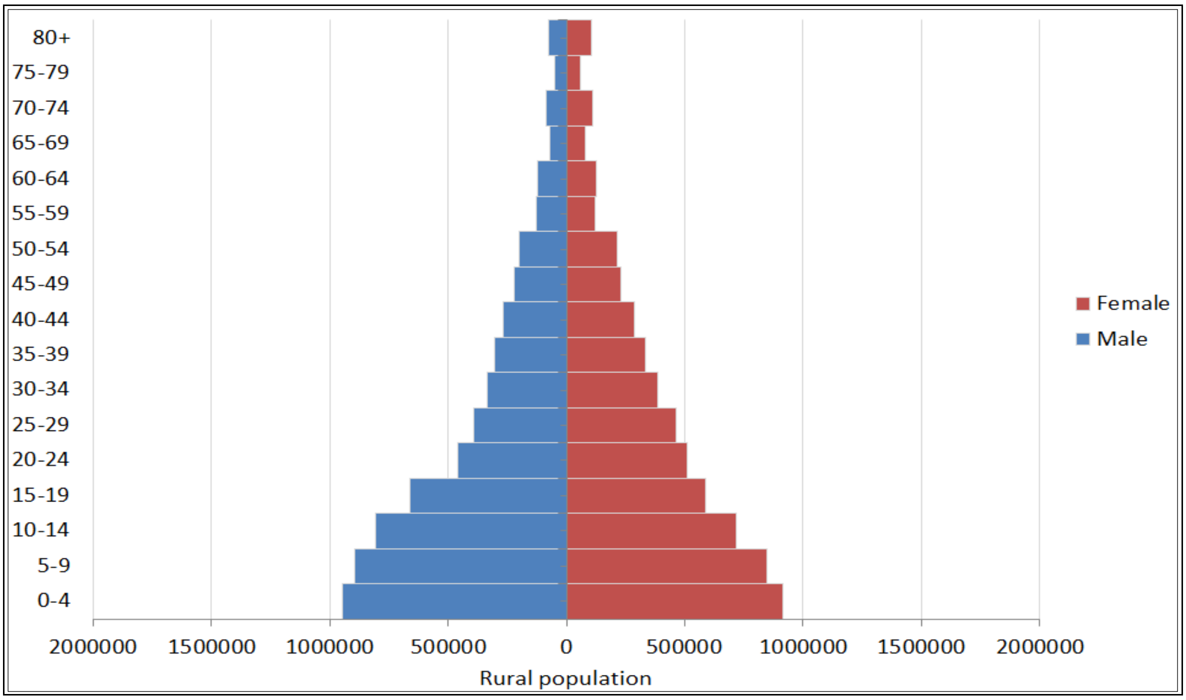
Age-sex distribution of deaths

The data on deaths in the 2010 PHC are reported by the head of household or by another member in the absence of the head of household. The 2010 PHC asked a specific question: 'has any member of this household died in the past 12 months?' If a death is reported in the last 12 months prior to the census date, further information is collected on the age and sex of the deceased, and specifically on whether the death happened as a result of an accident, violence, homicide or suicide.

(b) Urban population



(c) Rural population



For death of women in the reproductive ages, a follow-up question was asked on whether the death occurred whilst pregnant, during delivery or within 6 weeks after the end of a pregnancy or child birth.

A better understanding of mortality in a population would require a detailed examination of the distribution of reported deaths by age and sex. This is important since data on deaths are sensitive and not easy to collect in population censuses or surveys. The reporting bias tends to vary according to the age of the deceased in the household. In some cultures, death of a family member is not discussed for personal reasons especially if the deceased is a young child or if the death happened close to the time of investigation. On the other hand, the household death reporting is almost unlikely in case of death of both the mother and her child. There are alternative questions in the census to capture mortality of children. For example, household members are asked to report the children ever-born in the family and their survival status. However, there is no information on the age at death of children who died in the household. Also, it is likely that respondents might under or misreport births and deaths of both older and younger children.

The Crude Death Rate (CDR) directly estimated from the 2010 PHC was 6.6 deaths per 1000 for the total population and 5.4 deaths per 1000 and 7.9 deaths per 1000 mid-year population in urban and rural areas respectively. The estimated CDR of 7 deaths per 1000 is lower than the Population Reference Bureau estimate of 9 deaths per 1000 and the UN estimate of 9.6 deaths per 1000 for the period 2005-2010 (PRB 2013; 2010; United Nations 2013a). The absolute size of the mid-year population and the number of deaths by age and sex for total, urban and rural population are presented in the Appendix (see Tables A2.1-A2.3).

From the household death record, it is possible to estimate infant mortality directly by dividing the number of deaths below age 1 in the last 12 months by the number of births in the last 12 months. The 2010 PHC reported a total of 615,062 births and 28,068 deaths in the last 12 months. Based on these data, the infant mortality is estimated at 46 deaths per 1000 live births which is close to the 2008 DHS estimate of 50 infant deaths per 1000 live births for the 5 years preceding the survey (GSS, GHS and ICF Macro 2009). The 2011 MICS data, however, show an estimate of 53 infant deaths per 1000 live births which appear somewhat higher than the 2008 DHS estimate (GSS 2011).

There is evidence to suggest that the births in the 12 months preceding the census are likely to be underestimated. This is because of the discrepancy between the recorded household population aged below 1 year and the number of births in the last 12 months. Ideally, the number of births in the last 12 months should be greater than the recorded population aged below 1 year, assuming that not all births would survive infancy.

According to the 2010 PHC, the recorded household population aged below 1 year is 731,201, which is about 16% more than the reported births. If the recorded household population aged below 1 year is deemed accurate, then the number of births in the last 12 months should be at least 731,201. This will yield an infant mortality of 38 deaths per 1000 live births. Obviously, this is rather unrealistic given the current trends based on data from the 2008 GDHS and 2011 MICS. On the other hand, the total fertility rate based on births in the last 12 months is also underestimated (Fertility Report, GSS 2014) which suggests that recent births and deaths in the census are under-estimated.

Further investigation of age and sex specific distribution of deaths shows evidence of severe under-reporting of deaths at adult ages (see Section 3.2). This clearly points out the need to estimate mortality using indirect techniques (Moultrie et al. 2013). In particular, the data on children ever-born and their survival status are deemed essential and inevitable for the estimation of infant and child mortality. The quality of data on children ever-born and surviving is examined in the next section.

Data on children ever-born and surviving

The mean distribution of children-ever born, children surviving and children dead is shown in Table 2.1. There is high concentration of births and deaths of children ever-born in older ages which suggest potential high fertility among women of older cohorts. On the other hand, there is often a tendency among older women to underreport births and deaths of children which can bias the estimation of total fertility rates. However, it is also clear that survival probabilities of children of older women are relatively lower than their younger counterparts, especially for those residing in rural areas (Figure 2.2). The mean distribution of children ever-born, surviving and dead by sex and age of mother is presented in Table 2.2.

Biologically, male children are more vulnerable to dying at early ages than their female counterparts. This is confirmed in Figure 2.3 which shows that the survival probabilities are generally lower for males in Ghana. The sex ratio in the mean distribution of children by residence shows higher representation of children ever-born especially in rural areas (Table 2.3). However, the sex ratio is poorly represented in the children surviving which suggests relatively high male mortality especially in urban areas.

Table 2.1: Mean number of children ever-born (CEB), children surviving (CS) and children dead (CD) by age of mother and residence

Age of mother	Urban			Rural			Total		
(in years)	CEB	CS	CD	CEB	CS	CD	CEB	CS	CD
10-14	0.004	0.003	0.001	0.01	0.005	0.001	0.005	0.004	0.00
15-19	0.075	0.066	0.009	0.14	0.128	0.015	0.106	0.094	0.01
20-24	0.477	0.427	0.05	0.98	0.888	0.088	0.684	0.618	0.07
25-29	1.223	1.113	0.11	2.12	1.945	0.176	1.601	1.463	0.14
30-34	2.198	2.014	0.184	3.36	3.057	0.304	2.706	2.47	0.24
35-39	3.004	2.753	0.251	4.29	3.865	0.429	3.587	3.256	0.33
40-44	3.646	3.3	0.346	5.07	4.453	0.616	4.31	3.838	0.47
45-49	4.039	3.607	0.432	5.45	4.706	0.744	4.705	4.126	0.58

The sex difference is generally trivial, although potential under-reporting of female births cannot be ruled out in Ghana. Misclassification or omission of age reporting can also affect the way in which births are recorded in the census. Other errors that could potentially influence the estimation of lifetime fertility is the way in which enumerator fills in the questionnaire by leaving a blank instead of recording zero for no children, which can lead to missing or unknown observations. This is a common problem identified in the census data. In order to correct such errors, a procedure known as the El-Badry correction is applied which apportions the number of women whose parity is unknown or missing between women whose parity is truly unknown and those with no children whose responses are left void in the data entry phase (El-Badry, 1961).

Table 2.2: Mean number of children ever-born (CEB), children surviving (CS) and children dead (CD) by sex and age of mother

Age of mother (in years)	Male			Female		
	CEB	CS	CD	CEB	CS	CD
10-14	0.002	0.002	0	0.003	0	0
15-19	0.052	0.045	0.01	0.053	0.05	0
20-24	0.346	0.305	0.04	0.339	0.31	0.03
25-29	0.813	0.731	0.08	0.789	0.73	0.06
30-34	1.372	1.24	0.13	1.334	1.23	0.1
35-39	1.816	1.636	0.18	1.771	1.62	0.15
40-44	2.175	1.923	0.25	2.135	1.92	0.22
45-49	2.369	2.062	0.31	2.336	2.06	0.27

Figure 2.2: Mean number of children dead from the children-ever born data by residence

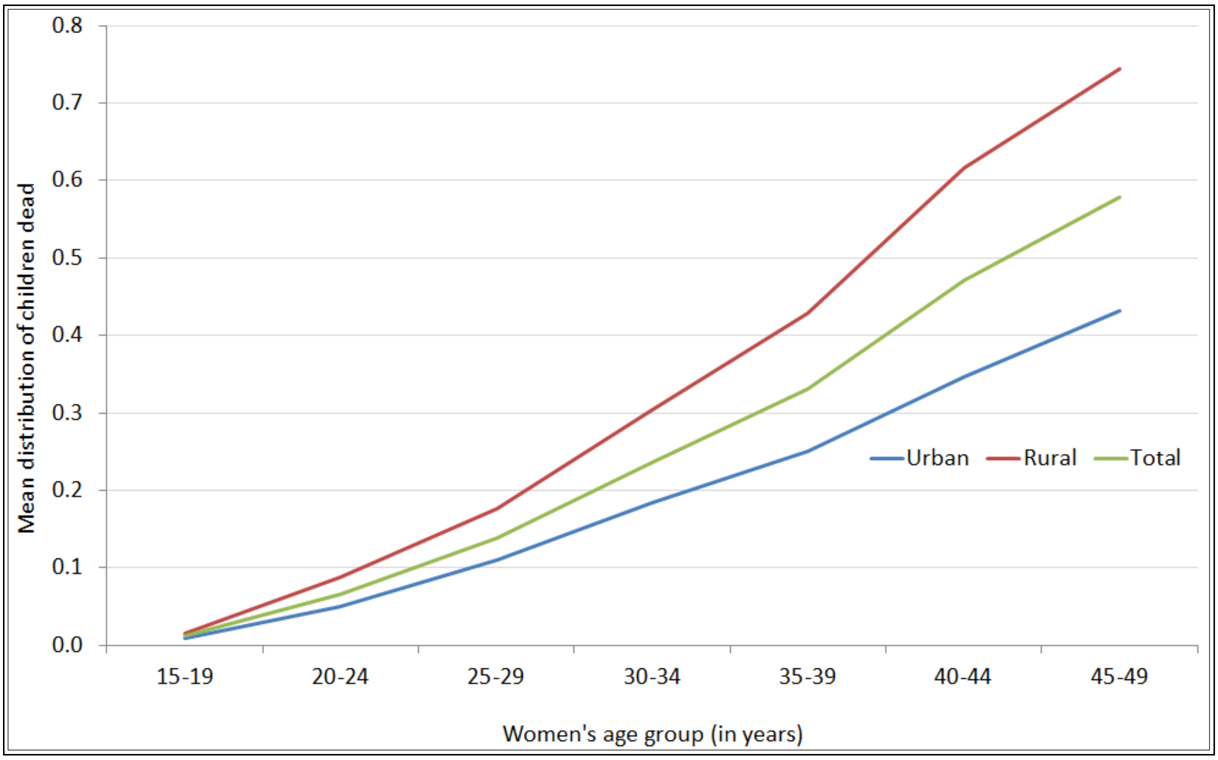


Figure 2.3: Mean number of children dead from the children-ever born data by sex

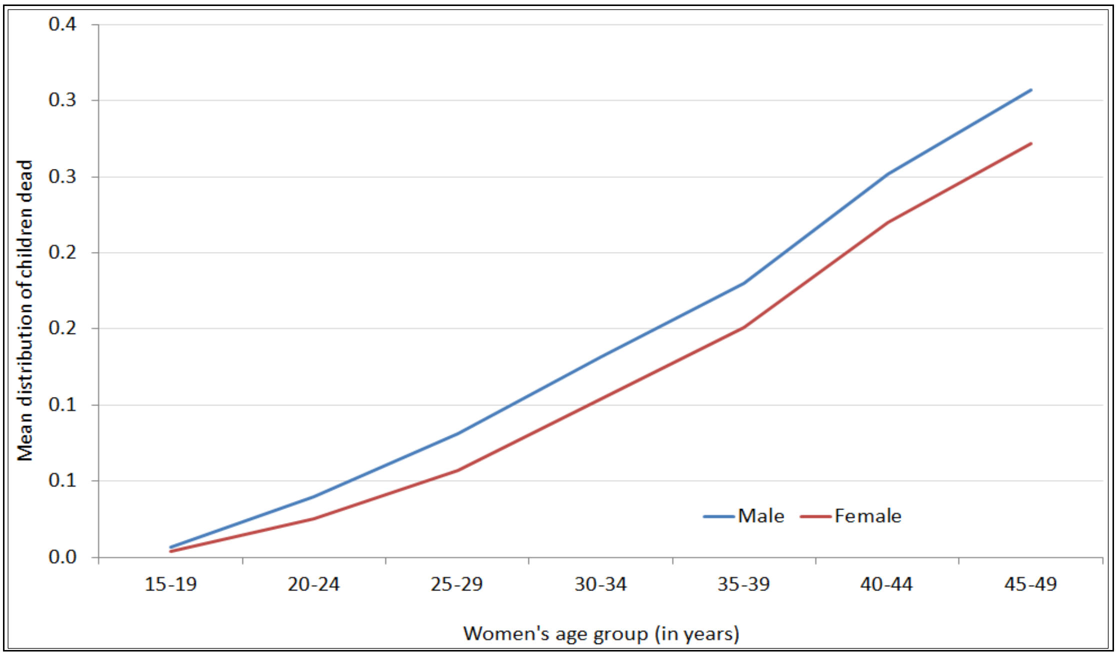


Table 2.3: Sex ratio (males per 100 females) of children ever-born and surviving by age of mother and residence

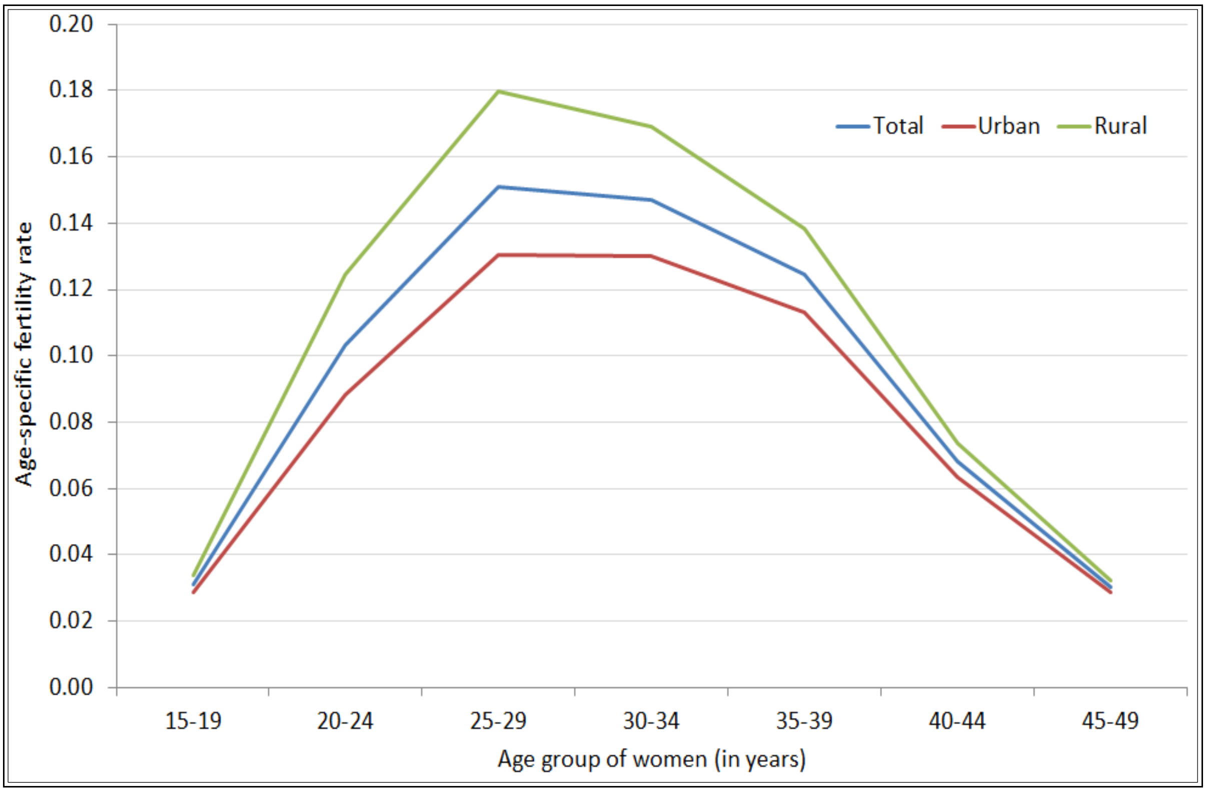
	Urban		Rural		Total	
Age of mother (in years)	CEB	CS	CEB	CS	CEB	CS
10-14	85	79	92	84	89	82
15-19	96	91	101	95	99	93
20-24	101	96	103	98	102	97
25-29	102	98	104	101	103	100
30-34	102	99	104	102	103	101
35-39	102	100	103	102	103	101
40-44	101	99	103	102	102	100
45-49	100	98	103	101	101	100
Total	101	99	103	101	102	100

Births in the last 12 months

The 2010 PHC asked a question on the number of births in the last 12 months, although there is no information available on the survival status of the recent birth. Nonetheless, data on recent births are useful to estimate maternal deaths which are recorded for the 12 months preceding the census. The information on recent births could be subject to potential misclassification in the reference period. For example, children born in the past 12 months could be mistaken as children born in the last year instead of precisely 12 months prior to the month of census, which is September 2010 for the Ghana PHC. This could influence the direct estimation of fertility and maternal mortality ratio expressed as maternal deaths per 100,000 live births.

The evaluation of recent births is undertaken by plotting the Age-Specific Fertility Rates (ASFR), which is estimated by dividing the number of births in each age group by the number of women in the corresponding age group. Figure 2.4 shows the distribution of fertility by age group of women. The shape of the fertility curve by age is standard with fertility peaking around 25-29 years in both rural and urban areas. The age-specific fertility curve is higher in rural areas than in urban areas. It has to be noted that the total fertility rate estimated from recent births based on the census data is 3.3 children per woman (2.9 in urban areas and 3.8 in rural areas) which is about 18% lower than the estimate from the 2008 Ghana DHS (GSS, GHS and ICF Macro 2009).

Figure 2.4: Age specific fertility rates by residence for births recorded in the 12 months preceding the census



CHAPTER THREE
LEVELS, TRENDS AND PATTERNS OF MORTALITY

This section examines the levels, trends and patterns of mortality based on direct and indirect estimation techniques.

3.1 Direct estimation from household death records

3.1.1 Crude Death Rate

Crude Death Rate (CDR) is an unrefined measure of the level of mortality and is heavily influenced by the age structure of the population under investigation. To eliminate the influence of the underlying age structure and to ease comparison of CDR across different populations within Ghana, a direct standardisation procedure was applied by multiplying the deaths by the corresponding population in each group of the standard population. Given that the choice of a standard population is arbitrary, the average age structure of the world population is regarded as standard (Ahmad et al. 2001).

Table 3.1 presents the results of the adjusted crude death rates by region and residence. The standardised crude death rate for Ghana was 7.7 deaths per 1000 which is slightly higher than the unadjusted rate of 6.4 deaths per 1000. The level of mortality varies by region and residence. The rural death rate was the highest in the Upper Eastern, Upper Western, Volta and Eastern regions respectively. The urban death rate was above the national average in six regions including Upper Eastern, Eastern, Central, Volta, Western and Brong Ahafo regions. There is also marked difference in mortality by sex (Table 3.2). Male mortality was consistently higher than female mortality in all regions. Upper Eastern and Upper Western regions had the highest overall male and female mortality rates.

Table 3.1: Standardised crude death rates (per 1000) by region and residence

Region	Urban	Rural	Total
Western	7.1	7.7	7.4
Central	7.9	9.1	8.5
Greater Accra	5.5	6.9	5.7
Volta	7.7	10.2	9.3
Eastern	8.4	9.9	9.3
Ashanti	6.5	8.2	7.1
Brong Ahafo	6.9	7.2	7.1
Northern	6.7	5.9	6.1
Upper East	9.9	12.3	11.8
Upper West	5.5	10.9	10
All	6.7	8.7	7.7

Table 3.2: Standardised crude death rates (per 1000) by region and sex

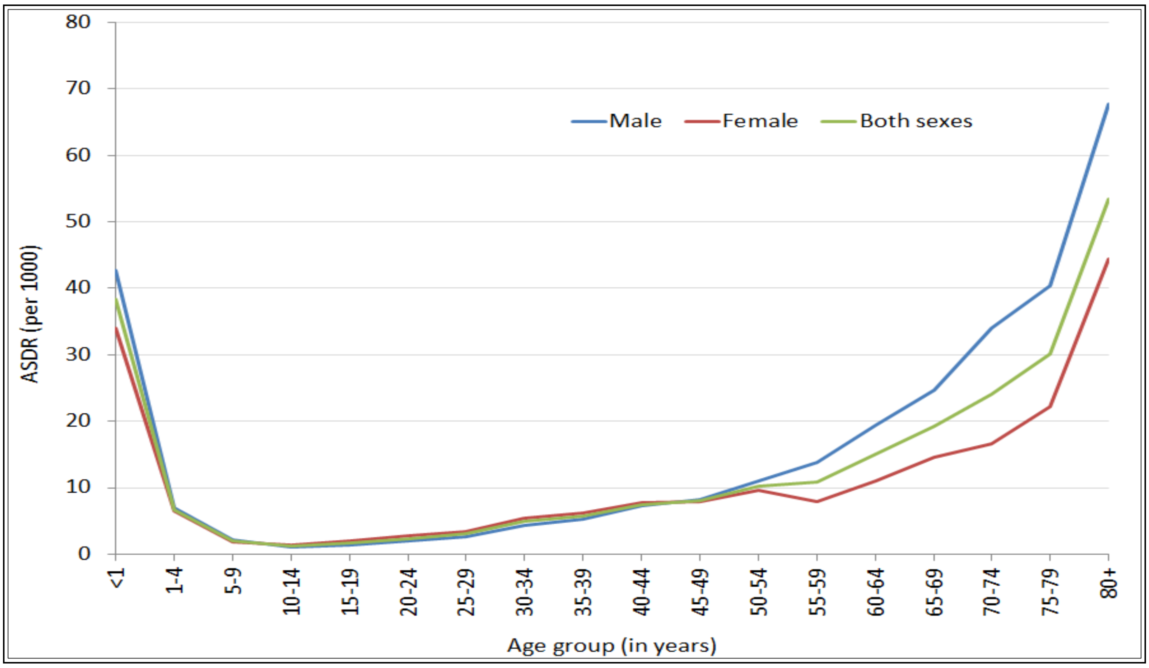
Region	Male	Female
Western	7.9	7.1
Central	10	7.4
Greater Accra	6.5	5
Volta	10.4	8.6
Eastern	10.3	8.6
Ashanti	8.1	6.4
Brong Ahafo	8	6.3
Northern	6.5	5.7
Upper East	14.7	9.4
Upper West	12.3	8.2
All	8.6	6.9

3.1.2 Age-Sex Specific Death Rates

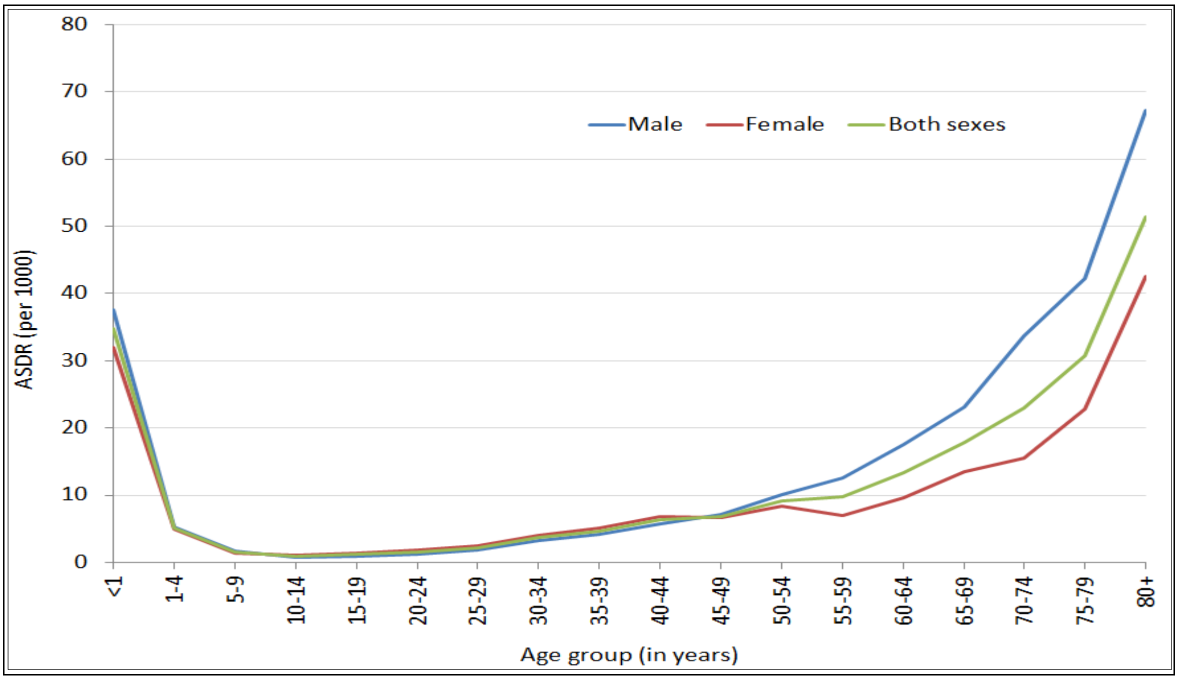
An assessment of the distribution of reported deaths by age and sex is undertaken by graphically illustrating the age-sex specific death rates (Figure 3.1). Although the mortality curves resemble closely the U-shape seen across middle and low income countries, it is clear that there is substantial under-reporting of deaths, especially in the adult ages (Figure 3.2a). The number of reported deaths by age is generally much lower for females than males and the patterns are the same in both urban and rural areas. Overall, male mortality is higher in the younger and older ages whereas female mortality tends to be slightly high in the 15-39 age range and declines thereafter remains relatively stable till age 60. This pattern is found to be similar in both urban and rural areas (Figure 3.2b and Figure 3.2c).

Figure 3.1: Age Specific Death Rate (ASDR) per 1000 mid-year population, Ghana

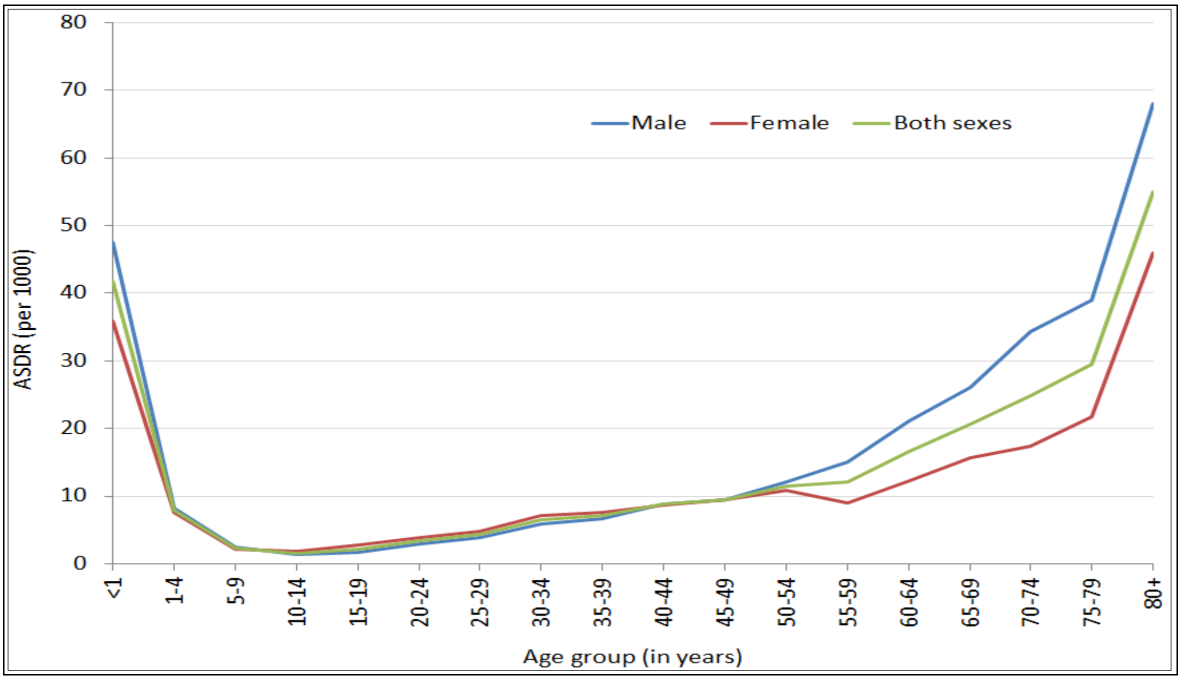
(a) Total population



(b) Urban population



(c) Rural population



The death rates are higher in rural areas throughout from age below 1 until 50. The gap between male and female mortality is substantial after age 55. For example, there is a difference of about 20 excess male deaths per 1000 population from age 70 onwards in both urban and rural areas. The difference is trivial in the adult ages between 15 and 60. The direct estimates of the age-specific death rates are presented in Table 3.3.

3.1.3 Maternal mortality

One of the United Nations Millennium Development Goals is to reduce maternal mortality by three-fourth between 1990 and 2015. Although maternal mortality has declined over the past few years, the progress is rather slow in many African countries including Ghana.

A major challenge in monitoring the maternal mortality indicator is the measurement especially in the absence of reliable vital registration systems (Graham et al. 2008). Most of the recent estimates on maternal mortality in Ghana are based on data from population surveys including the 2007 Ghana Maternal Health Survey (GHMS). On the other hand, population surveys do not always provide reliable estimates since maternal death is a rare event and the estimates based on small sample could suffer from large sampling errors. Also, the household report of a maternal death might not be accurate as it is difficult to disentangle the cause of a maternal death especially if the death occurs at home. Additionally, there are restrictions in defining a maternal death based on whether the death of a woman occurred while pregnant from any cause related to pregnancy or incidental causes or within 42 days of termination of pregnancy irrespective of the cause of death (WHO 2012b).

Table 3.3: Age specific death rates (ASDR) per 1000 mid-year population by residence

Age group (years)	Urban			Rural			Total		
	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes
<1	0.038	0.032	0.035	0.047	0.036	0.042	0.043	0.034	0.038
1-4	0.005	0.005	0.005	0.008	0.008	0.008	0.007	0.006	0.007
5-9	0.002	0.001	0.002	0.003	0.002	0.002	0.002	0.002	0.002
10-14	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.001	0.001
15-19	0.001	0.001	0.001	0.002	0.003	0.002	0.001	0.002	0.002
20-24	0.001	0.002	0.002	0.003	0.004	0.003	0.002	0.003	0.002
25-29	0.002	0.002	0.002	0.004	0.005	0.004	0.003	0.003	0.003
30-34	0.003	0.004	0.004	0.006	0.007	0.007	0.004	0.005	0.005
35-39	0.004	0.005	0.005	0.007	0.008	0.007	0.005	0.006	0.006
40-44	0.006	0.007	0.006	0.009	0.009	0.009	0.007	0.008	0.007
45-49	0.007	0.007	0.007	0.009	0.009	0.009	0.008	0.008	0.008
50-54	0.010	0.008	0.009	0.012	0.011	0.011	0.011	0.010	0.010
55-59	0.013	0.007	0.010	0.015	0.009	0.012	0.014	0.008	0.011
60-64	0.018	0.010	0.013	0.021	0.012	0.017	0.019	0.011	0.015
65-69	0.023	0.014	0.018	0.026	0.016	0.021	0.025	0.015	0.019
70-74	0.034	0.016	0.023	0.034	0.017	0.025	0.034	0.017	0.024
75-79	0.042	0.023	0.031	0.039	0.022	0.030	0.040	0.022	0.030
80+	0.067	0.043	0.051	0.068	0.046	0.055	0.068	0.044	0.054

The census provides a unique data source for estimating maternal mortality. In addition to the question on age and sex of death of a household member in the last 12 months, the census asks a specific question: 'Did the death occur whilst pregnant, during delivery, or within 6 weeks after the end of a pregnancy or child birth?' Pregnancy-related deaths are also likely to be underreported along with general underreporting of deaths in the household (Wilmoth 2009).

In the 2010 PHC, about 9% of deaths reported to women aged 10-54 years were pregnancy-related (see Table 3.4). The WHO estimates that 11.3% of all female deaths in the reproductive ages (15-49) are maternal related (WHO 2012b). The highest concentration of pregnancy-related deaths is observed in the 25-29 age range where over a quarter of all births are also concentrated.

Table 3.4: Distribution of general female deaths and pregnancy-related deaths by age and residence, 2010

Age group (in years)	Number of women	Total number of births	Total female deaths	Total pregnancy related deaths	Percentage of pregnancy related deaths
10-14	1,438,515	917	2,054	52	2.5
15-19	1,298,877	40,307	2,647	228	8.6
20-24	1,222,764	126,417	3,350	480	14.3
25-29	1,106,898	167,306	3,809	600	15.8
30-34	888,508	130,724	4,821	666	13.8
35-39	744,635	92,751	4,636	463	10.0
40-44	613,730	41,898	4,714	308	6.5
45-49	485,123	14,742	3,858	146	3.8
50-54	438,498	8,638	4,201	83	2.0
Total	8,237,548	623,700	34,090	3,026	8.9

Table 3.5 presents the Maternal Mortality Ratio (MMR) expressed as deaths per 100,000 live births. The MMR at the national level is 485 deaths per 100,000 live births, which is higher than the 2010 WHO estimate of 350 per 100,000 live births and the 2007 GMHS estimate of 378 deaths per 100,000 live births for the 5 years preceding the survey (WHO 2012b; GSS, GHS and Macro International 2009). However, the census estimate falls within the WHO 95% confidence interval range between 210 and 630 deaths per 100,000 live births (WHO 2012b). This suggests that the census data could be considered fairly reasonable for the direct estimation of MMR.

Maternal mortality is generally higher in rural areas when compared to urban areas (Table 3.5). The age patterns resemble closely between urban and rural areas, except for the relatively high mortality in the 50-54 age range for women in rural areas (Figure 3.2). This observation corresponds to a relatively high fertility among rural women aged above 50 years (Fertility Report, GSS 2014).

There are regional differences in maternal mortality with the Upper East and Volta recording the highest level of maternal mortality and Greater Accra recorded the lowest level (Table 3.6). Four regions including Greater Accra, Ashanti, Brong Ahafo and Upper West regions have maternal mortality below the national level. However, the rural-urban differences within region are noticeable, especially in the Upper East region where maternal mortality in urban areas is twice the level than in rural areas (Figure 3.3). Similar pattern is observed in Volta, Eastern, Northern and Western regions although the rural-urban difference in these regions is trivial.

Table 3.5: Maternal mortality ratio (per 100,000 live births) by age and residence

Age group (in years)	Urban	Rural	Total
10-19	681	678	679
20-24	320	421	380
25-29	317	399	359
30-34	468	553	510
35-39	458	540	499
40-44	732	738	735
45-49	1,055	938	990
50-54	671	1,295	961
Total	444	522	485

Figure 3.2: Age-specific maternal mortality ratios (per 100,000 live births) by residence

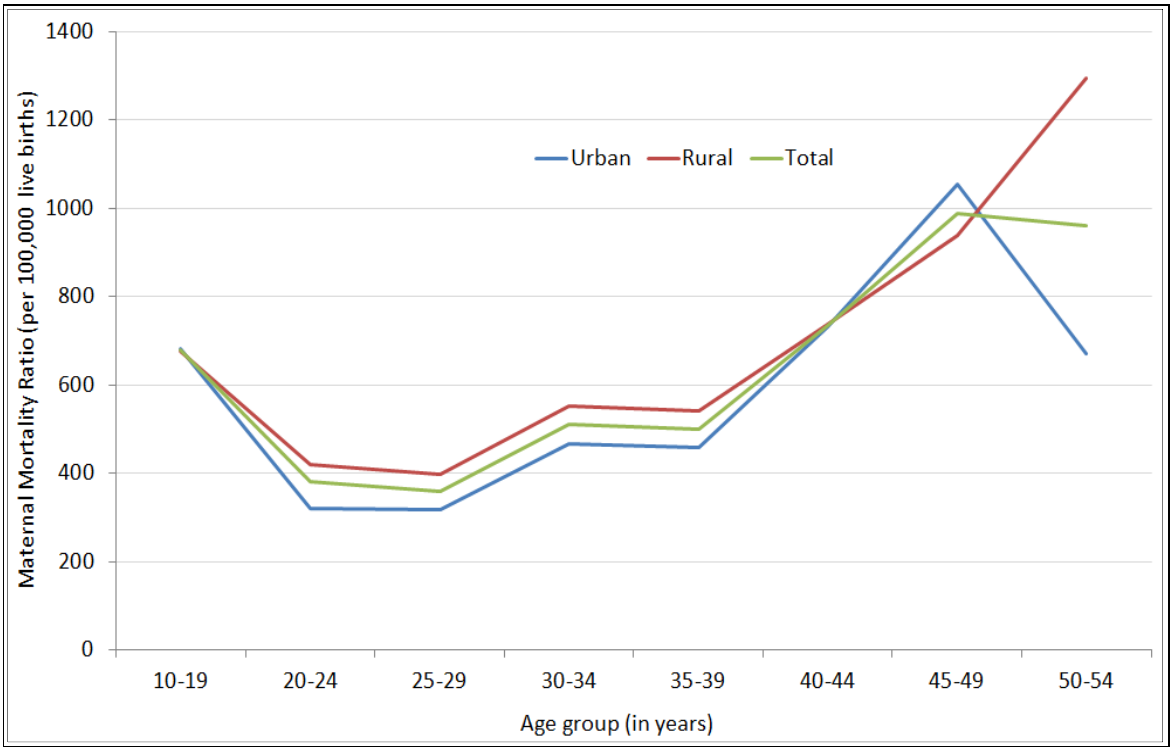
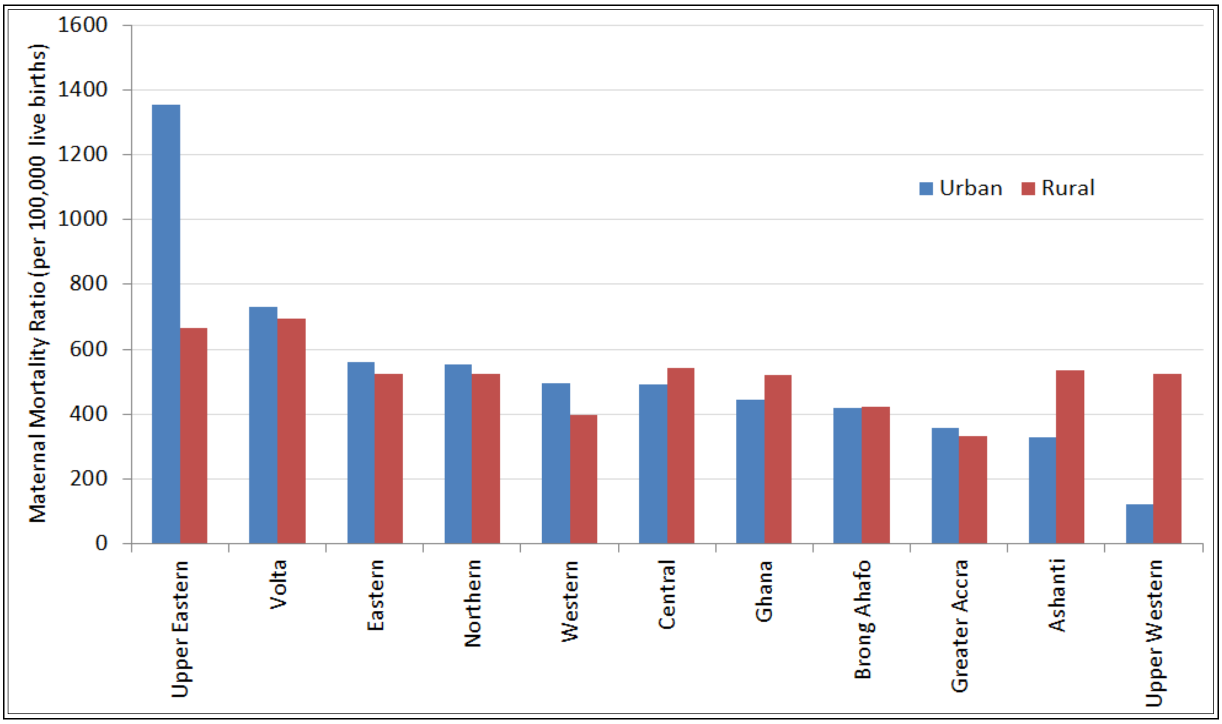


Table 3.6: Maternal mortality ratio (per 100,000 live births) by residence and region,

Region	Urban	Rural	Total
Western	495	397	435
Central	493	542	520
Greater Accra	357	332	355
Volta	730	696	706
Eastern	560	523	538
Ashanti	330	536	421
Brong Ahafo	418	424	422
Northern	554	523	531
Upper East	1354	665	802
Upper West	122	526	466
All	444	522	485

Figure 3.3: Age-specific maternal mortality ratios (per 100,000 live births) by region



3.2 Indirect estimation of mortality

An assessment of the quality of mortality data collected by the 2010 PHC in Ghana demonstrated evidence of reporting bias and errors. This is not specific to Ghana but generally seen across population and housing censuses in both developing and developed countries. This was established through a careful scrutiny of the census data, examining the age and sex distributions of the population, and comparing and validating the observed data with similar recent data obtained from relevant published sources for consistency and reliability.

It is possible to correct these measurement errors in the underlying data and derive reliable estimates of mortality through the application of indirect techniques. The following sub-sections will focus on the indirect estimation of infant and under-five mortality and population life expectancies.

3.2.1 Indirect estimation of infant and under-five mortality based on children ever-born and children surviving data

A general assessment of the demographic data suggests that the age patterns of mortality in Ghana conform to the North Family of the Coale-Demeny Model Life Tables (Coale and Demeny 1983). It was established in the earlier part of this report that data on recent births were inappropriate for the estimation of infant mortality. This is because the births recorded in the 12 months preceding the census do not correspond to the enumerated population aged below 1 year at the time of census, suggesting potential misclassification and underreporting of births. Also, the 2010 PHC has no information on the survival status of recent births. Hence, the estimations relied on the Children Ever-Born (CEB) and Children Surviving (CS) data corresponding to women aged 15-49 years. It has to be noted that the cleaned version of the census data have information on births to women from age 10 to 54 years. However, in relative terms the births below 15 and above 50 are lesser when compared to those in the 15-49 years – although the survival chances of children born to younger and older women are low. Yet another reason for restricting the analysis to 15-49 years is to ensure comparison of indicators with other sources and also taking into account the options available in the MORTPAK package version 4.3 (United Nations 2013b).

The estimation of infant, child and under-five mortality was carried out by using the QFIVE option based on Brass methods comparing the Trussell version of the Coale-Demeny model life tables and the Palloni-Heligman version of the United Nations model life tables. The input data used were the month and year of enumeration (September 2010), life table referring to whether the sex is male or female or both sexes, sex ratio at birth, mean age at childbearing and the average CEB and CS based on age group of women. Brass et al. (1968) estimated the probability of dying between birth and age *a* as:

$$\mathbf{q(a) = M(x,5) \times D(x,5)} \quad \mathbf{(1)}$$

where *M(x,5)* is a multiplier or an age-specific factor which depends on indices of the age patterns of fertility and D(x,5) is the proportion of children dead to women aged (x, x+5). The proportion of children dead for women in each age group is used to calculate q(a) for different values. A set of regression equations are derived to estimate the probabilities of dying between age 0 and 1(q(0,1), age 1 and 4 (q(1,4)) and age 0 and 5 (q(0,5) corresponding to the q(a) values of mortality patterns within each Model Life Table. A detailed description of the estimation procedure is available elsewhere (United Nations 2013b). After making an initial comparison of different families of model life tables and reflecting on the age patterns of mortality, the North Model has been found appropriate for Ghana. The mortality estimation based on Trussell's version of the Coale and Demeny model life table for infant and under-five mortality for both sexes is illustrated in Tables 3.7 and 3.8 respectively.

Based on the estimates, the infant mortality for both sexes was derived by averaging the values from the North model for women in the age group 25-39. This produced a realistic estimate of 59 infant deaths per 1000 live births for the reference period 2002-2006 (Table 3.7). This is higher than the 2008 DHS which provides a direct estimate of infant mortality rate at 50 based on the reference period 2004-2008 and 59 based on an indirect estimate based on 2008 GDHS data (GSS 2013). The estimated under-five mortality rate of 90 deaths per 1000 live births is also slightly higher than the 2008 GDHS data. However, the general trends in infant and under-five mortality over the last 25 years seem fairly consistent, except for the slightly higher estimates obtained indirectly from the 2000 and 2010 PHCs (Figure 3.4).

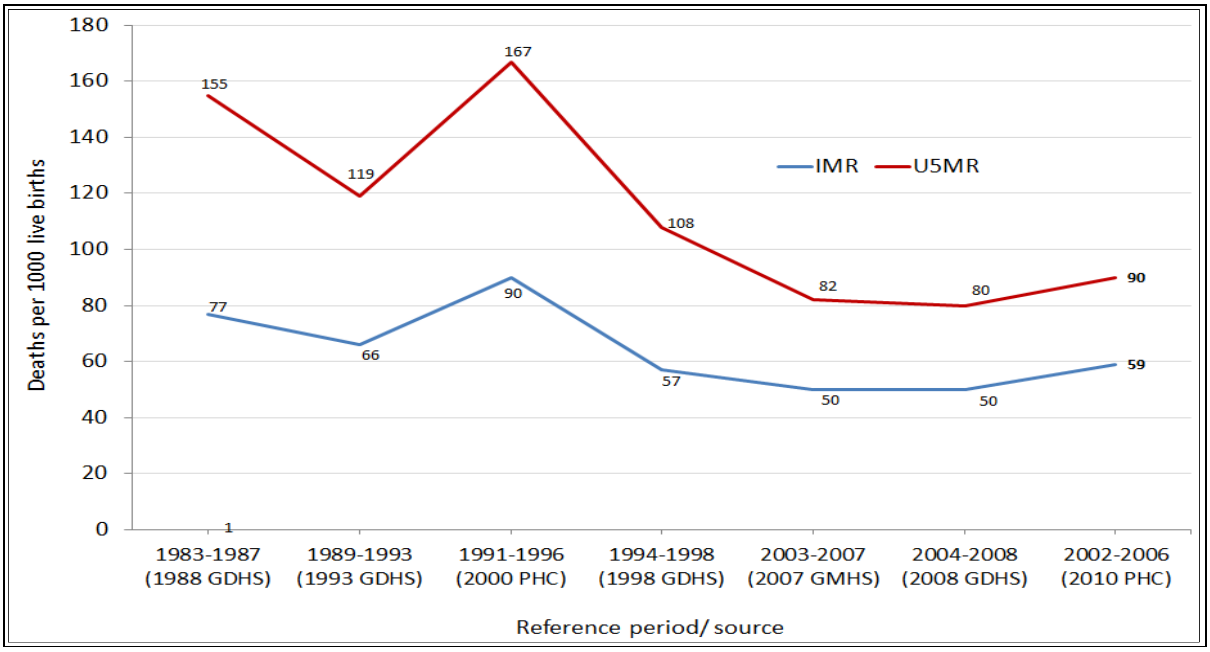
Table 3.7: Indirect estimates of infant mortality rate ($_1q_0$) by applying the Trussell equations

Mother's age group (years)	Average number of children ever-born	Average no. of children surviving	Proportion dead	Age	Reference date	West	North	East	South
15-19	0.106	0.094	0.113	1	2009.6	0.119	0.116	0.12	0.112
20-24	0.684	0.618	0.096	2	2008.5	0.086	0.078	0.09	0.086
25-29	1.601	1.463	0.086	3	2006.8	0.069	0.062	0.075	0.072
30-34	2.706	2.470	0.087	5	2004.9	0.065	0.058	0.072	0.070
35-39	3.587	3.256	0.092	10	2002.7	0.065	0.057	0.072	0.072
40-44	4.310	3.838	0.110	15	2000.2	0.070	0.061	0.080	0.078
45-49	4.705	4.126	0.123	20	1997.4	0.071	0.061	0.083	0.082

Table 3.8: Indirect estimates of under-five mortality rate ($_5q_0$) by applying the Trussell equations

Mother's age group (years)	Average no. of children ever born	Average no. of children surviving	Proportion dead	Age	Reference date	West	North	East	South
15-19	0.106	0.094	0.113	1	2009.6	0.175	0.194	0.159	0.17
20-24	0.684	0.618	0.096	2	2008.5	0.121	0.125	0.116	0.117
25-29	1.601	1.463	0.086	3	2006.8	0.095	0.095	0.093	0.094
30-34	2.706	2.47	0.087	5	2004.9	0.089	0.088	0.089	0.091
35-39	3.587	3.256	0.092	10	2002.7	0.088	0.086	0.09	0.093
40-44	4.31	3.838	0.11	15	2000.2	0.097	0.093	0.101	0.104
45-49	4.705	4.126	0.123	20	1997.4	0.099	0.093	0.105	0.11

Figure 3.4: Trends in mortality rates comparing estimates from the 2010 PHC and other relevant sources pertaining to different reference period



Data source: 1988, 1993, 1998, 2008 GDHS; 2007 GHMS; 2000, 2010 PHC

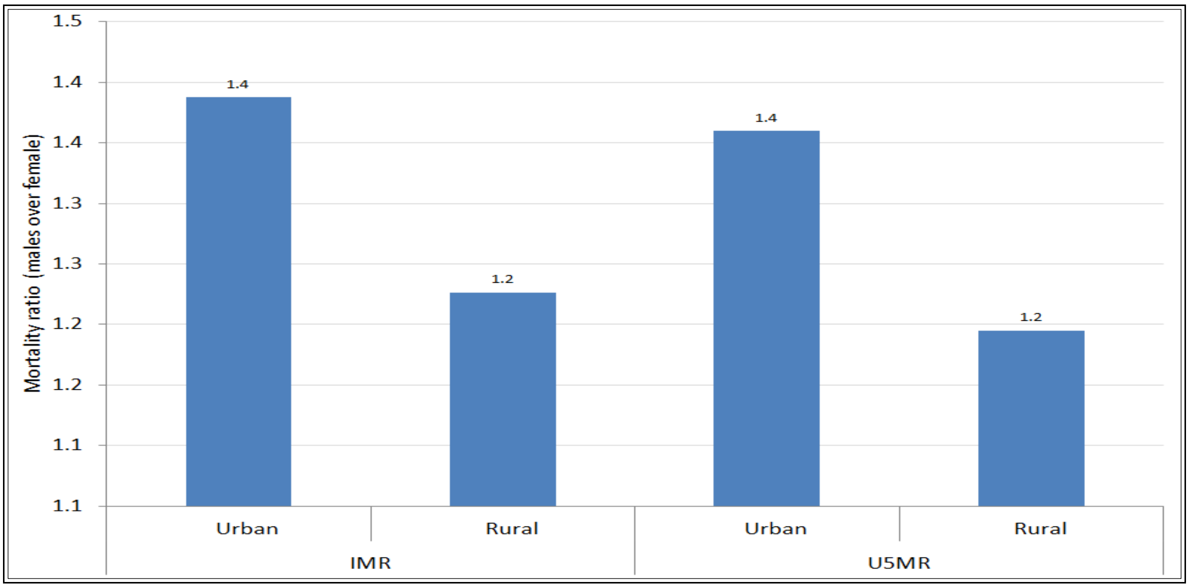
Table 3.9 presents the estimates of infant, child and under-five mortality by sex. The rural-urban difference in mortality rates is trivial for both sexes. However, male infant and under-five mortality rates are slightly higher in urban areas when compared to their counterparts in rural areas, whereas the corresponding mortality rates for females are higher in rural areas (Figure 3.5). This could be attributed to possible high under-reporting of deaths in rural areas. More generally, both infant and under-five mortality rates are relatively higher for males than females.

Table 3.9: Estimates of infant ($_1q_0$), child ($_1q_4$) and under-five mortality rate ($_5q_0$) by sex and residence

	Rate (per 1000 live births)		
Estimate	Male	Female	Both sexes
Infant mortality rate ($_1q_0$)			
Urban	68	49	58
Rural	65	53	59
Total	67	51	59
Child mortality rate ($_4q_1$)			
Urban	35	26	31
Rural	33	29	31
Total	33	28	31
Under-five mortality rate ($_5q_0$)			
Urban	102	75	89
Rural	98	82	90
Total	100	79	90

Note: reference period corresponding to mothers aged between 25 and 40 in the North model is considered for the estimation of mortality rates

Figure 3.5: Male-female ratio of estimated mortality rates by residence

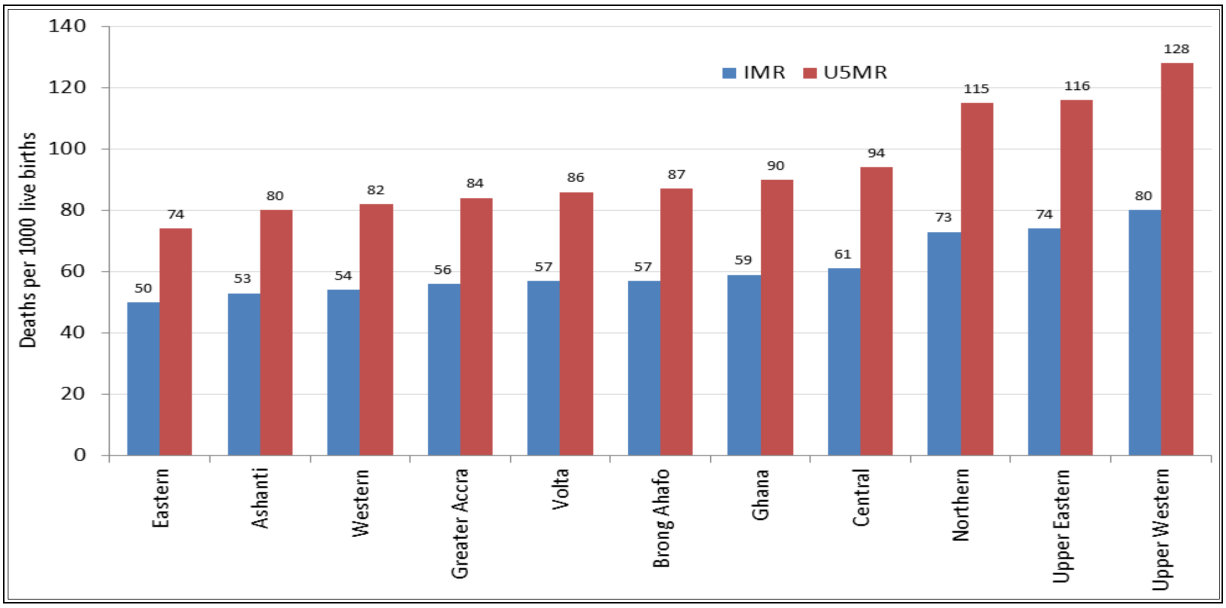


There are marked regional differences in infant, child and under-five mortality rates (Figure 3.6a). Both IMRs and U5MRs are consistently the highest in the Upper West and Upper East regions and the lowest in the Eastern and Ashanti regions. The difference between IMR and U5MR is also the highest in the Upper West and Upper East regions when compared to other regions. This suggests high mortality rates between ages 1 and 4 in these regions. The Central, Northern, Upper East and Upper West regions have both IMRs and U5MRs above the national average.

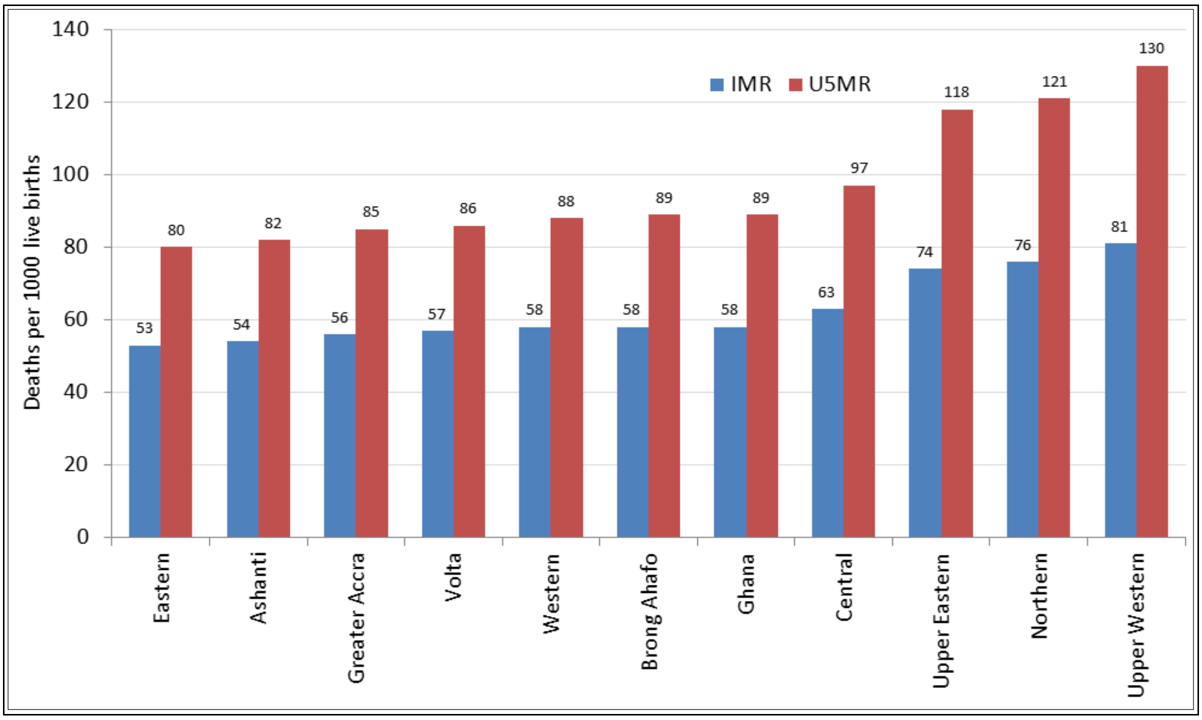
Both IMRs and U5MRs are consistently higher in urban areas across all regions. The mortality rates in urban areas are the highest in the Upper West, Northern and Upper East regions respectively (Figure 3.6b).

Figure 3.6: Infant (IMR) and under-five mortality (U5MR) rates by region

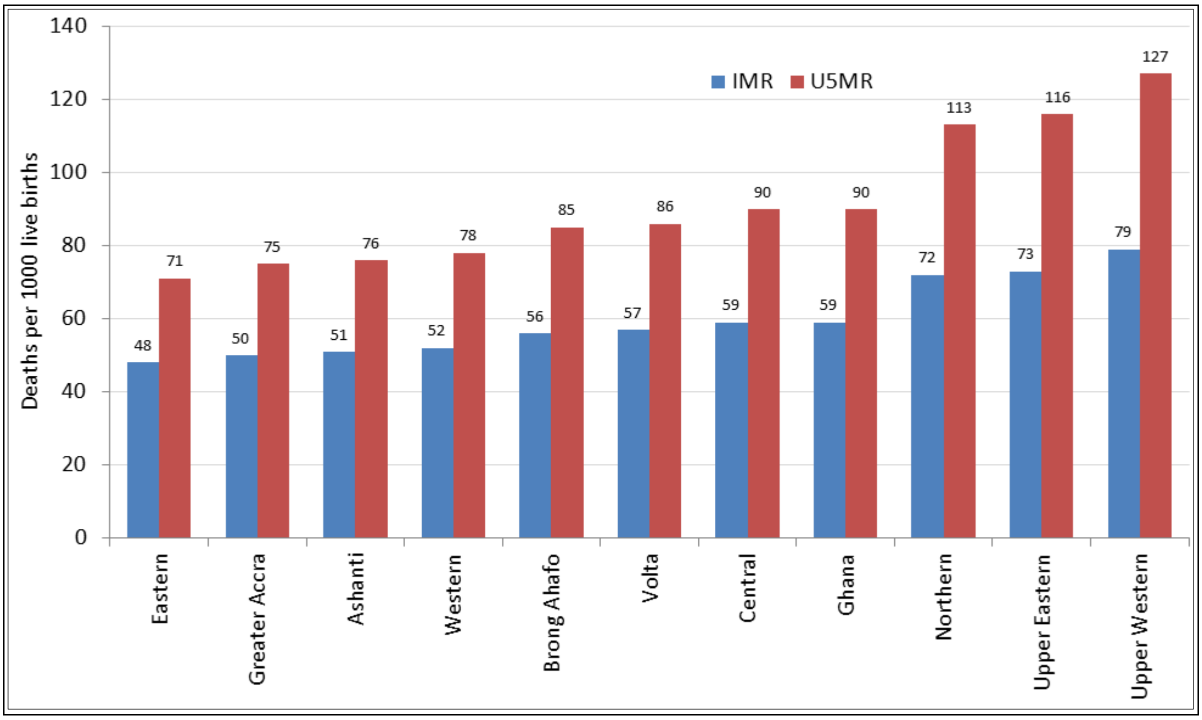
(a) Total



(b) Urban



(c) Rural



However, in rural areas, the patterns resemble closely those observed at the national level (Figure 3.5b). There is clearly high rates of child mortality between ages 1 and 5 in the Upper West, Upper East and Northern regions.

3.2.2 Indirect estimation of life expectancy

Life expectancy is a measure of population longevity that summarises the mortality experiences of a population at different ages throughout the life into a single index that may be derived from a life table calculated from the age-specific death rates. For example, the life expectancy at birth indicates how long a new born may be expected to live if he or she experiences the age –specific death rates observed during a given year. Life expectancy measures the additional number of years that an average person may be expected to live if mortality conditions remain unaltered. Life tables are applied more widely beyond mortality studies including fertility, nuptiality, contraceptive use, migration and also as a key input for projecting future populations.

The basic input data for the construction of life tables are age-specific distribution of mid-year population and deaths which are usually provided by the census. It is important to ensure that the reported age and sex distribution of deaths are not influenced by any irregularities or reporting bias. As reported earlier, the mortality data from the 2010 PHC are underreported especially uniformly across different ages which will influence the estimation procedure and the life expectancies at various ages. To overcome the problems with inaccurate or incomplete mortality data, model life tables can be used (Coale and Demney 1983). The model life tables are a set of life tables indexed by a family or a group of model life tables with similar age patterns of mortality based on the experience of populations which are geographically close to each other and by the level of mortality within each family from low to high life expectancy at birth.

Model life tables can be classified into two types: empirical and relational. The empirical model life tables developed by Coale and Demeny are widely used consisting of four different families based on age patterns of mortality: North, West, East and South model life tables (Coale and Demney 1983). The relational model life tables are based on the mathematical relationship between two life tables constructed by performing a logit transformation of the probabilities of dying before a specific age (Brass 1971). The Brass logit adjusts the probabilities of dying by smoothing or completing a life table with missing values based on regression equations. The life tables presented in this report are based on the Coale and Demeny North Model Life Tables generated using the procedure MATCH available in the MORTPAK software package version 4.3 (United Nations 2013b). The input data for the life table estimation were the probabilities of dying between age 0 and 1 derived from QFIVE procedure.

Alternative options correcting for reported number of deaths and completeness of reporting of adult mortality over the intercensal period were not explored due to limited data availability.

The empirical model life tables based on the Coale and Demeny North model are presented separately for males and females and by residence in Tables 3.10-3.15. Readers are referred to section 2 for the definition of the specific life table functions.

Table 3.10: Empirical model life table for males based on Coale and Demeny North Model

Age (in years)	Average years lived by $_na_x$	Age-specific death rate $_nm_x$	Probability of dying $_nq_x$	Probability of survival $_np_x$	Number alive l_x	Number dying $_nd_x$	Person years lived $_nL_x$	Total person years lived T_x	Life expectancy e_x
0	0.24	0.0706	0.0670	0.9330	100,000	6,700	94,875	5,937,088	59.4
1	1.45	0.0094	0.0367	0.9633	93,300	3,420	364,484	5,842,213	62.6
5	2.50	0.0035	0.0171	0.9829	89,880	1,539	445,556	5,477,728	60.9
10	2.50	0.0020	0.0101	0.9899	88,342	890	439,485	5,032,173	57.0
15	2.65	0.0029	0.0145	0.9855	87,452	1,272	434,269	4,592,688	52.5
20	2.58	0.0042	0.0209	0.9791	86,180	1,803	426,531	4,158,420	48.3
25	2.51	0.0044	0.0217	0.9783	84,378	1,830	417,337	3,731,889	44.2
30	2.53	0.0047	0.0233	0.9767	82,547	1,923	407,986	3,314,551	40.2
35	2.56	0.0053	0.0262	0.9738	80,624	2,112	397,957	2,906,565	36.1
40	2.58	0.0065	0.0319	0.9681	78,512	2,505	386,489	2,508,608	32.0
45	2.60	0.0081	0.0399	0.9601	76,008	3,031	372,770	2,122,119	27.9
50	2.61	0.0115	0.0559	0.9441	72,976	4,078	355,122	1,749,350	24.0
55	2.61	0.0152	0.0735	0.9265	68,898	5,067	332,391	1,394,227	20.2
60	2.63	0.0229	0.1086	0.8914	63,831	6,934	302,692	1,061,837	16.6
65	2.61	0.0351	0.1617	0.8383	56,897	9,202	262,484	759,145	13.3
70	2.58	0.0550	0.2425	0.7575	47,694	11,568	210,425	496,661	10.4
75	2.51	0.0873	0.3584	0.6416	36,127	12,947	148,370	286,236	7.9
80+	5.95	0.1681			23,179	23,179	137,865	137,865	5.9

Table 3.11: Empirical model life table for females based on Coale and Demeny North Model

Age (in years)	Average years lived by those dying nax	Age-specific death nmx	Probability of dying nqx	Probility of survival npx	Number alive lx	Number dying ndx	Person years lived nLx	Total person years lived Tx	Life expect-ancy ex
0	0.20	0.0532	0.0510	0.9490	100,000	5,100	95,935	6,441,926	64.4
1	1.44	0.0075	0.0294	0.9706	94,900	2,792	372,454	6,345,990	66.9
5	2.50	0.0026	0.0129	0.9871	92,107	1,186	457,573	5,973,536	64.9
10	2.50	0.0016	0.0081	0.9919	90,922	739	452,760	5,515,964	60.7
15	2.59	0.0020	0.0102	0.9898	90,183	916	448,709	5,063,203	56.1
20	2.58	0.0026	0.0129	0.9871	89,267	1,155	443,535	4,614,494	51.7
25	2.55	0.0030	0.0150	0.9850	88,112	1,322	437,319	4,170,960	47.3
30	2.55	0.0034	0.0170	0.9830	86,789	1,471	430,342	3,733,641	43.0
35	2.57	0.0040	0.0196	0.9804	85,318	1,673	422,526	3,303,299	38.7
40	2.57	0.0050	0.0246	0.9754	83,645	2,057	413,233	2,880,773	34.4
45	2.59	0.0059	0.0291	0.9709	81,588	2,372	402,232	2,467,540	30.2
50	2.61	0.0082	0.0404	0.9596	79,217	3,197	388,459	2,065,308	26.1
55	2.63	0.0111	0.0541	0.9459	76,020	4,115	370,352	1,676,848	22.1
60	2.66	0.0172	0.0829	0.9171	71,905	5,957	345,562	1,306,496	18.2
65	2.65	0.0279	0.1310	0.8690	65,948	8,641	309,394	960,935	14.6
70	2.61	0.0459	0.2067	0.7933	57,306	11,843	258,218	651,541	11.4
75	2.55	0.0746	0.3155	0.6845	45,463	14,344	192,163	393,324	8.7
80+	6.46	0.1547	...	...	31,119	31,119	201,161	201,161	6.5

Table 3.12: Empirical model life table for urban males based on Coale and Demeny North Model

Age (in years)	Average years lived by those dying $_na_x$	Age-specific death rate $_nm_x$	Probability fo dying $_nq_x$	Probability of survival $_np_x$	Number alive l_x	Number dying $_nd_x$	Person years lived $_nL_x$	Total person years lived T_x	Life expec-tancy e_x
0	0.24	0.0717	0.0680	0.9320	100,000	6,800	94,818	5,912,194	59.1
1	1.45	0.0096	0.0375	0.9625	93,200	3,491	363,890	5,817,376	62.4
5	2.50	0.0035	0.0175	0.9825	89,709	1,566	444,627	5,453,486	60.8
10	2.50	0.0021	0.0102	0.9898	88,142	903	438,453	5,008,859	56.8
15	2.65	0.0030	0.0147	0.9853	87,239	1,284	433,172	4,570,406	52.4
20	2.58	0.0043	0.0212	0.9788	85,955	1,820	425,360	4,137,235	48.1
25	2.51	0.0044	0.0220	0.9780	84,135	1,848	416,080	3,711,874	44.1
30	2.53	0.0048	0.0236	0.9764	82,287	1,941	406,641	3,295,795	40.1
35	2.56	0.0054	0.0265	0.9735	80,346	2,130	396,522	2,889,154	36.0
40	2.58	0.0066	0.0323	0.9677	78,216	2,525	384,955	2,492,632	31.9
45	2.60	0.0082	0.0403	0.9597	75,690	3,052	371,131	2,107,677	27.8
50	2.61	0.0116	0.0564	0.9436	72,638	4,096	353,386	1,736,546	23.9
55	2.61	0.0154	0.0742	0.9258	68,542	5,084	330,568	1,383,160	20.2
60	2.62	0.0231	0.1094	0.8906	63,458	6,943	300,803	1,052,592	16.6
65	2.61	0.0353	0.1627	0.8373	56,516	9,196	260,588	751,789	13.3
70	2.57	0.0553	0.2438	0.7562	47,320	11,539	208,612	491,201	10.4
75	2.51	0.0877	0.3599	0.6401	35,781	12,878	146,800	282,589	7.9
80+	5.93	0.1687	...	...	22,903	22,903	135,789	135,789	5.9

Table 3.13: Empirical model life table for urban females based on Coale and Demeny North Model

Age (in years)	Average years lived by those dying nax	Age-specific death rate nmx	Probability of dying nqx	Probability of survival npx	Number alive lx	Number dying ndx	Person years lived nLx	Total person years lived Tx	Life expect-ancey ex
0	0.20	0.0510	0.0490	0.9510	100,000	4,900	96,065	6,501,228	65.0
1	1.44	0.0070	0.0277	0.9723	95,100	2,633	373,671	6,405,162	67.4
5	2.50	0.0024	0.0121	0.9879	92,467	1,121	459,534	6,031,491	65.2
10	2.50	0.0015	0.0077	0.9923	91,346	705	454,970	5,571,957	61.0
15	2.60	0.0020	0.0097	0.9903	90,641	881	451,088	5,116,987	56.5
20	2.58	0.0025	0.0125	0.9875	89,760	1,118	446,092	4,665,899	52.0
25	2.55	0.0029	0.0144	0.9856	88,642	1,280	440,074	4,219,807	47.6
30	2.55	0.0033	0.0163	0.9837	87,362	1,423	433,321	3,779,734	43.3
35	2.57	0.0038	0.0189	0.9811	85,939	1,621	425,758	3,346,413	38.9
40	2.58	0.0048	0.0238	0.9762	84,318	2,007	416,723	2,920,655	34.6
45	2.59	0.0057	0.0282	0.9718	82,311	2,325	405,964	2,503,932	30.4
50	2.62	0.0080	0.0394	0.9606	79,986	3,153	392,416	2,097,968	26.2
55	2.63	0.0109	0.0529	0.9471	76,833	4,064	374,543	1,705,553	22.2
60	2.66	0.0169	0.0812	0.9188	72,769	5,908	350,009	1,331,010	18.3
65	2.65	0.0274	0.1288	0.8712	66,861	8,611	314,052	981,001	14.7
70	2.61	0.0451	0.2037	0.7963	58,250	11,867	262,911	666,949	11.4
75	2.55	0.0737	0.3121	0.6879	46,383	14,477	196,483	404,038	8.7
80+	6.51	0.1537	...	...	31,906	31,906	207,555	207,555	6.5

Table 3.14: Empirical model life table for rural males based on Coale and Demeny North Model

Age (in years)	Average years lived by those dying $_na_x$	Age-specific death rate $_nm_x$	Probability of dying $_nq_x$	Probability of survival $_np_x$	Number alive l_x	Number dying $_nd_x$	Person years lived $_nL_x$	Total person years lived T_x	Life expectancy e_x
0	0.23	0.0684	0.0650	0.9350	100,000	6,500	94,991	5,987,270	59.9
1	1.46	0.0090	0.0350	0.9650	93,500	3,276	365,670	5,892,279	63.0
5	2.50	0.0033	0.0164	0.9836	90,224	1,483	447,412	5,526,609	61.3
10	2.50	0.0020	0.0097	0.9903	88,741	863	441,548	5,079,197	57.2
15	2.65	0.0029	0.0142	0.9858	87,878	1,246	436,463	4,637,649	52.8
20	2.58	0.0041	0.0204	0.9796	86,632	1,768	428,874	4,201,186	48.5
25	2.51	0.0043	0.0212	0.9788	84,864	1,795	419,857	3,772,311	44.5
30	2.53	0.0046	0.0227	0.9773	83,069	1,888	410,682	3,352,454	40.4
35	2.56	0.0052	0.0255	0.9745	81,181	2,073	400,837	2,941,772	36.2
40	2.58	0.0063	0.0311	0.9689	79,108	2,463	389,569	2,540,935	32.1
45	2.60	0.0079	0.0390	0.9610	76,645	2,988	376,064	2,151,366	28.1
50	2.61	0.0113	0.0549	0.9451	73,657	4,042	358,616	1,775,301	24.1
55	2.61	0.0150	0.0723	0.9277	69,614	5,032	336,063	1,416,685	20.4
60	2.63	0.0226	0.1071	0.8929	64,582	6,916	306,504	1,080,622	16.7
65	2.61	0.0346	0.1598	0.8402	57,667	9,214	266,320	774,118	13.4
70	2.58	0.0543	0.2399	0.7601	48,453	11,624	214,103	507,798	10.5
75	2.51	0.0863	0.3553	0.6447	36,828	13,086	151,568	293,694	8.0
80+	5.99	0.1671	...	...	23,743	23,743	142,127	142,127	6.0

Table 3.15: Empirical model life table for rural females based on Coale and Demeny North Model, 2010

Age (in years)	Average years lived by those dying $_na_x$	Age-specific death rate $_nm_x$	Probability of dying $_nq_x$	Probability of survival $_np_x$	Number alive l_x	Number dying $_nd_x$	Person years lived $_nL_x$	Total person years lived T_x	Life expectancy e_x
0	0.21	0.0553	0.0530	0.9470	100,000	5,300	95,808	6,383,279	63.8
1	1.44	0.0080	0.0312	0.9688	94,700	2,953	371,234	6,287,471	66.4
5	2.50	0.0027	0.0136	0.9864	91,747	1,251	455,609	5,916,237	64.5
10	2.50	0.0017	0.0085	0.9915	90,496	773	450,549	5,460,628	60.3
15	2.59	0.0021	0.0106	0.9894	89,723	950	446,329	5,010,079	55.8
20	2.58	0.0027	0.0134	0.9866	88,774	1,192	440,978	4,563,751	51.4
25	2.55	0.0031	0.0156	0.9844	87,582	1,364	434,568	4,122,772	47.1
30	2.55	0.0036	0.0176	0.9824	86,218	1,518	427,369	3,688,204	42.8
35	2.57	0.0041	0.0204	0.9796	84,700	1,725	419,305	3,260,836	38.5
40	2.57	0.0051	0.0254	0.9746	82,975	2,106	409,758	2,841,531	34.2
45	2.59	0.0061	0.0299	0.9701	80,869	2,417	398,522	2,431,773	30.1
50	2.61	0.0084	0.0413	0.9587	78,452	3,238	384,532	2,033,251	25.9
55	2.63	0.0114	0.0554	0.9446	75,214	4,164	366,200	1,648,719	21.9
60	2.65	0.0176	0.0845	0.9155	71,050	6,004	341,166	1,282,519	18.1
65	2.64	0.0284	0.1333	0.8667	65,046	8,668	304,805	941,353	14.5
70	2.61	0.0466	0.2096	0.7904	56,378	11,815	253,613	636,548	11.3
75	2.55	0.0756	0.3189	0.6811	44,563	14,209	187,947	382,936	8.6
80+	6.42	0.1557	...	...	30,353	30,353	194,988	194,988	6.4

The results based on the model life table estimations show a life expectancy at birth of 59.4 and 64.4 years for males and females respectively. The UN medium and high variant estimation for the period 2005-2010 shows a male life expectancy of 60 years and 61.9 years for females (United Nations 2013a). The observed difference in the estimations could be attributed to the different assumptions, although the differences are trivial.

The male and female probabilities of dying and those by residence are illustrated in Figures 3.7 and 3.8 respectively. The age patterns of mortality confirm the general expected shape, despite little fluctuations and elevated mortality risks for males in the adult ages, especially in rural areas. To derive meaningful interpretations, we need to compare life tables adjusting for age distortions in reported number of deaths observed during the intercensal period.

Table 3.16 provides a summary of life expectancies at various ages. More generally, females are likely to live longer at all ages than males in both urban and rural areas. The sex difference is pronounced in urban areas with a gap of 6 years between male and female life expectancy at birth, and the difference narrows after age 60 especially in rural areas. Male life expectancy is generally slightly lower in urban areas when compared to their counterparts in rural areas. At age 60, an average male in Ghana can expect to live an additional 16.6 years whereas an average female can live an additional 18.2 years.

Table 3.16: Summary of life expectancies at various ages

Exact age (in years)	Urban		Rural		Total	
	Male	Female	Male	Female	Male	Female
0	59.1	65	59.9	63.8	59.4	64.4
5	60.8	65.2	61.3	64.5	60.9	64.9
15	52.4	56.5	52.8	55.8	52.5	56.1
25	44.1	47.6	44.5	47.1	44.2	47.3
45	27.8	30.4	28.1	30.1	27.9	30.2
60	16.6	18.3	16.7	18.1	16.6	18.2
65	13.3	14.7	13.4	14.5	13.3	14.6
70	10.4	11.4	10.5	11.3	10.4	11.4

Figure 3.7: Probabilities of dying between exact ages by sex based on the Coale and Demeny North Model life tables

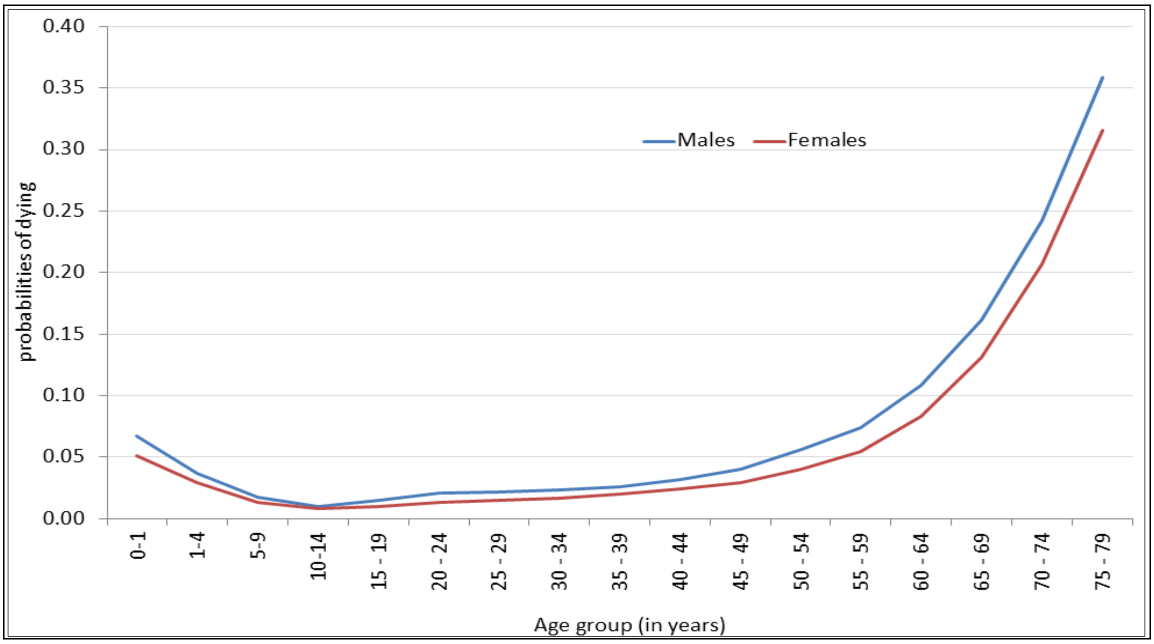
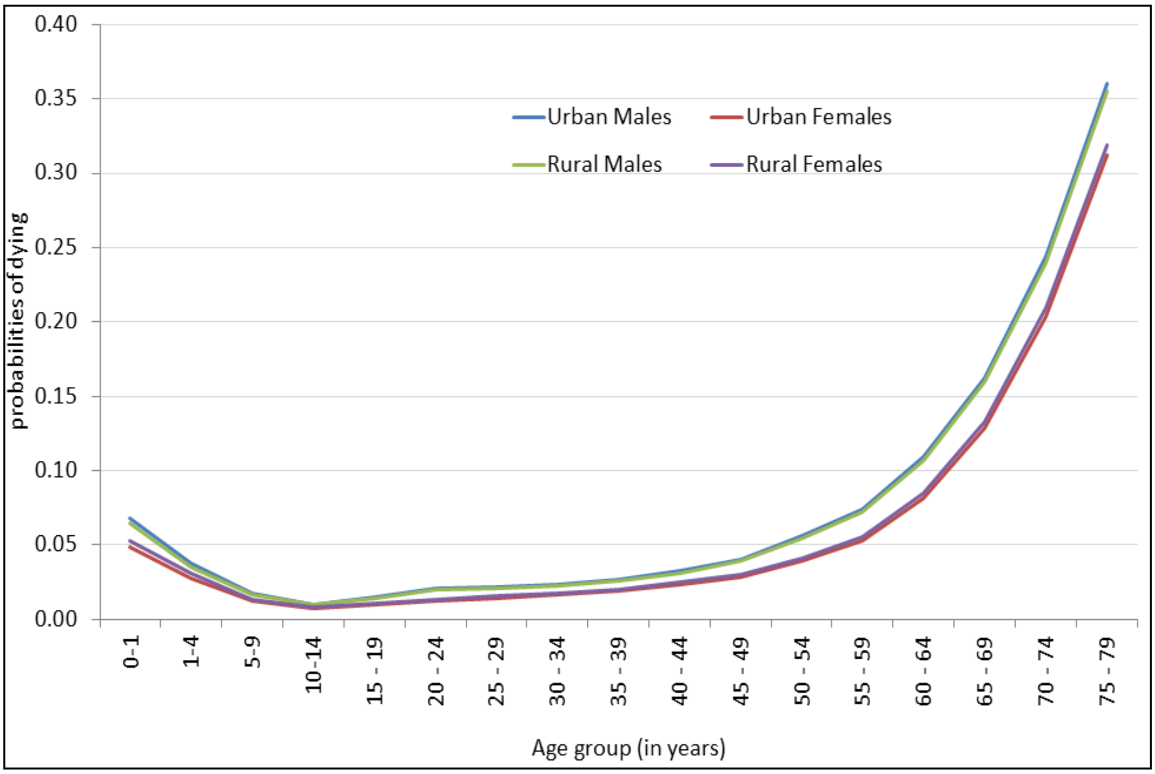


Figure 3.8: Probabilities of dying between exact ages by sex and residence based on the Coale and Demeny North Model life tables



<data on CEB, CS for males and females not available by region and residence>

CHAPTER FOUR
DEMOGRAPHIC AND SOCIOECONOMIC DIFFERENTIALS IN MORTALITY

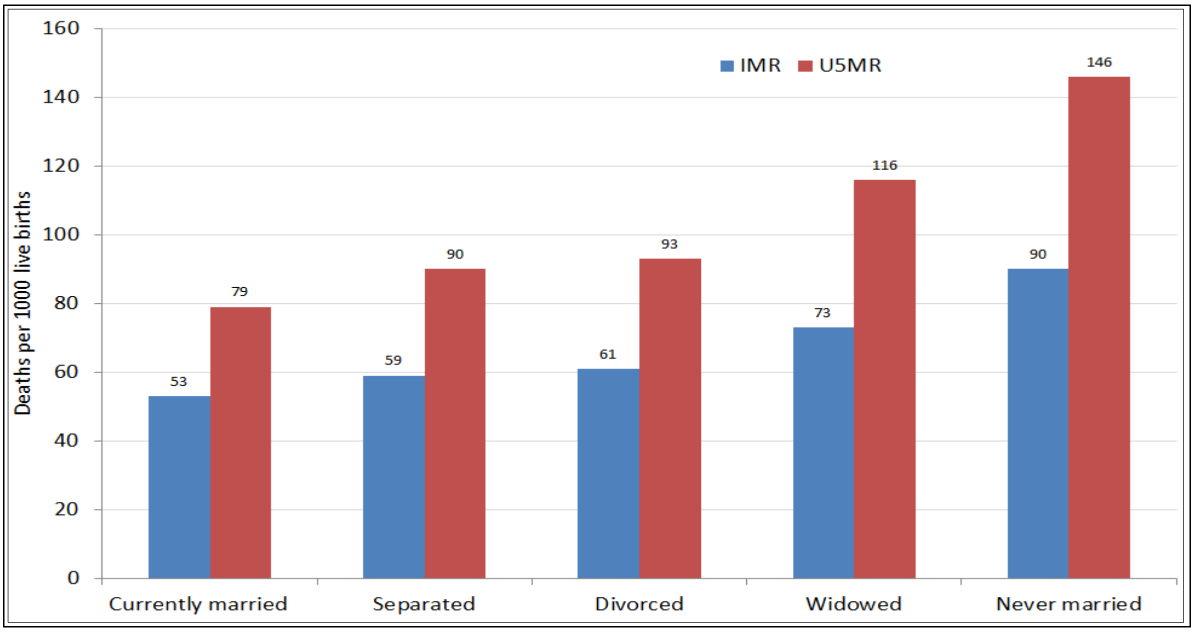
As discussed in the background section, demographic and social factors exert significant influence in mortality at younger ages. This section presents the demographic and social differentials in infant, child and under-five mortality rates. Table 4.1 presents the IMR, CMR and U5MRs disaggregated by demographic and socioeconomic characteristics of women aged 12 years and over.

Marital status

Children born in households with both father and mother in marital union are generally more likely to survive than those born in households with a single parent. This is partly explained by the care provision and family environment where children have better opportunities for cognitive development and physical growth. It is important to note that union status is a function of an individual's biological age. Women usually experience widowhood during old ages. On the other hand, young women are vulnerable to marital dissolution through divorce or separation which can affect the mental and physical development of young children.

The analysis of 2010 PHC shows that never-married or widowed women experienced the highest rates of IMR and U5MR. In contrast, currently married women had the lowest rates of IMR and U5MR (Figure 4.1a). Similar mortality patterns are observed in both urban and rural areas. However, the levels of IMR and U5MR especially for the never-married and widowed women are relatively high in urban areas when compared to their rural counterparts.

Figure 4.1: Infant (IMR) and under-five mortality (U5MR) rates by women's marital status

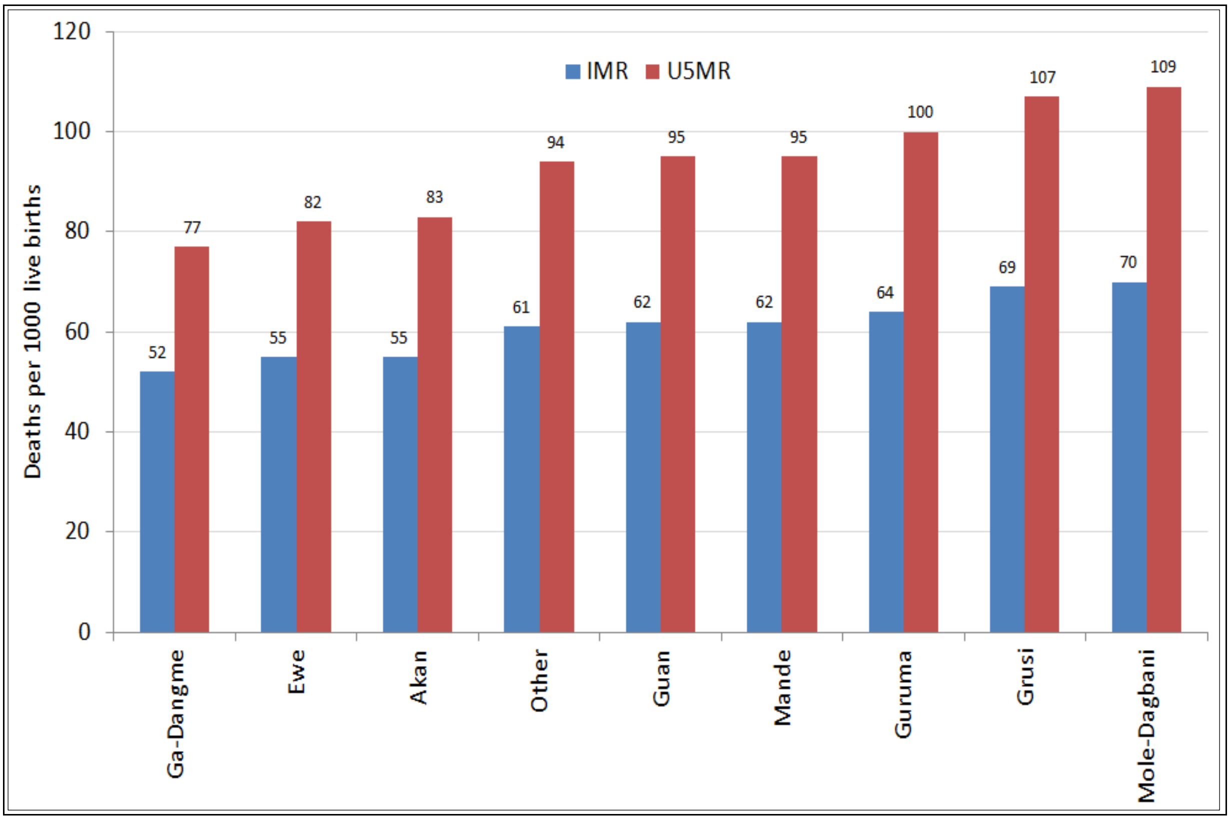


Ethnicity

The ethnic origin of people is an indicator of social and economic status and population representation. Usually, minority groups are generally socially disadvantaged and marginalised in terms of education, employment and health related outcomes. Ethnicity is also used to classify population groups according to whether they are born native or non-native within a community or region. The Ghanaian population is generally divided into 8 sub-groups with Akans representing the largest group of about 50% of the total population, followed by Mole-Dagbon, Ewe and Ga-Dangme (GSS, GHS and ICF Macro 2009).

Based on the 2010 PHC data, the majority Akans have an IMR of 55 deaths per 1000 live births and an U5MR of 83 deaths per 1000 live births. In comparison, IMR and U5MRs are highest among the Mole-Dagbani who represents the second largest ethnic group whereas the Ga-Dangme group experienced the lowest rates of mortality (Figure 4.2). On the other hand, Akan women residing in urban areas had the lowest level of IMR and U5MR followed by Ga-Dangme. Grusi and Mole-Dagbani women in urban areas experienced the highest infant and under-five mortality (Table 4.1). Child mortality defined in terms of the probability of dying between ages 1 and 4 is also the highest amongst the Mole-Dagbani group.

Figure 4.2: Infant (IMR) and under-five mortality (U5MR) rates by women's Ethnicity

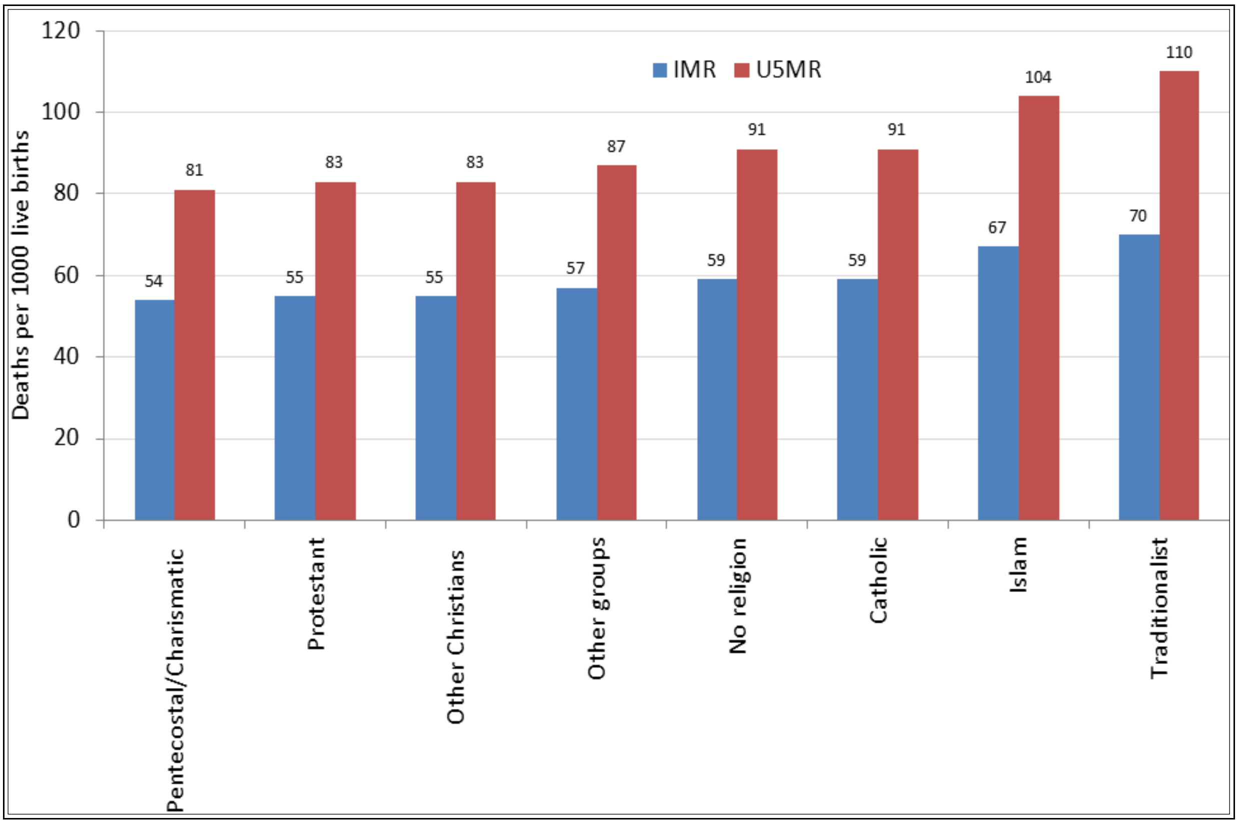


Religious affiliation

Religion is embedded in the sociocultural fabric of a society, especially in economically less developed countries where population subgroups are identified mainly by their ethnic status and religious affiliation. There is also evidence that associate religious affiliation and related cultural practices to certain demographic or reproductive behaviour. Over three-fourth of the population in Ghana follow Christianity followed by less than one-fifth of those who practice Islam.

The 2010 PHC demonstrates evidence of relatively high mortality amongst who follow the Traditionalist faith with an IMR of 70 deaths per 1000 live births and an U5MR of 110 deaths per 1000 live births, followed by Islam and Catholic groups (Figure 4.3). Those who practice no religion also have IMR and U5MR close to the national average. Those who follow Pentecostal or Charismatic or Protestant faith had the lowest level of IMR and U5MR. Similar mortality patterns are observed between women in urban and rural areas.

Figure 4.3: Infant (IMR) and under-five mortality (U5MR) rates by women's Religious affiliation

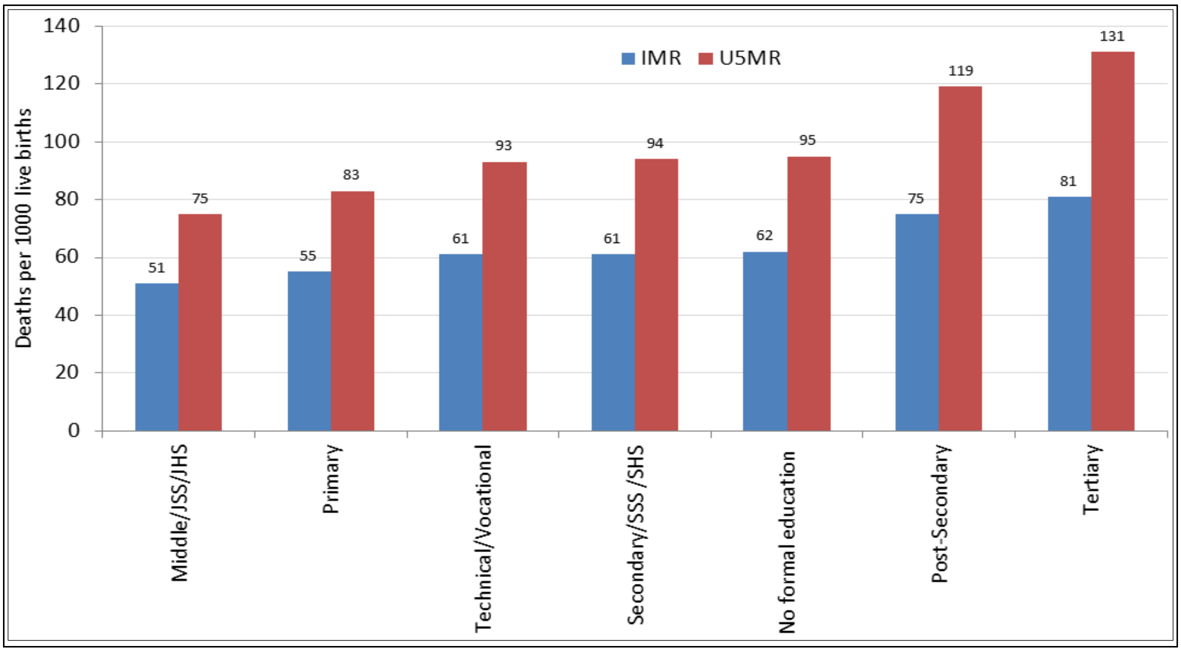


Educational attainment

There is plethora of evidence on the influential role of education in lowering the risks of infant and child mortality. Generally, an inverse relationship is found between women's education and child mortality. Women with more years of schooling experience are also likely to seek health care, delay marriage, use contraception for spacing and limiting births, practice exclusive breastfeeding and seek immunisation services.

The 2010 PHC data show inconsistent results contrary to what is generally observed including in Ghana based on existing evidence from GDHS and previous studies. Further examination of the raw data is suggested. It is possible that mortality is severely under-reported by household members with little or no formal education experience.

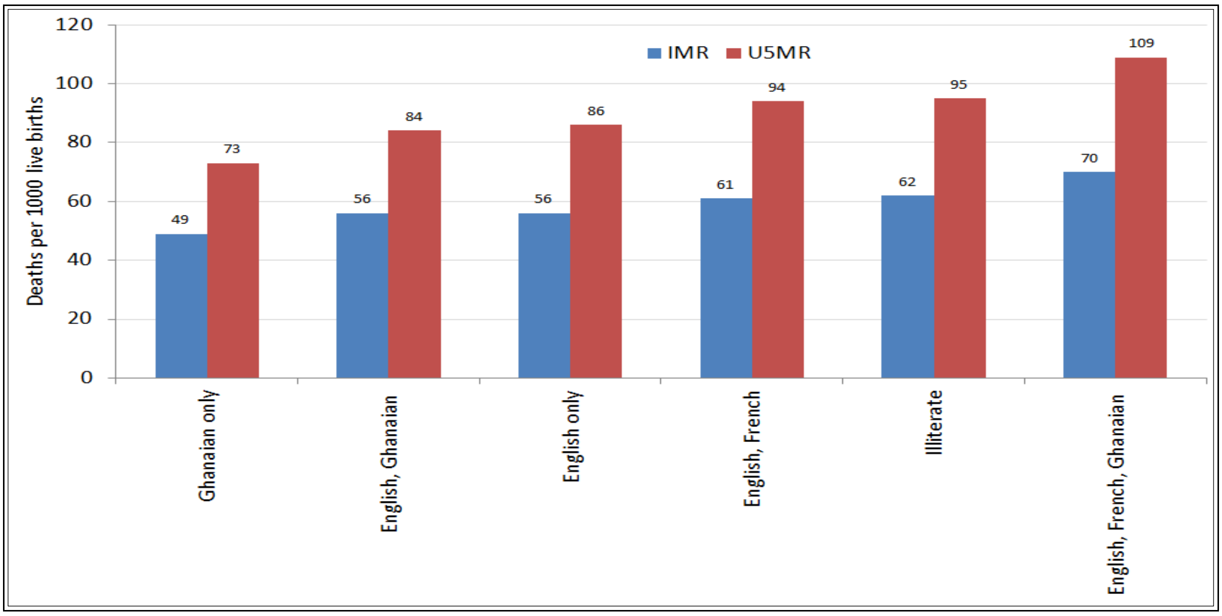
Figure 4.4: Infant (IMR) and under-five mortality (U5MR) rates by women's educational attainment



Literacy

The analysis of infant and child mortality by language literacy shows some interesting patterns. For example, women literate in English, French and Ghanaian language had the highest level of IMR and U5MR followed by the non-literate with an IMR of 62 deaths per 1000 live births and an U5MR of 95 deaths per 1000 (Figure 4.5). In contrast those who were litereate in only Ghanaian language experienced the lowest mortality rate.

Figure 4.5: Infant (IMR) and under-five mortality (U5MR) rates by women's Skills in literacy



Economic activity

Women's employment status is an effective socioeconomic indicator of autonomy, empowerment and access to financial resources. The analysis of 2010 PHC shows a clear gradient by whether a woman is employed, unemployed or non-active. The results show some marginal differences in the level of IMR and U5MR between employed and unemployed/non-active women (Figure 4.6). There is no noticeable difference in the levels of IMR and U5MR by residence.

Figure 4.6: Infant (IMR) and under-five mortality (U5MR) rates by women's Economic activity

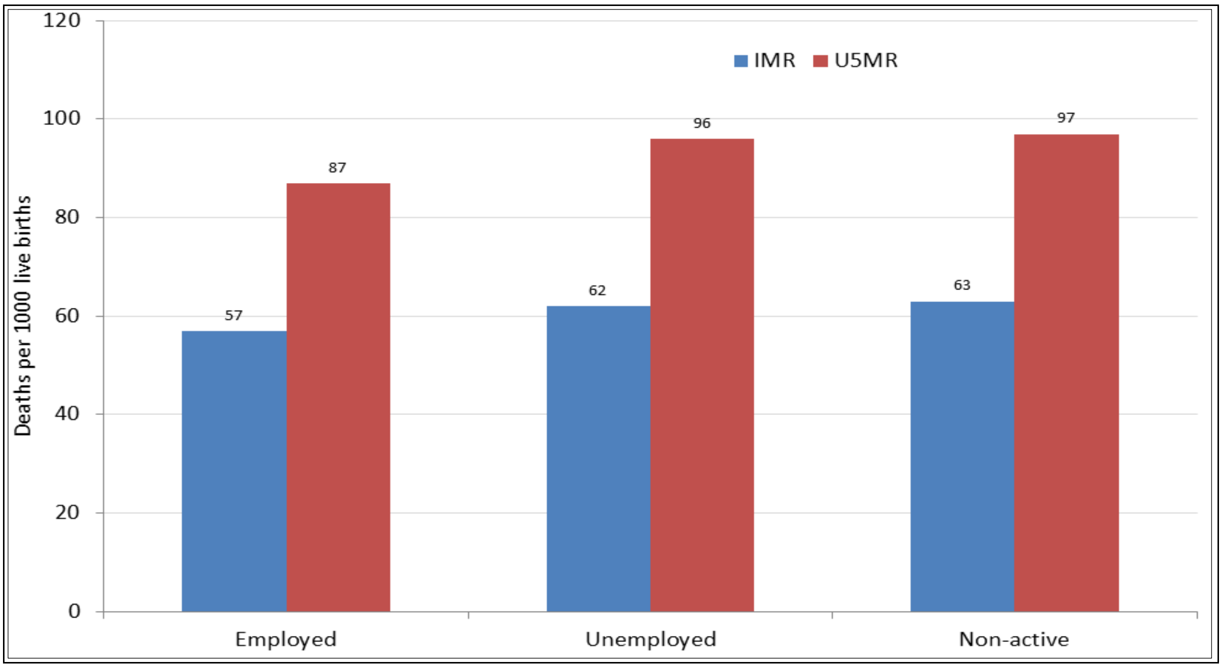


Table 4.1: Infant, child and under-five mortality rates (per 1000 live births) by demographic and socioeconomic characteristics

	Urban			Rural			Total		
Characteristics	IMR	CMR	U5MR	IMR	CMR	U5MR	IMR	CMR	U5MR
Marital status									
Never married	93	59	153	85	51	136	90	56	146
Currently married	49	24	73	56	29	85	53	26	79
Separated	56	29	85	63	34	96	59	31	90
Divorced	58	30	88	65	36	101	61	33	93
Widowed	70	39	109	76	44	120	73	43	116
Ethnicity									
Akan	55	28	83	53	27	80	55	28	83
Ga-Dangme	55	28	83	48	22	70	52	26	77
Ewe	57	30	87	53	26	79	55	28	82
Guan	66	37	103	58	31	89	62	33	95
Guruma	64	34	98	65	36	100	64	36	100
Mole-Dagbani	69	39	108	70	40	109	70	39	109
Grusi	64	35	100	70	40	110	69	39	107
Mande	61	32	93	62	33	95	62	33	95
Other	63	34	96	60	32	92	61	33	94

Table 4.1: Infant, child and under-five mortality rates (per 1000 live births) by demographic and socioeconomic characteristics (Cont'd)

Characteristics	Urban			Rural			Total		
	IMR	CMR	U5MR	IMR	CMR	U5MR	IMR	CMR	U5MR
Religious affiliation									
No religion	60	31	91	59	31	90	59	31	91
Catholic	60	31	91	59	31	90	59	32	91
Protestant	57	29	86	53	27	80	55	28	83
Pentecostal/charismatic	55	28	83	53	26	79	54	27	81
Other Christians	55	29	84	55	28	84	55	28	83
Islam	67	37	104	67	37	104	67	37	104
Traditionalist	69	39	107	71	40	111	70	40	110
Other	59	31	91	55	29	84	57	30	87
Educational attainment									
No formal education	61	33	94	62	33	95	62	33	95
Primary	54	28	82	56	28	84	55	28	83
Middle/JSS/JHS	52	25	77	50	24	74	51	24	75
Secondary/ SSS/SHS	61	32	93	62	33	95	61	33	94
Technical/ Vocational	62	33	95	58	30	88	61	32	93
Post-Secondary	75	44	119	76	45	121	75	44	119
Tertiary	82	50	133	81	49	130	81	50	131
Literacy									
Illiterate	61	33	94	62	33	95	62	33	95
English only	56	30	86	57	29	87	56	30	86
Ghanaian only	50	24	74	49	23	73	49	24	73
English, Ghanaian	57	30	87	54	28	82	56	28	84
English, French	65	36	101	55	27	82	61	33	94
English, French, Ghanaian	71	40	111	68	38	106	70	39	109
Economic activity									
Employed	57	29	86	58	30	88	57	29	87
Unemployed	63	34	96	61	33	94	62	34	96
Non-active	62	34	97	63	34	97	63	34	97

CHAPTER FIVE
SUMMARY AND CONCLUSIONS

This report provided an overview of patterns, trends and differentials in mortality and life expectancy based on the analysis of the 2010 Population and Housing Census data from Ghana. The analysis preceded by a systematic evaluation of the census data on mortality by age and sex demonstrated evidence of under-reporting of births and deaths particularly in rural areas. The analysis considered both direct and indirect estimation techniques to estimate key mortality indicators, addressing potential biases associated with reporting of deaths in the census.

Summary of key findings and conclusions

The Crude Death Rate (CDR) directly estimated from the 2010 PHC was 6.6 deaths per 1000 for the total population and 5.4 deaths per 1000 and 7.9 deaths per 1000 mid-year population in urban and rural areas respectively. The estimated CDR of 7 deaths per 1000 is lower than the Population Reference Bureau estimate of 9 deaths per 1000 and the UN estimate of 9.6 deaths per 1000 for the period 2005-2010 (PRB 2013; 2010; United Nations 2013a).

The infant mortality is estimated at 46 deaths per 1000 live births which is close to the 2008 GDHS estimate of 50 infant deaths per 1000 live births for the 5 years preceding the survey (GSS, GHS and ICF Macro 2009). The 2011 MICS data, however, show an estimate of 53 infant deaths per 1000 live births which appear somewhat higher than the 2008 DHS estimate (GSS 2011).

The standardised crude death rate for Ghana was 7.7 deaths per 1000 which is slightly higher than the unadjusted rate of 6.4 deaths per 1000. The level of mortality varies by region and residence. The rural death rate was highest in the Upper East, Upper West, Volta and Eastern regions respectively. The urban death rate was above the national average in six regions including Upper East, Eastern, Central, Volta, Western and Brong Ahafo regions. There is also marked difference in mortality by sex. Male mortality was consistently higher than female mortality in all regions. Upper East and Upper West regions had the highest overall male and female mortality rates.

The number of reported deaths by age is generally much lower for females than males and the patterns are the same in both urban and rural areas. Overall, male mortality is higher in the younger and older ages whereas female mortality tends to be slightly high in the 15-39 age range and declines thereafter from age 50 onwards. This pattern is found to be similar in both urban and rural areas (Figure 3.2b and Figure 3.2c).

In the 2010 PHC, about nine percent of deaths reported to women aged 10-54 years were pregnancy-related (see Table 3.4). The WHO estimates that 11.3 percent of all female deaths in the reproductive ages (15-49) are maternal related (WHO 2012b). The highest concentration of pregnancy-related deaths is observed in the 25-29 age range where over a quarter of all births are also concentrated.

The MMR at the national level is 485 deaths per 100,000 live births, which is higher than the 2010 WHO estimate of 350 per 100,000 live births and the 2007 GMHS estimate of 378 deaths per 100,000 live births for the 5 years preceding the survey (WHO 2012b; GSS, GHS and Macro International 2009). However, the census estimate falls within the WHO 95% confidence interval range between 210 and 630 deaths per 100,000 live births (WHO 2012b). This suggests that the census data could be considered fairly reasonable for the direct estimation of MMR.

Maternal mortality is generally higher in rural areas when compared to urban areas (Table 3.5). There are regional differences in maternal mortality with the Upper East and Volta regions recording the highest level of maternal mortality and Greater Accra region recording the lowest level.

This produced a realistic estimate of 59 infant deaths per 1000 live births for the reference period 2002-2006 (Table 3.7). This is higher than the 2008 DHS which provides a direct estimate of infant mortality rate at 50 based on the reference period 2004-2008 and 59 based on an indirect estimate based on 2008 GDHS data (GSS 2013). The estimated under-five mortality rate of 90 deaths per 1000 live births is also slightly higher than the 2008 GDHS data. However, the general trends in infant and under-five mortality over the last 25 years seem fairly consistent, except for the slightly higher estimates obtained indirectly from the 2000 and 2010 PHCs (Figure 3.4).

The rural-urban difference in mortality rates is trivial for both sexes. However, male infant and under-five mortality rates are slightly higher in urban areas when compared to their counterparts in rural areas, whereas the corresponding mortality rates for females are higher in rural areas (Figure 3.5). This could be attributed to possible high under-reporting of deaths in rural areas. More generally, both infant and under-five mortality rates are relatively higher for males than females.

There are marked regional differences in infant, child and under-five mortality rates (Figure 3.6a). Both IMRs and U5MRs are consistently the highest in the Upper West and Upper East regions and the lowest in the Eastern and Ashanti regions. The difference between IMR and U5MR is also the highest in the Upper West and Upper East regions when compared to other regions. This suggests high mortality rates between ages 1 and 4 in these regions. The Central, Northern, Upper East and Upper West regions have both IMRs and U5MRs above the national average.

Both IMRs and U5MRs are consistently higher in urban areas across all regions. The mortality rates in urban areas are the highest in the Upper West, Northern and Upper East regions respectively (Figure 3.6b).

The results based on the model life table estimations show a life expectancy at birth of 59.4 and 64.4 years for males and females respectively. The UN medium and high variant estimation for the period 2005-2010 shows a male life expectancy of 60 years and 61.9 years for females (United Nations 2013a). The observed difference in the estimations could be attributed to the different assumptions, although the differences are trivial.

The male and female probabilities of dying and those by residence are illustrated in Figures 3.7 and 3.8 respectively. The age patterns of mortality confirm the general expected shape, despite little fluctuations and elevated mortality risks for males in the adult ages, especially in rural areas. To derive meaningful interpretations, we need to compare life tables adjusting for age distortions in reported number of deaths observed during the intercensal period.

Table 3.16 provides a summary of life expectancies at various ages. More generally, females are likely to live longer at all ages than males in both urban and rural areas. The sex difference is pronounced in urban areas with a gap of 6 years between male and female life expectancy at birth, and the difference narrows after age 60 especially in rural areas. Male life expectancy is generally slightly lower in urban areas when compared to their counterparts in rural areas whereas the female life expectancy is generally higher in urban areas than that in rural areas. At age 60, an average male in Ghana can expect to live an additional 16.6 years whereas an average female can live an additional 18.2 years.

The analysis of 2010 PHC shows that never-married or widowed women experienced the highest rates of IMR and U5MR. In contrast, currently married women had the lowest rates of IMR and U5MR (Figure 4.1a). Similar mortality patterns are observed in both urban and rural areas. However, the levels of IMR and U5MR especially for the never-married and widowed women are relatively high in urban areas when compared to their rural counterparts.

There is plethora of evidence on the influential role of education in lowering the risks of infant and child mortality. Generally, an inverse relationship is found between women's education and child mortality. Women with more years of schooling experience are also likely to seek health care, delay marriage, use contraception for spacing and limiting births, practice exclusive breastfeeding and seek immunisation services.

Policy implications

Ghana's progress towards the achievement of the health-related Millennium Development Goals has been mixed so far. The MDGs 4 and 5 (5a and 5b) are either slightly behind the target or unlikely to be achieved by 2015 (UNDP, Ghana and NDPC/GOG, 2012). The analysis of census data provides some evidence in support of this argument.

There is an urgent need to strengthen and reorient existing safe motherhood and newborn healthcare systems and related community-based intervention programmes in Ghana. Programme efforts, for example health insurance and community health interventions, should be directed more towards the poorly developed rural areas of the Upper Eastern, Upper Western, Volta and Eastern regions, as well as the urban areas of Upper Eastern, Eastern, Central, Volta, Western and Brong Ahafo regions. On the other hand, it is important to accelerate and sustain communicable and non-communicable disease prevention programmes in both urban and rural areas.

Given the increase in population migration and mobility, health systems, local authority and vital registration systems should ensure systematic monitoring and recording of the causes of death. Also, it is imperative to promote HIV/TB, malaria and injury prevention programmes in vulnerable and disadvantaged communities across Ghana. Finally, to systematically monitor the disease and mortality burden, population level data on mortality and morbidity indicators should be collected on a routine basis.

REFERENCES

Ahmad, O.B., Boschi-Pinto, C., Lopez A.D. Murray, C.J.L., Lozano, R., Inoue, M. (2001) Age standardisation of rates: a new WHO standard. GPE Discussion Paper Series No. 31, EIP/GPE/EBD, World Health Organization. http://www.who.int/healthinfo/paper31.pdf (date accessed 15 November 2013).

Brass, W. (1971) On the scale of mortality. In Brass, W. (Ed). Biological Aspects of Demography, London: Taylor and Francis Ltd.

Brass, W. et al. (1968) The Demography of Tropical Africa, Princeton, Princeton University Press.

Coale, A.J., Demeny, P. (1983) Regional Model Life Tables and Stable Populations, 2nd ed. New York: Academic Press.

El-Badry, M.A. (1961) Failure of enumerators to make entries of zero: errors in recording childless cases in population censuses. *Journal of the American Statistical Association*, 56(296): 909-924.

Ghana Statistical Service. 2013. Ghana 2010 Population and Housing Census, National Analytical Report. Ghana Statistical Service. http://www.statsghana.gov.gh/docfiles/publications/ 2010_PHC_National_Analytical_Report.pdf (date accessed: 28 November 2013)

Ghana AIDS Commission (2012) Ghana Country AIDS Progress Report: Reporting period (January 2000 - December 2011). http://www.unaids.org/en/dataanalysis/knowyourresponse/country progressreports/2012countries/ce_GH_Narrative_Report[1].pdf (date accessed: 10 December 2013).

Ghana Statistical Service (2011) Ghana Multiple Indicator Cluster Survey with an Enhanced Malaria Module and Biomarker, 2011, Final Report. Accra, Ghana.

Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF Macro (2009) Ghana Demographic and Health Survey 2008. Accra, Ghana: GSS, GHS, and ICF Macro.

Ghana Statistical Service (GSS), Ghana Health Service (GHS), and Macro International (2009). Ghana Maternal Health Survey 2007. Calverton, Maryland, USA: GSS, GHS, and Macro International.

Graham, W., Ahmed, S., Stanton, C., Abou-Zahr, C., Campbell, O. (2008) Measuring maternal mortality: An overview of opportunities and options for developing countries, *BMC Medicine* 6:12.

Moultrie, T.A., Dorrington, R.E., Hill, A.G., Hill,K., Timæus, I.M., Zaba, B (2013). Tools for Demographic Estimation (Eds). Paris: International Union for the Scientific Study of Population. www.demographicestimation.iussp.org (date accessed 21 November, 2013).

PRB (2013) World Population Datasheet 2013, Washington DC: Population Reference Bureau. http://www.prb.org/pdf13/2013-population-data-sheet_eng.pdf (date accessed: 01 December 2013).

PRB (2010) World Population Datasheet 2010, Washington DC: Population Reference Bureau. http://www.prb.org/pdf10/10wpds_eng.pdf (date accessed: 01 December 2013).

UNDP, Ghana and NDPC/GOG (2012) 2010 Ghana Millennium Development Goals Report. http://www.gh.undp.org/content/dam/ghana/docs/Doc/Inclgro/UNDP_GH_IG_2010MDGreport_18102013.pdf (date accessed: 15 August 2015).

UNDP (2013) The Rise of the South: Human Progress in a Diverse World. 2013 Human Development Report, New York: United Nations Development Programme. http://hdr.undp.org/ sites/default/files/reports/14/hdr2013_en_complete.pdf (date accessed 11 December 2013).

United Nations (2013a) World Population Prospects: The 2012 Revision, Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. http://esa.un.org/unpd/wpp/index.htm (date accessed 12 December 2013)

United Nations (2013b) MORTPAK for Windows Version 4.3. POP/SW/MORTPAK/2003, New York: United Nations. http://www.un.org/en/development/desa/population/publications/pdf/ mortality/mortpak_manual.pdf (accessed 15 November 2013).

Wilmoth, J.R. (2009) The lifetime risk of maternal mortality: Concept and measurement, *Bulletin of the World Health Organization*, 87(4):256–262.

WHO (2013) Ghana Tuberculosis profile http://www.who.int/countries/gha/en/ (date accessed 13 December 2013).

WHO (2012a) 2012 World Malaria Report. World Health Organization. http://www.searo.who.int/ entity/malaria/documents/wmr2012_no_profiles.pdf (date accessed 12 December 2013).

WHO (2012b) Trends in maternal mortality: 1990 to 2010. WHO, UNICEF, UNFPA and The World Bank estimates, World Health Organization. http://www.unfpa.org/webdav/site/global/shared/ documents/publications/2012/Trends_inmaternal_mortality_A4-1.pdf (accessed 11 December 2013).

WHO (2010) Non-Communicable Disease Country Profile 2011, Ghana, World Health Organization. http://www.who.int/nmh/countries/gha_en.pdf (accessed 3 December 2013).

APPENDICES

Table A1: Age-sex distribution of midyear population and deaths, Ghana

	Male		Female		Total	
Age group (years)	Midyear population	Deaths	Midyear population	Deaths	Midyear population	Deaths
<1	370,320	15,807	360,881	12,261	731,201	28,068
01-04	1,361,467	9,424	1,312,738	8,444	2,674,205	17,868
05-09	1,589,632	3,437	1,539,320	2,838	3,128,952	6,275
10-14	1,477,525	1,587	1,438,515	2,054	2,916,040	3,641
15-19	1,311,112	1,752	1,298,877	2,647	2,609,989	4,399
20-24	1,100,727	2,117	1,222,764	3,350	2,323,491	5,467
25-29	943,213	2,516	1,106,898	3,809	2,050,111	6,325
30-34	790,301	3,397	888,508	4,821	1,678,809	8,218
35-39	676,768	3,579	744,635	4,636	1,421,403	8,215
40-44	572,620	4,141	613,730	4,714	1,186,350	8,855
45-49	452,975	3,715	485,123	3,858	938,098	7,573
50-54	394,600	4,376	438,498	4,201	833,098	8,577
55-59	258,582	3,564	265,113	2,092	523,695	5,656
60-64	227,050	4,418	248,799	2,741	475,849	7,159
65-69	136,244	3,360	157,627	2,310	293,871	5,670
70-74	149,512	5,096	201,818	3,347	351,330	8,443
75-79	89,149	3,599	116,804	2,598	205,953	6,197
80+	123,048	8,329	193,330	8,599	316,378	16,928
Total	12,024,845	84,214	12,633,978	79,320	24,658,823	163,534

Table A2: Age-sex distribution of midyear population and deaths in urban Ghana

	Male		Female		Total	
Age group (year)	Midyear population	Deaths	Midyear population	Deaths	Midyear population	Deaths
<1	180,060	6,770	176,623	5,651	356,683	12,421
01-04	602,957	3,196	581,751	2,867	1,184,708	6,063
05-09	697,031	1,195	692,629	1,000	1,389,660	2,195
10-14	672,906	521	718,323	736	1,391,229	1,257
15-19	651,829	641	712,295	1,030	1,364,124	1,671
20-24	642,140	767	714,698	1,348	1,356,838	2,115
25-29	553,927	1,013	640,940	1,567	1,194,867	2,580
30-34	455,204	1,449	500,494	2,045	955,698	3,494
35-39	373,678	1,558	408,174	2,068	781,852	3,626
40-44	304,875	1,759	327,174	2,235	632,049	3,994
45-49	231,146	1,630	256,046	1,703	487,192	3,333
50-54	195,556	1,962	225,922	1,887	421,478	3,849
55-59	132,984	1,677	142,974	1,000	275,958	2,677
60-64	105,738	1,860	119,647	1,151	225,385	3,011
65-69	64,588	1,492	78,526	1,065	143,114	2,557
70-74	63,786	2,149	90,165	1,399	153,951	3,548
75-79	38,300	1,616	54,997	1,256	93,297	2,872
80+	49,354	3,318	87,792	3,741	137,146	7,059
Total	6,016,059	34,573	6,529,170	33,749	12,545,229	68,322

Table A3: Age-sex distribution of midyear population and deaths in Rural, Ghana

	Male		Female		Total	
Age group (year)	Midyear population	Deaths	Midyear population	Deaths	Midyear population	Deaths
<1	190,260	9,037	184,258	6,610	374,518	15,647
01-04	758,510	6,228	730,987	5,577	1,489,497	11,805
05-09	892,601	2,242	846,691	1,838	1,739,292	4,080
10-14	804,619	1,066	720,192	1,318	1,524,811	2,384
15-19	659,283	1,111	586,582	1,617	1,245,865	2,728
20-24	458,587	1,350	508,066	2,002	966,653	3,352
25-29	389,286	1,503	465,958	2,242	855,244	3,745
30-34	335,097	1,948	388,014	2,776	723,111	4,724
35-39	303,090	2,021	336,461	2,568	639,551	4,589
40-44	267,745	2,382	286,556	2,479	554,301	4,861
45-49	221,829	2,085	229,077	2,155	450,906	4,240
50-54	199,044	2,414	212,576	2,314	411,620	4,728
55-59	125,598	1,887	122,139	1,092	247,737	2,979
60-64	121,312	2,558	129,152	1,590	250,464	4,148
65-69	71,656	1,868	79,101	1,245	150,757	3,113
70-74	85,726	2,947	111,653	1,948	197,379	4,895
75-79	50,849	1,983	61,807	1,342	112,656	3,325
80+	73,694	5,011	105,538	4,858	179,232	9,869
Total	6,008,786	49,641	6,104,808	45,571	12,113,594	95,212