An Analysis of the Trends, Differentials, and Key Proximate Determinants of Infant and Under-Five Mortality in Ethiopia

August 2013

An Analysis of the Trends, Differentials, and Key Proximate Determinants of Infant and Under-Five Mortality in Ethiopia

Further Analysis of the 2000, 2005, and 2011 Demographic and Health Surveys

Assefa Negera[1]
Gebeyehu Abelti[2]
Terefe Bogale[3]
Tesfayi Gebreselassie[4]
Roger Pearson[5]

MoFED and UNICEF
Addis Ababa, Ethiopia

ICF International
Calverton, Maryland USA

August 2013

[1] Central Statistical Agency, Ethiopia
[2] USAID/Ethiopia
[3] Ministry of Finance and Economic Development, Ethiopia (MoFED)
[4] ICF International, USA
[5] UNICEF

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

ABSTRACT

Childhood mortality is useful for the calculation of overall mortality, as the highest risk of death and proportion of deaths occurs during childhood. It is also considered, for many reasons, an important demographic, health and development issue.

This research has the overall objectives of describing the level, trends and differentials of infant and under-five mortality rates in Ethiopia by major background demographic and socio-economic characteristics based on data from the 2000, 2005 and 2011 Ethiopian Demographic and Health Surveys and identifying the major determinants of infant and under-five mortality. A synthetic cohort life table is used to examine levels and trends of childhood mortality and a Cox Regression is applied to assess the associations of child, mother and household characteristics with infant and under-five mortality.

The results from the level and trend analysis indicated that all the five childhood mortality indicators (neonatal, postnatal, infant, child and under-five mortality) have been steadily declining over the last decade in Ethiopia. For instance, the infant mortality rate has declined from 97 deaths per 1000 live births in 2000 to 77 deaths per 1000 live births in 2005, to 59 deaths per 1000 live births in 2011. This is equivalent to 39 per cent reduction from 2000 to 2011. Similarly, under-five mortality has shown a continuous reduction over time; from 166 deaths per 1000 in 2000 to 123 deaths per 1000 in 2005, and to 88 deaths per 1000 in 2011. This is equivalent to a 47 per cent reduction in the level of under-five mortality from the year 2000. However, the contribution of neonatal mortality to infant mortality, both by region and at national level has increased over time.

The multivariate analysis revealed that the significant determinants of infant mortality are; sex of the child, birth size, birth interval, mother's education, mother's marital status and access to an improved toilet facility. Likewise, under-five mortality is influenced by the same characteristics. Region of residence was also a significant predictor of infant and under-five mortality. However, the significant difference between the reference (Addis Ababa) and other regions was more prominent for under-five mortality than it was for infant mortality.

1. INTRODUCTION

1.1 Background

Childhood mortality is an important demographic, health and development issue for a number of reasons. It is a critical element in the calculation of overall mortality since the highest risk of death and proportion of deaths occur during childhood. It is one of the three measures (along with fertility and migration) that determine population size and growth rate, the age-sex distribution and the spatial spread of the population. Most importantly, of course, all human beings have a right to life and the extent to which that right is enjoyed is summarized by tracking trends and disparities in childhood mortality.

Decreasing childhood mortality is thus a focus of communities and governments all over the world. The United Nations enshrined the right to life in the Declaration of Human Rights (UN, 1948) and for children this is reaffirmed in the Convention of the Rights of the Child. Millennium Development Goal number 4 is a target to reduce under-five mortality rates, at global level, by two-thirds over the years 1990 to 2015. The Ethiopian government has prioritized MDG 4 as one if its own national development targets. More recently, the Growth and Transformation Plan of Ethiopia (GTPE) has outlined the strategic measures that can significantly contribute to reducing childhood mortality. These include improving the quality and coverage of basic health services, improving maternal and child health, increasing the supply of iodized salt, the reduction of malnutrition, and improving household sanitation (MoFED, GTP Policy Matrix, 2010, p 21).

Looking beyond the GTPE the MoH has started to make plans for reducing under-five mortality rates to below 30 deaths per thousand live births by 2035. Reaching this low level will require improvements in socio-economic status of the population as well as improvements in the direct services provided by the health sector.

According to the Population Reference Bureau's estimate, globally, in 2012, an average of 41 children per 1000 live births died before reaching their first birthday (Figure 1). Most infant deaths occur in the less developed world (with 45 infant deaths per 1000 live births in the less developed world compared with 5 infant deaths per 1000 live births in more developed countries).

Figure 1: Infant mortality rates in regions of the world, 2011
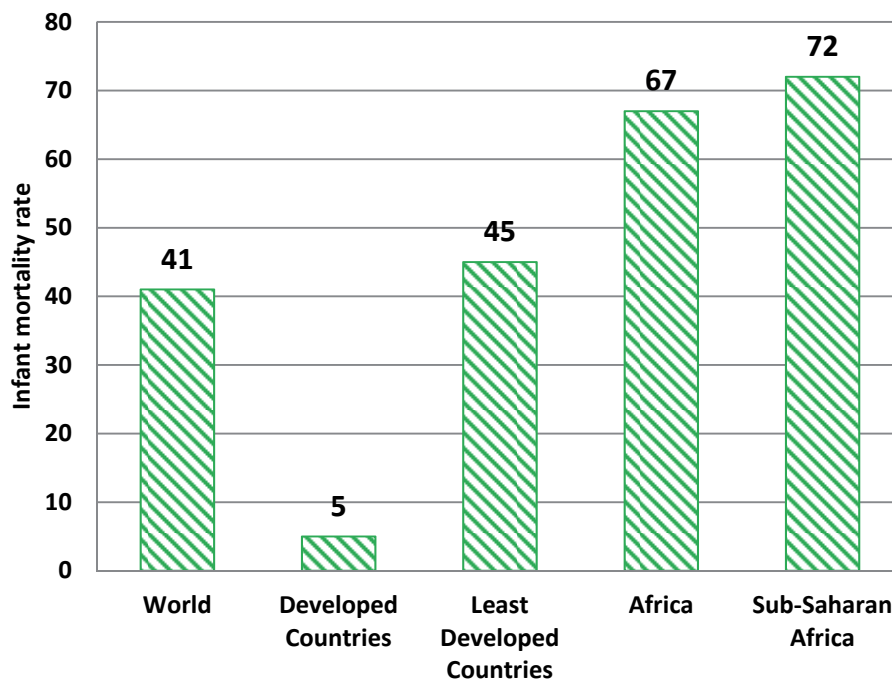
Source: Population Reference Bureau (2012), World Population Data Sheet 2012.

In Ethiopia, Demographic and Health Surveys (DHS) conducted since 2000 show decreasing trends in both infant and under-five mortality rates. Infant mortality was recorded as 97 deaths per 1000 live births in the year 2000 survey, referring to the five year period leading up to the survey year, and had declined to 59 per 1000 live births in the five year period leading up to the 2011 survey, a 39 per cent reduction. Similarly, under-five mortality rate was measured as 166 per 1000 live births in the year 2000 survey and reduced to 88 deaths per 1000 live births in the period leading up to 2011, a 47 per cent reduction between 2000 and 2011 (EDHS 2000, 2005 and 2011 Final Reports).

This study will describe the level, trends and differentials of infant and under-five mortality rates in Ethiopia by major proximate demographic and socio-economic characteristics based on the 2000, 2005 and 2011 Ethiopian Demographic and Health Surveys. It will then conclude by analyzing the determinants of infant and under-five mortality from amongst the variables collected by the surveys.

1.2 Determinants of Childhood Mortality: A Review of Literature

Many studies have investigated the determinants of childhood mortality in different socio-economic settings. Different factors may determine childhood mortality depending on the socio-economic and environmental situations.

Hong et al (2009) conducted an analysis of infant and under-five mortality in Rwanda using the nearly two decades of Rwandan Demographic and Health Surveys data. They found that, in the case of infant mortality, the number of children ever born[1], birth interval, availability of professional antenatal and delivery care, full immunization of children, mother's education, and urban-rural residence were important determinants. The same study also revealed that, in the case of under-five mortality; multiplicity of births (i.e. number of births for each pregnancy), birth intervals, antenatal care and deliveries by health professionals, full immunization of children, mother's education, use of contraception and possession of mosquito nets were determinants.

In another study, Pandey et al (1998) examined infant and child mortality of India. This research found that sex of the child, mother's residence, mother's exposure to mass media, use of clean cooking fuel, mother's literacy status, access to a toilet facility, mother's religion and ethnicity, income of the household, birth order, mother's age at birth and mother's health care were important determinants of infant and child mortality in India.

Similar findings were reported in a study by Kumar and Gemechis (2010) using data from the 2005 Ethiopian Demographic and Health Survey. The study reported that birth interval, mother's literacy, household wealth, mother's age at birth, mother's exposure to mass media, sex of the child, religion, family size, birth order and residence were important predictors of infant and child mortality.

Many studies reported that children born at short birth intervals are at higher risk of infant and child mortality (Rutstein 2005; Rutstein 2008; Hong et al, 2009; Saha and van Soest 2012). Using multi-country DHS data collected between 2000 and 2005 Rutstein (2008) found that waiting 36 months or more to have another pregnancy substantially decreases risk to children of death and undernutrition.

Based on the existing literature, the major proximate determinants of infant and under-five mortality can be categorized into three groups: Mother, child, and household characteristics.

- Mother's Characteristics: Such as mother's literacy status, health service utilization (i.e. antenatal care), age at birth, exposure to mass media and total number of births;
- Child's Characteristics: Birth interval, sex of the child, and total number of sibling births;
- Household Characteristics: Household wealth, religion and ethnicity, residence, availability of safe drinking water, and improved toilet facility.

The relative importance of these predictive variables of childhood mortality may vary depending on the prevailing socio-economic conditions in a community.

The distribution of causes of childhood mortality for under-five children indicated that 34 per cent of deaths occurred in the first week after birth. The major causes of under-five mortality in Ethiopia were ARI/Pneumonia (21 per cent), diarrhoea (14 per cent), complications of prematurity (12 per cent), intrapartum related events (birth asphyxia) (9 per cent), meningitis (6 per cent), and measles (4 per cent). Other causes of death (including deaths due to severe malnutrition) accounted for 18 per cent of under-five mortality (UNICEF, 2012).

---

[1] Defined as number of children born alive to the woman concerned up until the date of the interview.

The Ethiopia Child Survival Technical Working Group, a group made up of staff from a number of government departments and international development partners, in 2012, used Countdown and Lives Saved Tool (LiST) (developed by Johns Hopkins University) to estimate mortality reductions over the period 2000-2010 by specific interventions. The analysis of the causes of the under-five mortality and the analysis of the probable causes for the reductions of observed mortality showed that health sector interventions led by actions implemented by health extension workers are the major contributors for the decline. For example, actions implemented by health extension workers have brought about better vaccination coverage rates, improved sanitation and hygiene and better access to ready to eat therapeutic foods (given to severely malnourished children). Meanwhile improvements in socio-economic status have probably had an influence on the reduction of stunting (Ethiopia Child Survival Technical Working Group, 2012).

1.3 The Demographic and Socio-Economic Situation of Ethiopia: An Overview

Ethiopia is the third most populous country on the African continent and has over 84 million inhabitants. Nearly 84 per cent of people live in rural areas with uneven spatial distribution. Currently, the population is estimated to be growing by 2.6% per annum with wide regional variations.

Ethiopia launched the national population policy in 1993. The goal of the policy is to harmonize the demographic characteristics of the country with its socio-economic development and its natural environment. The objectives include reducing the total fertility rate through increasing the prevalence of contraceptives use; reducing maternal, infant and child morbidity and mortality; and increasing female participation in all levels of education and socio-economic life (Transitional Government of Ethiopia, 1993a).

The country's economy is primarily agrarian. Agriculture contributed 45.6% to the national GDP in 2010/11 declining to 44.0% in 2011/12, while the service sector's contribution to the national GDP has increased from 44.5% in 2010/11 to 45.6% in 2011/12 (MoFED, 2013).

The country is undergoing fast socio-economic change following the adoption of a free market economy in 1991. Currently, the government of Ethiopia is intensively engaged in the expansion of new health, educational, transport and communication services – mainly in the rural areas where the lion's share of the population resides. The country has important population and health policies which are being implemented through different strategies. The results of these strategies are seen in improvements in health service coverage, literacy, accessibility, and in the decline of mortality and fertility rates.

Ethiopia launched its health policy in 1993.The policy focuses primarily on prevention of health problems. Its main strategy is creating awareness in the community. Reduction of mortality and fertility through awareness and community mobilization or public participation are given priority (Transitional Government of Ethiopia, 1993b).

Ethiopian children face a high level of communicable infections, disease and malnutrition; 70 per cent of deaths among children under-five are attributed to pneumonia, diarrhoea, malaria and neonatal conditions (UNICEF, 2012).

The expansion of health services in the rural and urban areas is helping to bring about successful results in mortality and fertility reduction as well as improvements in maternal and child health. In 2004, the government decided to put in place a new cadre of health service providers at the kebele (sub-district) level to deliver life saving services. By 2010, over 35,000 health extension workers (HEW) were giving basic health services and creating community awareness of health issues. This expansion required more

financial allocations to health. Per capita expenditure increased from 7.14 USD in 2004/05 to 16.09 USD in 2007/08. Other higher level health professionals are being trained by the large number of government and private higher learning institutions in the country. These policies play a significant role in reducing childhood mortality and morbidity.

Childhood mortality is a widely accepted indicator of a country's progress in socio-economic and health development. Improvements in education, income, access to mass media, coverage and quality of health services, access to safe water and toilet facilities all play a role in reducing the infant and under-five mortality levels worldwide.

The indicators used in this study were selected based on their relevance to childhood mortality and by their availability for analysis; i.e., they were included in the DHS data sets. The indicators are grouped in two main categories, health and socio-economic indicators. Health indicators include levels of malnutrition (stunting, wasting and being underweight), health service coverage, contraceptive prevalence rate, antenatal care coverage, skilled delivery and institutional delivery coverage, early initiation of breastfeeding, exclusive breastfeeding, complementary feeding, immunization coverage, vitamin A supplementation, seeking care for pneumonia, seeking care for fever, oral rehydration salt (ORS) use during diarrhoea, received antibiotics for pneumonia, received antimalerials for fever, mothers' age at first birth and birth interval.

Socio-economic indicators include access to safe drinking water supply, improved toilet facilities, mothers' educational attainment, access to mass media and the marital status of the mothers.

Table 1: Levels and trends of health and socio-economic indicators in Ethiopia, 2000-2011

Indicators	Unit	Survey Years		
		2000	2005	2011
Health indicators				
Potential health service coverage	%	51	72	92
Proportion of children stunted	%	52	47	44
Proportion of children wasted	%	11	11	10
Proportion of children underweight	%	47	38	29
Previous birth interval (median no of months)	months	34	34	34
Proportion of women 15-49 using Contraception (any method)	%	8	15	29
Antenatal care coverage (1 visit)	%	6	29	43
Antenatal care coverage (4 visits)	%	10	12	19
Protection against tetanus	%	17	32	48
Delivery at health institution	%	6	5	10
Skilled delivery	%	5	6	10
Early initiation of breastfeeding	%	52	69	52
Exclusive breastfeeding until six months	%	8	49	52
DPT3 vaccination	%	22	32	37
Measles vaccination	%	22	35	56
Fully Immunized children	%	14	20	24
Vitamin A supplementation	%	56	46	53
Seeking care for pneumonia	%	16	19	27
Seeking care for fever	%	19	18	24
ORS during diarrhoea	%	13	20	26
Received antibiotics for pneumonia	%	6	5	7
Received antimalarials for fever	%	3	3	4
Socio-economic indicators				
Households with Access to safe drinking water	%	25	35	54
Households with access to toilet facilities	%	18	38	62
Women 15-49 Primary education attainment	%	18	26	41
Women 15-49 Secondary education attainment	%	5	6	4
Proportion of women in union	%	64	65	62
Women's median age at first birth	years	19	19	19

Source: CSA, Ethiopia Demographic and Health Surveys (2000, 2005, 2011) and MoH

In summary, the data in Table 1 indicates that the majority of health status indicators have improved over time. Potential health service coverage (the population covered in percentage based on the existing health centres and health posts in a catchment area) was 51 per cent in 2000 improving to 72 per cent in 2005. It further increased to 92 per cent in 2011. The three measures of child malnutrition, i.e., stunting, wasting and underweight, declined between 2000 and 2011. Children's full immunization coverage, which was 14 per cent in 2000, improved to 20 per cent in 2005 and to 24 per cent in 2011.

Contraceptive prevalence rate (CPR) has shown improvement from 8 per cent in 2000 to 15 per cent in 2005 and to 29 per cent in 2011. Antenatal care coverage (4 visits) showed a very slight improvement between 2000 and 2005 (10 per cent in 2000 to 12 per cent in 2005), moderately increasedto 19 per cent in 2011.

Similarly, the proportion of deliveries taking place at health institution and the proportion of deliveries by skilled health professionals have increased during these years, though the changes are not substantial and there remains room for improvement.

As indicated in the table many of the socio-economic indicators showed improvement over the last 10 years. Access to safe drinking water has improved from 25 per cent in 2000 to 54 per cent in 2011. Access to improved toilet facilities was 18 per cent in 2000 and increased to 62 per cent in 2011. Mothers' educational attainment is another social indicator that has shown improvement in the country.

To sum up, with the exception of a few indicators, most of the indicators discussed above and believed to have impact on infant and under-five mortality, appear to have improved during the three surveys under consideration.

2. DATA AND METHOD

2.1 Data Source

This study uses data from the three Ethiopian Demographic and Health Surveys (EDHS) conducted in 2000, 2005 and 2011. The surveys were conducted with nationally representative samples from all of the country's regions [2]. Details of the sample design, including the sampling framework and sample implementation, and response rates are provided in the respective EDHS reports (www.measuredhs.com).

The 2000, 2005, and 2011 EDHS data is used in this study to describe the level, trend and differentials of infant and under-five mortality rates in Ethiopia by background characteristics. The 2011 EDHS data is employed to analyze determinants of infant and under-five mortality rates by background characteristics.

2.2 Study Variables

The dependent variables are infant and under-five mortality rates.

 i. Infant mortality (1q0)- the probability of dying before the first birthday;
 ii. Under-five mortality (5q0)-the probability of dying between birth and the fifth birthday.

The selection of potential predictors of infant and under-five mortality in this study is based on the literature (as described in section 1.2) and the availability of data on these potential predictors. These potential predicting variables are categorized into three groups; household, mother's characteristics and child characteristics. Most of the predictors are proximate determinants of infant and under-five mortality and hence the health sector cannot directly influence these characteristics of the study population. We have included improved water provision and improved sanitation as predictors.

Child Characteristics

This group of potential predictors consists of four variables; sex of the child, birth order, previous births interval and birth size.

- Sex of the child refers to whether the child is male or female and is included in the study because probability of death is not equal between the two sexes. The male sex is taken as the reference category.
- Birth order refers to the number of siblings the child has at birth. Birth order has a U-shaped pattern with children who are born first or last having the highest probability of death. This variable is divided into four categories as 1, 2-3, 4-6 and 7 and above. The first birth order is the reference category.
- Previous birth interval, measures the time between the current birth and the preceding birth. It is assessed in this study for its contribution to infant and under-five deaths. Studies show that a shorter birth interval is a risk factor for survival of children. It is categorized into five interval groups as first born, less than 2 years, 2 years, 3 years and 4 and above years. First birth is the reference category.
- Birth size, the size of the child at birth, is also examined in terms of its contribution to the variation in child death between smaller and larger size babies at birth. Studies revealed children born with a lower birth size are more susceptible to child death than those born a larger size. This variable is categorized into two; small or large at birth while the reference category is the former.

---

[2]The geographic sample for Afar and Somali was greatly expanded and covered other zones in 2011 compared to 2005 and 2000 thus the data may not give a real picture of the trend in these two regions.

Mother's Characteristics

In this study, three characteristics of mothers were examined to determine the extent to which they can predict mortality outcomes for young children; mother's education, marital status and contraceptive use.

- Mother's education is an important factor in childhood mortality reduction; more education is associated with a lower risk of child death. There is also a high correlation between better educational outcomes for the mother, and thus better employment opportunities. In this study mothers were categorized into three educational categories; no education, primary education and secondary and above with no education serving as the reference category.
- Marital status refers to whether the mother is currently in union or not. It is included in this study since children from mothers not in union have more risk of death than children born to mothers in union. The children from mothers who are not currently in union are the reference group for the analysis.
- Mother's contraceptive use was the third variable chosen. Research has shown that mothers using contraception have the advantages of spacing (longer birth intervals)**,** and limiting the number of children. The analysis used two categories of contraceptive use: Mothers currently using contraception and those not currently using. The latter is the reference category.
  These factors, taken together, contribute to lower risks of mortality for children.

Household Characteristics

The household characteristics consist of five independent variables; i.e. type of residence, region, wealth status, source of drinking water and the type of toilet facility used by the household.

- Type of residence; whether the household is in a rural or urban area is a factor that always affects child mortality because living in urban areas is advantageous in terms of easy access to quality health and educational services facilities compared to rural areas. The study took the urban areas asa reference group.
- Region of residence is another potential variable that influences childhood mortality in the country. The country has nine administrative regions and two city administrations. Addis Ababa is taken as a reference category.
- Wealth is important to determine household capacity for health and education services and then child mortality. To make the data in the three survey years comparable and to overcome difference in type of household assets used by households a new wealth index was computed using only those household assets common to all surveys. The statistical method of principal components was used to construct a wealth index. The indicators used to construct the index were the following: Possession of a radio, possession of a television, electricity, type of flooring of the house, toilet facility, and drinking water facility, number of members per room in the household, and ownership of pack animals, cattle, and sheep and goats. With these variables three wealth categories were constructed and categorized as poor, middle and rich with the poor category acting as the reference.
- Source of drinking water, i.e., whether the household uses an improved or unimproved source of drinking water was used as a variable in this study. Many studies have shown that child mortality is highly correlated with the source of drinking water; cleaner and more abundant water reduces mortality as a result of reducing the incidence and severity of diarrhoea. The analysis categorized households into two, those having and those not having improved sources of drinking water with the non-improved source category as the reference. In this study the classification of improved sources that was applied, is the same as it was used by the EDHS 2011. This classification of water sources had been developed based on WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation, 2010. The improved water sources are classified as; a piped source within

the dwelling, yard, or plot; a public tap/stand pipe, or borehole; a protected well; spring water and rainwater.

▪ Type of toilet facility; whether the household uses improved or non-improved type of toilet was the fifth independent variable considered. Similar to sources of drinking water, the study categorized this variable into two categories; those having access to improved toilet facilities and those not having access to improved toilet facilities with the later chosen as the reference group.

2.3 Data Analysis

This study employed a two stage analysis. In the first stage the levels, trends and differential analysis of infant and under-five mortality by background characteristics were calculated using the direct synthetic cohort method.

In the second stage of the analysis Cox regression was employed to assess the determinants of infant and under-five mortality. The data from the three surveys was pooled for a survival analysis using Cox regression. A survival analysis was used to estimate the risk of dying (expressed in hazard ratios) before the age of one year (infant mortality) and before the age of 5 years (under-five mortality). A positive regression coefficient (i.e., Hazard Ratio > 1) for a predictor variable means that the hazard is higher, i.e., increased risk of death. Conversely, a negative regression coefficient (Hazard Ratio < 1) implies a decreased risk of death.

Our analysis was based on 32,388 births (31, 618 single births and 770 multiple births) in the five years preceding the dates of surveys. Results of the multivariate analyses for both infant and under-five mortality are presented as hazard ratios (that is, exponentiated coefficients). The hazard ratio is the percentage increase or decrease in the risk of dying associated with the specific category of variable when compared to the reference category for that variable. SPSS software was used to run both stages of the analyses.

2.4 Data Quality Assessment

The first part of the chapter on infant and child mortality in the EDHS final reports (Chapter 8) presents a summary of the results of data quality assessment for the mortality data. The data quality assessment report highlights its findings on mis-reporting, omission, and digit preference, which are common data quality problems observed in surveys and censuses in developing countries. Though considerable age heaping was noted at 6 and 12 months of age, it was mentioned in the EDHS final report that its effect on infant mortality in particular is negligible. Over all, the assessment shows that the problems do not exist to the extent that might challenge the quality of the conclusions of this study.

3. RESULTS

This section summarizes the results of the two stage analysis. The first part deals with the description of levels, trends and differentials of infant and under-five mortality in Ethiopia during the three EDHS from 2000-2011; the second part presents the results of a multivariate analysis both for infant and under-five mortality using pooled data from the three consecutive surveys.

3.1 Levels, Trends and Differentials of Infant and Under-five Mortality

Before identifying the major determinants of infant and under-five mortality rates (U5MR) it is worthwhile to see the levels, trends and differentials of infant and under-five mortality rates that resulted from the socio-economic and health changes in the country. Figure 2 presents trends and levels in neonatal, postnatal, infant, child and under-five mortality rates from 2000 to 2011. The figures pertain to the average mortality in the five-year period preceding the survey, not to the situation in the survey year itself.

Figure 2: Trends in Childhood Mortality Rates in Ethiopia, 2000-2011

	2000	2005	2011
Under-five	166	123	88
Child	77	50	31
Infant	97	77	59
Postneonatal	48	38	22
Neonatal	49	39	37
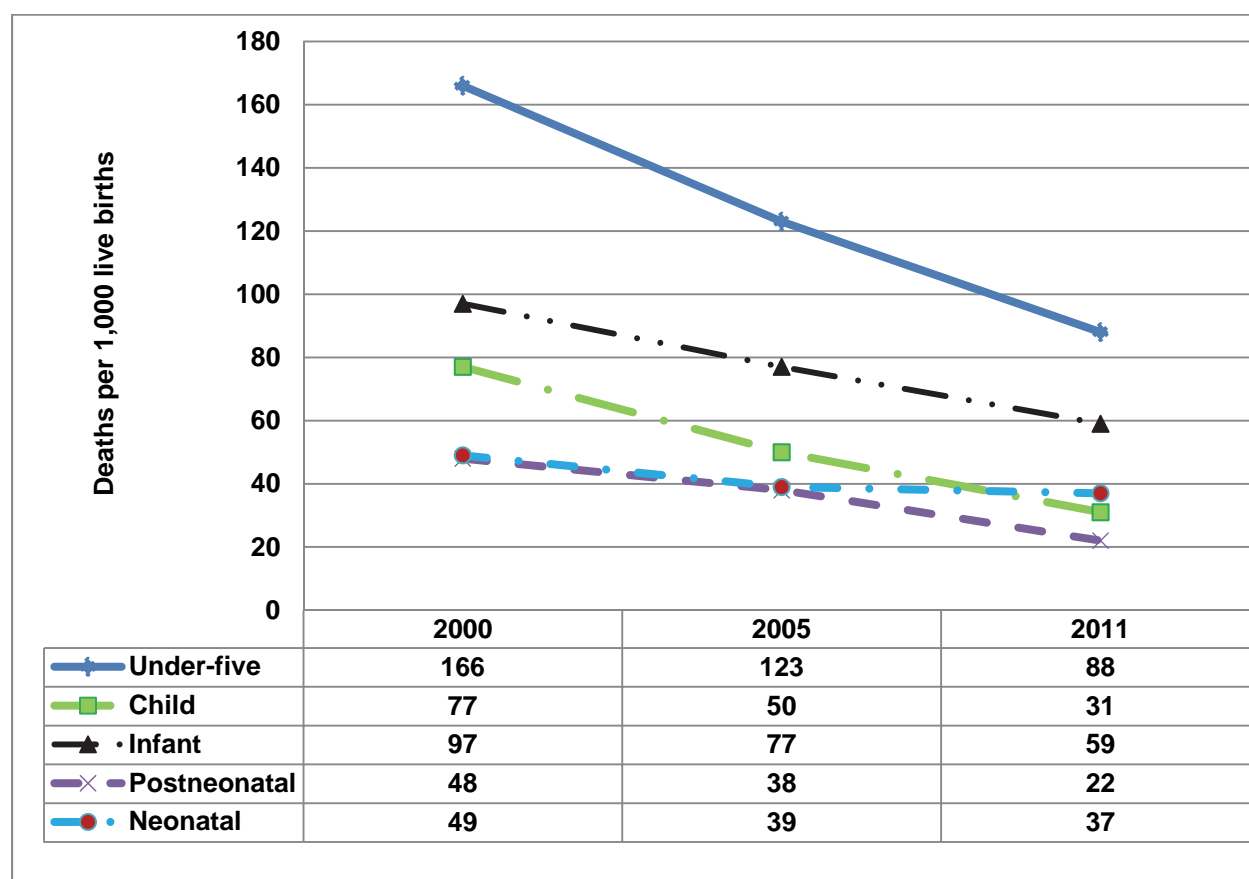
Source: Ethiopia Demographic and Health Survey 2000, 2005, and 2011

The data indicates that all the five childhood mortality indicators have been steadily declining over the last decades. The magnitude of decline varies among the component rates that combine to form the under-

11

five mortality rate. The highest mortality decline is observed in the child mortality rate (for children from 12 months to 47 months old) which declined from 77 deaths per 1000 live births in 2000 to 31 deaths per 1000 live births in 2011. This is equivalent to a 60 per cent decline between the two surveys.

Infant mortality also declined from 97 deaths per 1000 live births recorded in the year 2000 EDHS to 77 deaths per live births in the 2005 EDHS and to 59 deaths per live births in the 2011 EDHS, a decline of 40 per cent between the 2000 and the 2011 surveys. Similarly under-five mortality has shown a continuous reduction from 166 deaths per live births in the 2000 survey to 123 deaths per live births in the 2005 survey and 88 deaths per live births in the 2011 survey, this equates to a decline of 47 per cent from the initial level of under-five mortality of the country in 2000.

Neonatal mortality rates have not decreased to the same extent; the decline was just over 20 per cent. This is not surprising since neonatal mortality is mainly due to prematurity, asphyxia, and sepsis, three areas that require a skilled presence at the time of delivery and, as can be seen from Table 1, the proportion of women supported by skilled persons at time of delivery has only gone up from around 5 per cent to 10 per cent between 2000 and 2011.

The share of neonatal mortality to infant mortality by region and at national level has increased over time (see Table 6, Appendix). For instance, at a national level the contribution of neonatal mortality to infant mortality increased from 51 per cent to 58 per cent. The share of neonatal mortality to infant mortality also increased in many of the regions (except in Addis Ababa and Benshangul-Gumuz).

This study has also made analysis of the level, trend and differentials of infant and under-five mortality rates in Ethiopia by some major background variables believed to have effect on childhood mortality. The background variables considered in this analysis are categorized as child, mother and household characteristics. The results of the analysis are provided below in Tables 2 and 3 for infant and under-five mortality rates respectively.

Child Characteristics

This group of potential predictors consists of four major variables namely, sex of the child, birth order, the interval after the previous birth, and birth size.

The data revealed that male babies have a higher risk of death than female babies before reaching their first birthday. This result holds true for under-five mortality as well.

Various studies have shown birth order has a U-shaped pattern with highest probability of death of children at the beginning and end of birth orders. The finding here shows a similar higher prevalence of infant and under-five mortality for the lower and higher birth order children, and lower prevalence for the middle birth order children. Similarly, the survival of children was associated with previous birth interval (time elapsed between births). This study revealed that the highest prevalence of death, both for infants and under-fives, was for the lowest birth interval group (< 2 years) with declining trend towards the higher birth interval.

The size of the child at birth was also examined in terms of its contribution to variation in child death between small/ very small versus average or larger size babies at birth. Table 2 shows that average or larger size children at birth experienced slightly more deaths than smaller size children. In addition, the difference between the two birth sizes was higher among under-five year children, especially in 2011.

12

Mother Characteristics

In this study, the mother characteristics consist of mainly three predictor variables, i.e., mother's education, marital status and contraceptive use.

Mother's education is an important factor in childhood mortality reduction as more education is associated with lower risk of child death. This study showed that infant and under-five children born to educated mothers have a lower mortality risk. Concerning marital status the analysis shows that infant and under-five mortality is slightly higher for children born from mothers who are not in union. Mother's contraceptives use is another important independent variable considered in this study. The analysis indicated higher infant and under-five mortality among children born to mothers not using contraception than children born to mothers using contraception.

Household Characteristics

The household characteristics consist of five independent variables. These are type of residence, region, wealth index, source of drinking water, and the type of toilet facility the household uses. The study indicated, as expected, a higher infant and under-five mortality for children from households in rural areas than for children from households in urban areas. Region of residence was another variable that caused variation in infant and under-five mortality in the country. The highest infant and under-five mortality rates were observed in the Benishangul-Gumuz region. Figure 2 shows the trends derived from the three surveys with confidence intervals for the under five mortality rate for all regions.

Figure 3: Trends in Under-Five Mortality (per 1,000 live births) by region showing confidence intervals; for each survey the U5MR is an average for the ten years before the survey.

*The geographic sample for Afar and Somali was greatly expanded in 2011 compared to 2005 and 2000 thus the data cannot give us a real
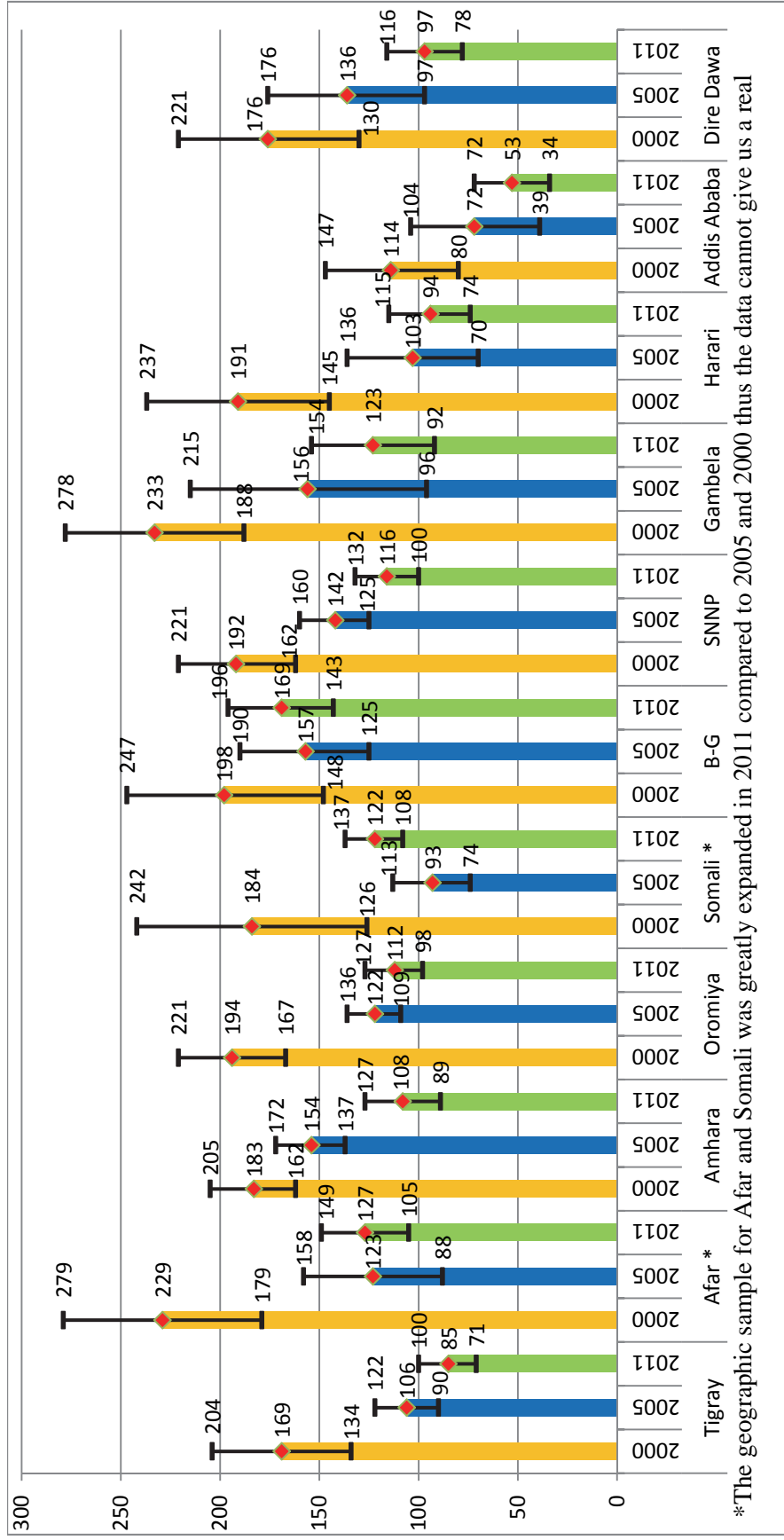
It's important to note that since the EDHS are sample surveys the figures have confidence intervals around them and it is not necessarily the case that one region is doing better than another one. This can be seen in the confidence intervals related to each of the figures shown. However, in general the figures show a declining trend especially between the period before the 2000 survey and the period before the 2005 survey. The declining trend continues in the period before 2011 but not as dramatically. The only region that, it seems, there might not have been a declining trend is in Beneshangul-Gumuz[3]. However, closer inspection, taking account of the confidence intervals, reveals that this is not necessarily the case.

Household wealth index is another variable assessed in this study. Wealth is important to determine household capacity for the utilization of health and education services. This study revealed a higher prevalence of infant and under-five mortality in the poor/poorest category, whereas results for the rich/richest categories seem to have the lowest mortality except in 2005.

The result of the study on source of drinking water indicated that slightly more infant and under-five deaths were observed in households using non-improved sources of drinking water than in households with improved sources of drinking water. Similar to sources of drinking water, the study found that the prevalence of infant and under-five mortality was higher for children living in households with a non-improved type of toilet.

---

[3]Afar and Somali also do not show a declining trend in the 2005 – 2011 time periods; however, as noted in the figure, the data for these two regions may be skewed due to expanded coverage in 2011.

Table 2: Level, Trends and Differentials of Infant Mortality, by selected characteristics, Ethiopia 2000-2011

Background Variables	Infant Mortality Rate*		
	2000	2005	2011
Sex of child			
Male	124.4	90.6	84.2
Female	100.6	69.5	62.7
Birth Order			
1	143.6	96.6	78.6
2-3	98.7	70.9	69.7
4-6	100.4	75.9	70.1
7+	126.4	88.5	82.4
Previous Birth Interval			
First birth	143.6	96.6	78.6
< 2 years	177.6	134	122.2
2 years	99.0	62.3	64.5
3 years	69.5	50.9	49.2
4+ years	57.2	37.6	36.8
Birth Size			
Small/very small	88.8	73.1	49.8
Average or larger	99.4	77.8	60.6
Mother's Characteristics			
Mother's Education			
No education	119.1	82.8	80.7
Primary	85.0	78.0	57.9
Secondary and above	63.5	37	34.4
Marital Status			
Currently not in union	136.3	279.5	73.9
Currently in union	110.3	98.5	72.3
Mother's Contraceptive Use			
Not Using contraceptive	114.8	83.3	81.6
Using contraceptive	90.0	61.5	50.9

Household Characteristics

Type of Residence

Urban	96.5	66.4	59.4
Rural	114.6	81.4	75.9

Region of Residence

Tigray	103.6	66.6	64.0
Afar	129.2	61.1	63.8
Amhara	112.4	94.4	76.4
Oromiya	116.2	75.5	72.8
Somali	99.4	56.6	70.7
Benshangul-Gumuz	97.6	84.0	101.2
SNNP	113.4	85.2	78.2
Gambella	122.6	92.2	75.8
Harari	118.3	65.6	63.5
Addis Ababa	81.0	44.8	40.0
Dire Dawa	105.6	71.2	60.1

Wealth Status

Poor/Poorest	114.4	81.6	75.5
Middle	64.5	49.1	51.1
Rich/Richest	54.8	80.3	51.2

Access to improved source of water

Improved sources of water	106.6	71.1	66.4
Non-improved sources of water	114.5	84.1	80.5

Access to improved toilet facility

Improved toilet	104.5	74.2	56.2
Non-improved toilet	112.9	80.8	76.5

* The figures are averages for the 10 years preceding each of the surveys

Table 3 Levels, Trends and Differentials of under-five mortality, by selected characteristics, Ethiopia 2000-2011

Background Variables	Under five Mortality Rate*		
	2000	**2005**	**2011**
Child Characteristics			
Sex of the child			
Male	197.0	141.6	122.1
Female	178.0	121.8	97.5
Birth Order			
1	205.6	141.6	105.7
2-3	177.4	120.4	101.6
4-6	181.7	128.4	112.1
7+	196.1	149.2	127.5
Previous Birth Interval			
First birth	205.6	141.6	105.7
< 2 years	271.9	207.9	178.6
2 years	186.1	111.6	106.1
3 years	137.4	92.0	71.8
4+ years	96.2	66.3	53.3
Birth Size			
Small/very small	137.6	103.8	65.8
Average or larger	169.1	135.6	92.8
Mother's Characteristics			
Mother's Education			
No education	197.4	139.4	120.3
Primary	147.1	111.1	87.8
Secondary and above	89.2	54.3	37.4
Marital Status			
Currently not in union	225.1	353.6	109.8
Currently in union	183.2	170.8	113.5
Mother's Contraceptive Use			
Not using contraceptive	192.0	138.5	120.7
Using contraceptive	136.1	91.6	79.9

Household Characteristics

Type of Residence

Urban	148.58	97.8	83.2
Rural	192.5	134.8	114.3

Region of Residence

Tigray	169.0	106.2	85.0
Afar	229.3	123.0	127.0
Amhara	183.4	154.3	107.9
Oromia	193.6	122.3	112.2
Somali	184.2	93.0	122.0
Benshangul-Gumuz	197.7	157.0	169.0
SNNP	191.5	142.3	115.9
Gambella	233.1	155.6	122.4
Harari	191.0	103.0	93.6
Addis Ababa	113.5	71.5	52.3
Dire Dawa	175.7	136.4	97.0

Wealth Status

Poor/Poorest	191.0	134.5	113.6
Middle	87.1	66.4	75.5
Rich/Richest	66.8	131.9	64.0

Access to source of water

Improved sources	166.2	116.5	97.9
Non-improved sources	192.2	138.2	121.0

Access to toilet facility

Improved toilet	114.0	123.6	90.1
Non-improved toilet	187.1	132.6	112.9

* The figures are averages for the 10 years preceding each of the surveys

3.2 Result of the Multivariate Analysis

In section 3.1, attempts were made to provide information about the changes in infant and under-five mortality over time as a result of different interventions and to examine mortality differentials among potential factors known to be responsible in influencing infant and under-five mortality. In this section, a multivariate analysis has been used to investigate which among the possible characteristics of children, mothers, and household are significantly influencing childhood mortality, and to sort out the independent effects of many of the potential determinants.

An appropriate statistical model suitable for the data type and purpose of the analysis is Cox proportional hazard model. The model is employed to examine the determinants of infant and under-five mortality in the five years preceding the survey. Results of the multivariate analyses for infant and under-five mortality are presented as hazard ratios (HR) (that is, exponentiated coefficients) and the corresponding 95% confidence interval (CI). The hazard ratio is the percentage increase or decrease in the risk of dying associated with the specific category of variable when compared to the reference category for that variable. Separate multivariate analyses were run for infant and under-five mortality and a brief summary of the results is given below.

Determinants of Infant Mortality

In Table 4 the model shows that infant mortality is significantly influenced by sex of child, birth size, birth interval, mother's education and marital status, place of residence, birth orderand household characteristics. Sex of the child is one of the predictors of infant mortality among child characteristics. Male children are at greater risk of dying before reaching their first birthday, by 14 per cent, than female children (HR = .86; 95% CI = (.785, .930))

This study also indicated that birth interval is significantly associated with infant mortality. Children born within an interval of less than two years have higher mortality risk than children born with an interval of four or more years. In particular, children born after an interval of four or more years are 58 per cent less likely to die before their first birthday compared to the first birth (HR = .42; 95% CI= (.344, .499)).

Birth size of a child has significant impact on child survival. The results showed that children with birth size of small/very small have significantly less risk of dying than children who have average or large birth weight. As most births in Ethiopia occur at home, where children often are not weighed at birth, data on birth size is used as a proxy for birth weight and hence, this finding should be interpreted with caution.

Mother's education is the most important determinant of infant mortality among the mother's characteristics that are considered in this study. Children whose mothers have attended secondary or higher education are 42 per cent less likely to die as infants compared with children whose mothers have no education (HR = .58; 95% CI=(.449,.739)). As shown in Table 4, marital status was a significant predicator of infant mortality. Children of mothers in a union have lower risk of dying before celebrating their first birthday than children whose mothers were not in union. Likewise, infants of households that were using improved toilet facility have lower risk of motality.

Determinants of Under-five Mortality

The result of the Cox regression analysis for under-five mortality is presented in Table 4. Among child characteristics under-five mortality is significantly influenced by sex of child, birth size and birth interval. Females are at lower risk of dying (17%) before their fifth birthday than male children (HR = .83; 95% CI = (.768, .889)).

Similarly, children of mother's with education level of secondary and above and those whose mother's are in union have lower mortality risk than children of mother's with no education and those whose mother's are not in union. The Cox regression results also show that improved toilet facilities have significant association with infant and under-five mortality.

A separate Cox hazard model was prepared including region of residence (Addis Ababa is the reference) as a predictor (see Table 5). In this model, region of residence was a significant predictor of infant and under-five mortality. The results in Table 5 indicate that all the findings in Table 4 hold when region of residence is included as a predictor. A significantly increased risk of infant mortality was observed only in two regions – Amhara and Gambella – as compared to Addis Ababa. However, under-five children in five regions, namely, Afar, Amhara, Benshangul-Gumuz, SNNP, and Gambella, showed significantly higher risk of mortality as compared to Addis Ababa.

Table 4: Results of the Cox regression for selected Predictor Variables Associated with Infant and Under-five Mortality, EDHS 2000-2011

Background Characteristics	Infant Mortality			Under-five Mortality		
	Hazard Ratio	95% CI		Hazard Ratio	95% CI	
		Lower	Upper		Lower	Upper
Child Characteristics						
Sex of Child (Ref = Male)						
Female	.855**	.785	.930	.826**	.768	.889
Birth Order (Ref = 1-2)						
3-4	.978	.852	1.123	.943	.837	1.063
5+	1.071	.943	1.216	1.053	.943	1.176
Previous Birth Interval (Ref = First born)						
< 3 years	.967	.841	1.111	.933	.825	1.055
3 years	.470**	.395	.561	.596**	.513	.692
4+ years	.415**	.344	.499	.479**	.407	.563
Birth Size (Ref = Average or larger)						
Small/very small	.831**	.758	.911	.917*	.846	.994
Mother's Characteristics						
Mother' Education (Ref = No education)						
Primary	.873*	.777	.981	.882*	.794	.979
Secondary and above	.576**	.449	.739	.522**	.416	.655
Marital Status (Ref = Not in union)						
Currently in union	.648**	.558	.753	.741**	.653	.841
Household Characteristics[4]						
Access to improved source of water (Ref = Non-improved sources of water)						
Improved sources of water	1.012	.919	1.114	.955	.878	1.038
Access to improved toilet facility (Ref = Non-improved toilet)						
Improved toilet	.853*	.738	.986	.865*	.761	.983
Place of residence (Ref = Urban)						
Rural	1.042	.889	1.222	1.046	.909	1.203
DHS Year (Ref = 2011)						
DHS 2000	1.124*	1.006	1.257	1.229**	1.114	1.355
DHS 2005	1.424**	1.282	1.583	1.699**	1.552	1.861

Significance level: * p < .05; ** p < .01

---

[4]The wealth Index is constructed from existing data on household assets, services, and amenities. The items used to construct the index include, among others, water supply and sanitation facilities. Thus, to avoid co-linearity the wealth index was removed from the model.

Table 5: Results of the Cox Regression for selected Predictor Variables Associated with Infant and Under-five Mortality, EDHS 2000-2011

Background Characteristics	Infant Mortality			Under-five Mortality		
	Hazard Ratio	95% CI		Hazard Ratio	95% CI)	
		Lower	Upper		Lower	Upper
Child Characteristics						
Sex of Child (Ref = Male)						
Female	.864**	.794	.941	.828**	.770	.891
Birth Order (Ref = 1-2)						
3-4	.983	.856	1.128	.945	.838	1.064
5+	1.080	.950	1.227	1.054	.943	1.177
Previous Birth Interval (Ref = First born)						
< 3 years	.987	.858	1.135	.939	.830	1.062
3 years	.466**	.391	.555	.593**	.510	.689
4+ years	.404**	.336	.487	.473**	.403	.557
Birth Size (Ref = Average or larger)						
Small/very small	.815**	.743	.894	.910*	.839	.987
Mother's Characteristics						
Mother' Education (Ref = No education)						
Primary	.866*	.770	.975	.880*	.791	.978
Secondary and above	.580**	.454	.741	.541**	.433	.676
Marital Status (Ref = Not in union)						
Currently in union	.671**	.577	.780	.735**	.648	.834
Household Characteristics						
Access to improved source of water (Ref = Improved sources of water)						
Non-improved sources of water	1.024	.931	1.127	.983	.904	1.068
Access to improved toilet facility (Ref = Improved toilet)						
Non-improved toilet	.885	.770	1.017	.885*	.784	.999
Region of residence (Ref = Addis Ababa)						
Tigray	1.097	.805	1.496	1.064	.804	1.409
Afar	1.239	.897	1.712	1.456*	1.094	1.938
Amhara	1.434**	1.065	1.931	1.483**	1.133	1.941
Oromia	1.062	.792	1.425	1.294	.992	1.687
Somali	1.017	.736	1.406	1.156	.865	1.543
Benishangul- Gumuz	1.085	.792	1.485	1.389*	1.049	1.840
SNNP	1.107	.824	1.488	1.357*	1.038	1.773
Gambella	1.457*	1.061	2.001	1.431*	1.072	1.910
Harari	.946	.677	1.323	1.064	.787	1.439
Dire Dawa	.986	.707	1.375	1.188	.882	1.599
DHS Year (Ref = 2011)						
DHS 2000	1.118	.999	1.251	1.224**	1.110	1.351
DHS 2005	1.416**	1.273	1.575	1.712**	1.561	1.876

Significance level: * p < .05; ** p < .01

4. CONCLUSION

Ethiopia is striving to achieve the MDG goal 4 of reducing the under-five mortality rate by two-thirds (67 per cent) from the estimated level in 1990 by the end of 2015. The analysis shows that the trend is on track to meet that target. Compared to the 1990 infant and under-five mortality estimates (118 and 198 deaths per 1000 live births, respectively), the overall declines are 50 and 56 per cent respectively. Improvements in socio-economic status have also probably had an influence on stunting reduction. However, neonatal mortality, with a decline of only 29 per cent since 1990 (52 per 1000 live births) has not seen so much progress because of the lack of action on emergency obstetric care and maternal health (UNICEF 2012). The triumvirate of prematurity, asphyxia and sepsis, the three causes of death attributed to the care of the mother and baby at the time of birth and soon thereafter, have not contributed significantly to the overall decline. This lack of progress in emergency obstetric care has also resulted in little, if any, decline in maternal mortality ratios and thus the MoH has started to focus on increasing investments in maternal health services at time of delivery which should result in declines in neonatal mortality in the years to come.

Differentials in infant and under-five mortality rates with respect to major independent variables analysed for this working paper provide information for programme interventions. Most of the independent variables showed large to small variations within sub-categories. This indicates that further change in these variables will result in further declines in mortality.

Of the possible proximate determinants that had an influence on infant and under-five mortality, sex of child, birth size, birth interval, mother's education, marital status and access to an improved toilet facility were found to be significant predictors. In a separate model that included region of residence, region was a significant predictor of infant and under-five mortality. However, regional difference is more pronounced for under-five mortality rather than for infant mortality.

5. RECOMMENDATIONS

The multivariate results shed light on the main proximate determinants of childhood mortality from amongst the variables measured in the DHS. Sex of child, shorter birth intervals, level of mother's education and whether the mother's in a union or not are statistically significant determinants of the childhood mortality. Children with small/very small birth size, children born at intervals of less than two years, children of mothers with no education, the children of mothers' who are not in union are at the higher risks of dying than others.

With the exception of child's sex, the challenge of shorter birth intervals, small size at birth and the low level of mothers' education are variables that can be improved by further strengthening interventions with the concerted efforts of all stakeholders.

While use of modern contraceptives has increased markedly (mainly as a result of the health extension workers, the unmet need for modern contraceptives, while it has declined from 37 per cent in 2000 to 26 per cent in 2011, is still high. Why the unmet need is so high despite the major increase in availability via the deployment of health extension workers is not clear and this is an area that needs further research. More could be done through various means of communication on the negative impacts of shorter birth intervals on the health of children and mothers, about contraceptives use for spacing and / or for limiting as well as making the supply of contraceptive fully available and accessible to address existing unmet need could be some of the possible interventions.

Focusing on girls education always remains one of the top priorities not only for the girls themselves but also for the children they are going to have today and tomorrow. A good education is an important factor helping to improve the use of available facilities, change behaviour and improve living conditions.

Though the results of some of explanatory variables included in the study are not significant determinants of infant and under-five mortality, it would be misleading to conclude that factors such as place of residence, birth order, household wealth and access to improved drinking water have no impact on child survival. These proximate determinants play important roles to influence infant and under-five mortality through the immediate determinants. For example, improved drinking water is well known to have a major impact on reducing diarrhoea, one of the major immediate causes of under-five mortality today in Ethiopia. Urban-rural residence, for instance, is likely to affect mothers' use of contraception and mothers' education both of which may have an effect on birth intervals.

Greater attention needs to be placed on reducing neonatal mortality rates by focusing on maternal and child health at the time of birth by increasing the proportion of births that are attended by skilled birth attendants; recent information from Tigray shows how this indicator can be improved through campaigning around convincing citizens to deliver in health centres. While the DHS 2011 indicated just over 10 per cent of births took place in health centres the figure in 2013 is reported to be close to 40 per cent.

Finally more research is needed to understand better why under-five mortality rates appear to be so high in Beneshangul-Gumuz. Though appearances may be deceptive due to the large confidence intervals around the results, more research is needed to better understand the true situation and, if further research confirms the initial results, to understand the reasons for these higher results.

Appendix

Table 6 : Contribution of Neonatal Mortality to Infant Mortality, Ethiopia 2000-2011

Region	2000	2011
Tigray	66%	69%
Afar*	35%	52%
Amhara	53%	71%
Oromiya	53%	55%
Somali*	61%	48%
Benshangul-Gumuz	66%	61%
SNNP	44%	49%
Gambella	47%	51%
Harari	46%	55%
Addis Ababa	53%	53%
Dire Dawa	40%	50%
National	51%	58%

* The geographic sample for Afar and Somali was greatly expanded in 2011 compared to 2005 and 2000 thus the data may not give a realistic picture of the trend in these two regions.

REFERENCES

Arvind Pandey, Minja Kim, Choe, Norman Y. Luther, Damodar Sahu and Jagdish Chand. 1998. Infant and Child Mortality in India: National Family Health Survey Subject Reports Number 11. Mumbai, India: International Institute for Population Science.

Central Statistical Agency (CSA) [Ethiopia]. 2012. *Statistical Abstract of Ethiopia.* Addis Ababa, Ethiopia: Central Statistical Agency.

Central Statistical Authority [Ethiopia] and ORC Macro. 2001. *Ethiopia Demographic and Health Survey 2000.* Addis Ababa, Ethiopia, and Calverton, Maryland: Central Statistical Authority and ORC Macro.

Central Statistical Agency [Ethiopia] and ORC Macro. 2006. *Ethiopia Demographic and Health Survey 2005.* Addis Ababa, Ethiopia, and Calverton, Maryland, USA: Central Statistical Agency and ORC Macro.

Central Statistical Agency [Ethiopia] and ORC Macro. 2012. *Ethiopia Demographic and Health Survey 2011.* Addis Ababa, Ethiopia, and Calverton, Maryland, USA: Central Statistical Agency and ORC Macro.

Central Statistical Agency (CSA). [Ethiopia]. 2008. *The 2007 Population and Housing Census of Ethiopia. Statistical Summary Report at National Level.* Addis Ababa, Ethiopia: Central Statistical Agency.

Ethiopia Child Survival Technical Working Group. Can Ethiopia reduce U5MR to Below 20 per 1,000 live births by 2035? Working paper, May 2012.

Ministry of Finance and Economic Development (MOFED) [Ethiopia]. 2010. *Growth and Transformation Plan, 2010/11-2014/15.* Addis Ababa, Ethiopia: Ministry of Finance and Economic Development.

Ministry of Finance and Economic Development (MOFED) [Ethiopia]. 2013. Annual Progress Report for F.Y. 2011/12 Growth and Transformation Plan. Addis Ababa, Ethiopia: Ministry of Finance and Economic Development.

Ministry of Health (MoH) [Ethiopia].November 2010. *Health Sector Development Program IV, 2010/11-2014/15.*Addis Ababa, Ethiopia: Ministry of Health.

Rathavuth Hong, Mohamed Ayad, Shea Rutstein and RuilinRen. 2009. Childhood Mortality in Rwanda Levels, Trends, and Differentials: Further Analysis of the Rwanda Demographic and Health Surveys Data. Calverton, Maryland, USA: ORC Macro.

Shea Rutstein, Mohamed Ayad, RuilinRen and Rathavuth Hong. 2009. Changing Health Conditions and the Decline of Infant and Child Mortality in Benin: Further Analysis of the Benin Demographic and Health Surveys Data. Calverton, Maryland, USA: ORC Macro.

Transitional Government of Ethiopia (TGE).1993a.*National Population Policy of Ethiopia.* AddisAbaba, Ethiopia: Transitional Government of Ethiopia.

Transitional Government of Ethiopia (TGE).1993b.*Health Policy of the Transitional Government of Ethiopia.* Addis Ababa, Ethiopia: Transitional Government of Ethiopia.

WHO. 2010. Countdown to 2015 decade report (2000-2010): Taking stock of maternal, newborn and child survival. Geneva, Switzerland

Rutstein, S. O. (2008). Further Evidence of the Effects of Preceding Birth Intervals on Neonatal, Infant, and Under-Five-Years Mortality and Nutritional Status in Developing Countries: Evidence from the Demographic and Health Surveys. Demographic and Health Research Division, Macro International Inc. 11785 Beltsville Drive, Calverton, MD 20705,

UNICEF (2012). Pneumonia and diarrhoea: Tackling the deadliest diseases for the world's poorest children. Statistics and Monitoring Section – Division of Policy and Strategy, UNICEF, New York, NY.

UNICEF (2012). Levels & Trends in Child mortality, estimate developed by the UN Inter_agency group for Child Mortality Estimation.

Unnati Rani Saha and Arthur van Soest (2012).Does Family Planning Reduce Infant Mortality? Evidence from Surveillance Data in Matlab, Bangladesh. Working paper, Tilburg University. Electronic copy available at: http://ssrn.com/abstract=2009853