REGIONAL VARIATION IN UNDER-FIVE MORTALITY IN RURAL ETHIOPIA

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DECLARATION

This research project is my own original work and has not been presented to this or any other university for an award of a degree.

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DEDICATION

This research project is dedicated to Tugi. May this study always inspire you to achieve more.

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First and foremost, I thank the Almighty God for His faithfulness in the journey to completing this research project. His gift of good health and encouragement has seen me complete the project successfully.

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ABBREVIATIONS

CSA	-	Central Statistical Agency
EDHS	-	Ethiopia Demographic and Health Survey
MDGs	-	Millennium Development Goals
SDGs	-	Sustainable Development Goals
SNNP	-	Southern Nations Nationalities and Peoples
UN	-	United Nations
UNICEF	-	United Nations Children's Fund
U5M	-	Under-five Mortality
U5MR	-	Under-five Mortality Rate

ABSTRACT

Childhood mortality is a crucial socioeconomic development aspect for any nation as it represents the health condition of a people. This study set out to establish how, despite the decrease in childhood mortality rates since 1990, regional variation in under-five mortality continues to be pronounced in rural Ethiopia. Ethiopia Demographic and Health Survey 2011 data was used for the survey, where a total of 9668 live births formed the sample out of which 725 children had died before their fifth birthday. The child survival framework development by Mosley and Chen (1984) was used to conceptualise the study. Direct approach in the estimation of under-five mortality rates and logistic regression were the main data analysis methods.

The study results indicated marked regional variation in childhood mortality rates with Benishangul-Gumuz and Gambela recording 193 and 160 deaths per 1000 live births respectively as Tigray and Dire Dawa recorded 127 and 119 deaths out of 1000 live births respectively. Higher mortality rates were obtained among children of women with primary education and higher, from the poorest wealth index, mother's age at birth below 18 years, male children, birth order 1-2, with short preceding birth intervals and from households with unsafe sources of drinking water and unimproved types of toilet facilities. Bivariate regression analysis results indicated that region of residence, wealth index, mother's age at birth and birth spacing had a significant influence on under-five deaths. Mother's age at birth and birth spacing were significant in the high mortality regions while wealth index, mother's age at birth, child's sex and birth spacing had significant influence in the low mortality regions. The results established that region of residence had significant effect on under-five mortality in regression models without proximate determinants but had mixed significance in models with proximate determinants. Wealth index, mother's age at birth and birth spacing had significant effect on under-five mortality in the full regression model.

The implication of the study findings is that stakeholders should develop programmes aimed at addressing specific determinants of under-five mortality in the different regions of rural Ethiopia. The programmes should also encourage increasing the maternal age at the birth of the child and longer birth spacing durations.

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Childhood mortality defines the risk of children dying before they celebrate their fifth birthday. As the highest risk of death occurs in childhood, understanding childhood mortality contributes to its estimation for the population while also contributing to determining the geographic, gender and sex distribution of the population while further understanding its size and growth. Efforts both at international and national levels have been developed and sustained to ensure that the levels of mortality remain at the minimum. Internationally, the Sustainable Development Goals (SDGs) have called for a reduction of childhood death rates to 25 per 1000 live births by 2030 (UN, 2015). These are efforts introduced after the end of the Millennium Development Goals (MDGs) period which set out to ensure a reduction in under-five mortality rates (U5MR) by two thirds between 1990 and 2015 (UN, 2000).

Global evidence documents a substantial reduction in U5MR from 93 to 39 deaths out of 1000 live births between 1990 and 2017- translating to a 58 percent decline (UNICEF, 2018). In Sub Sahara Africa where Ethiopia is located, the risk of childhood mortality is still high with1 in 13 children being at risk of dying before their fifth birthday (UNICEF, 2018). Ethiopia has seen the U5MR decline from 166 to 67 deaths per 1000 live births between 2000 and 2016 (CSA, 2001; CSA, 2016.).

The reduction of the under-five mortality rates has been prioritised by the Ethiopian government. Community mobilization and participation were strategized by the Ethiopian health policy, launched in 1993 in its efforts to ensure mortality and fertility levels are lowered (Transitional Government of Ethiopia (TFG), 1993b). In 2010, the Health Sector Development Plan of Ethiopia (Ministry of Health, 2010) efforts included promotional, preventive and curative interventions to enhance child survival. The strategy prevents under-five mortality by extending healthcare practices that can be undertaken by the children's families, immunization and treatment of child illnesses. Further decline in under-five mortality required targeting of the environments where the mothers lived through adequate and effective health services, family planning provision, access and provision of household sanitation and water with increased literacy among the mothers to access the improved services. (MoFED, 2010).

The sustained efforts in the reduction of under-five mortality has seen Ethiopia make significant strides in the achievement of MDG 4. However, the decline is unevenly distributed with substantial variations experienced among the different regions in the country. Addis Ababa has seen lower levels of under-five mortality with Benishangul-Gumuz, Gambela, Somali and Affar regions indicating higher rates over the years (CSA, 2001; CSA, 2006; CSA, 2012; CSA, 2016).

Variation in childhood mortality rates is a function of the environmental, socioeconomic, biologic and demographic factors which have been shown to influence the survival chances (Mosley and Chen, 1984). The regional and in-country variation could also be attributed to varied exposure to risk factors associated with mortality which are different across geographical spaces (Houweling & Kunst, 2009).

The risks associated with under-five mortality are connected to social structures and community ecologies. Crucial policy formulation thus requires understanding of the distribution of child deaths geographically (Picket and Pearl, 2001). Tailoring interventions specific to addressing the variations in under five mortality (U5M) calls for understanding of the specific determinants involved which to ensure the achievement of SDG 3.

1.2 Statement of the Problem

Ethiopia has realized remarkable reduction in U5M in the last twenty years. The country has seen the rates decline from 166 to 67 deaths out of 1000 live births between 2000 and 2016 (CSA, 2001; CSA, 2016). Regional variations in U5MR continue to be experienced among the regions Benishangul-Gumuz, Gambela, Affar and Somali regions which are largely rural recording higher mortality rates over the years (CSA, 2001; CSA, 2006; CSA,2012; CSA,2016).

Numerous studies have been carried out in Ethiopia to determine under-five mortality. They have examined the determinants at the country level (Kumar and Gemechis, 2010; Negera et al., 2013, and Getachew & Bekele, 2016). These studies established that maternal education and preceding birth intervals; region of residence, mother's education attainment and sex of the child; region of residence, mother's highest level of education, sex of the child and preceding birth interval respectively had significant effects on under-five mortality. Other studies focused on childhood mortality determinants in different locations in Ethiopia like

Bereka et al. (2017) whose study focused on the Somali regional state; Debebe and Dejene (2016), whose study focused on the Amhara regional state and Gebretsadik and Gabreyohannes (2016), whose study looked into the high mortality regions of Ethiopia and the factors determining childhood mortality in these regions. Findings from these studies indicated that birth order, birth spacing, status of breastfeeding, size of the family, drinking water sources; maternal level of education, maternal marital status, sex of the child, use of contraceptive, access to improved water sources; and maternal income and birth type had significant influence on under-five mortality.

Limited studies have critically looked at the influence of region of residence on under-five mortality. It is on this basis that this study is founded since the region of residence of the mother may affect the social, economic and environmental factors which influence under-five mortality.

1.3 Research Question

The research question of the study was "What is the effect of region of residence on under-five mortality in rural Ethiopia?".

1.4 Objectives of the Study

The general objective of the study was to explain the regional variation in childhood mortality in rural Ethiopia. To achieve this objective, specific objectives were;

i. To estimate the regional rates of childhood mortality in rural Ethiopia.
ii. To determine the factors influencing childhood mortality in the high and low mortality regions of Ethiopia.
iii. To determine the influence of region of residence on under-five mortality in rural Ethiopia.

1.5 Justification of the Study

Investing in children lays a foundation for a better society, a stronger economy and a society free from poverty. The survival of children is a fundamental indicator of the socioeconomic development of a society. Improvement on availability of education institutions, access and quality of health care services, improved water sources and enhanced household sanitation are all crucial in the reduction on under-five mortality.

Different geographic environments are endowed with different social, economic, cultural and environmental factors which in turn have an effect on under-five mortality. Understanding the socioeconomic, biodemographic and environmental factors influencing childhood mortality in the rural regions of Ethiopia will be crucial not only in planning for the children being born in a more effective way but also in enhancing their survival during their childhood. Formulation of the most appropriate policies for the regions ensures that there is better allocation of resources fundamental in the reduction of under-five mortality.

Findings of the study are hoped to encourage the government and other stakeholders on development of programs focused on addressing the specific determinants of under-five mortality in the different regions. Thus, achieving the SDG target of decreasing under-five mortality to 25 deaths per 1000 live births will be within reach.

1.6 Scope and Limitation of the Study

The Ethiopia Demographic and Health survey was utilised looking into the effect of region of residence on U5M in rural Ethiopia. The survey is nationally representative with a sample of 16,515 women aged 15-49 years on whom complete interviews were conducted. This yielded a response rate of 95 percent. There are inherent gaps in the data like data from women who had died was not available as only surviving mothers were interviewed.

In the Somali region, 28 percent of the selected enumeration areas were not interviewed due to security and drought problems making the sample from the region proportionally small.

The rural sample was further divided into ten regions. Due to the limitation in the number of cases in some of the regions, the estimation of under-five mortality rates may have resulted in unstable estimates. The number of cases in some of the variables like secondary education and higher in mother’s level of education and the richest wealth index category had be collapsed

which might have influenced the effect on some of the categories. Thus, the influence of secondary education and higher on U5M was not established by the study.

The study utilised the Mosley and Chen (1984) analytic framework. The framework argues that socioeconomic determinants of under-five mortality do not directly influence childhood mortality but rather works through the proximate determinants to influence mortality. Factors not included in the operational framework are in the categories of nutrient deficiency, personal illness control and injury as this information for individual children who died prior to the survey was not available.

CHAPTER TWO
LITERATURE REVIEW AND CONCEPTUALISATION

2.1 Introduction

This chapter explored the theoretical underpinning of the study. It reviewed literature from various scholars as well as major socio-economic, biological and environmental that affect childhood mortality in the rural regions of Ethiopia. The chapter further discussed the conceptual and operational frameworks used as well as definition of key variables.

2.2 Theoretical Background

Mosley and Chen (1984) noted a difference between social science and medical research in the study of childhood mortality. The former focused on the social, economic and cultural factors in child deaths while the latter explored on specific disease processes using morbidity as the most common outcome. They developed an analytic framework which would be later used to study child survival in developing countries. The model incorporated social and biological variables which all work together to influence mortality.

Mosley and Chen based their study on the premise that socioeconomic variables do not work directly to cause death but rather operate through both proximate and biological factors that consequently cause mortality. These proximate factors include maternal factors, the status of nutrition, environmental factors, household behaviours and injuries.

The assumptions of the framework are: that survival of new born children through their childhood would happen to 97 percent of the children born; socioeconomic factors cannot directly cause mortality but have to work through the proximate determinants; the operation of environmental, biological, economic and social variables decreases the probability of the new-borns survival; biological variables of the interaction of the proximate determinants manifests as specific diseases and deficiencies in nutrients; and mortality in children is a result of multiple factors and disease processes (Mosley and Chen, 1984).

2.3 Literature Review

2.3.1 Socio-economic Factors

2.3.1.1 Region of Residence

Regions of residence play a crucial role in U5M since they influence the risk of mortality due to their economic, social, ecological, and political and population health characteristics. The regional environment displays the socio-economic and political conditions which are not homogenous with geopolitical boundary lines affecting their variation, leading to potential inequities between regions.

Getiye (2011) using the 2005 Demographic and Health Survey showed that regional differences existed in childhood mortality in Ethiopia. Southern Nations Nationalities and People (SNNP), Benishangul-Gumuz and Amhara regions recorded elevated mortality risks compared to other regions. The under-five child deaths nationally was 0.052 but increased to 0.145 when region of residence was considered. Differentials in the environment, culture and lifestyle were attributed to the variation in mortality levels.

Houweling and Kunst (2009) in analysing DHS data from multiple countries found that lower socio-economic populations often lived in more economically and environmentally deprived regions within countries which are mostly rural. They attributed regional differences in childhood mortality in the rural areas to the socio-economic conditions in those areas. For example, they found variation in immunization coverage in African countries which is affected by individual level factors. Also, the geographic stratification influenced the social distribution of the proximate determinants of mortality.

Aigbe and Zanu (2012) attributed the regional variation in childhood mortality in Nigeria to infrastructural development. The lower mortality rates in the Southwest regions were attributed to the region being the most urbanized in Nigeria. The availability of more progressive learning and health care services presented the women from these regions with more exposure to better environment for taking care of their children compared to other regions thus improving their chances of survival. Antai (2009) found regional variations in immunization supplies in the regional states of Nigeria contributed to high childhood mortality rates in those regions.

To understand the influence of province of residence in the variation childhood mortality in Mozambique, Macassa et al (2012) posited that regional differences were due to the division

of Mozambique into three regions with unequal availability of water sources, toilet facilities and even health facilities which have an impact in child survival. The population in these regions lacked satisfaction in their basic needs. A similar study in Zimbabwe by Root (1997) noted that the uneven distribution of healthcare, basic infrastructure, economic and social variables were attributed to the observed regional differences in childhood mortality.

2.3.1.2 Maternal Level of Education

Maternal education has been shown to affect the survival of children in pregnancy, management of childhood diseases and even immunization. Caldwell (1979) argues that there are increased chances of survival for children whose mothers are educated as they are exposed to increased health care practices in preventive care, nutrition, hygiene and treatment of their children thus increasing their chances of survival.

Antai (2011) established that the unequal distribution in learning institutions in the northern regions of Nigeria were attributed to higher levels of childhood mortality in these regions. A higher proportion of the women had no education or primary education. Other factors associated with these differentials in the northern regions were political and religious variation, regional progress and the density of the population.

Getiye (2011) set out to explore regional variation in childhood mortality in Ethiopia and the major factors associated with it. His study indicated that educational attainment of the mother was significant for the survival of children. Women with no education had children with a 2.5 times higher risk of death in relation to those who had attained secondary education. While 3 percent of women with secondary and above education had lost their children, 85.7 percent of mothers with no education had at least lost a child.

Bedane et al (2011) attributed higher maternal education to higher survival chances for the children. He showed that secondary and above education among the mothers improved their children's survival status by 73.1 percent. He argued that education among the mothers is expected to result in higher awareness towards breastfeeding, higher gaps between births and controlling the size of their children at birth compared to mothers with no education.

In Gilgel Gibe Research Centre, educational attainment by the mother had an effect on under-five mortality. Belaineh et al. (2007) established that children whose mothers had attained

elementary education were 11.7 times more likely to experience mortality in relation to those who had attained higher education. Controlling for other socioeconomic and demographic variables had maternal education retain its significance where children whose mothers had no education had 25 times more risk of death in relation to those whose mothers had attained more than elementary education.

2.3.1.3 Wealth Index

Income plays an important role in enhancing child's health. More resources available in the households translate to more resource allocation for food and health. Poor environmental conditions present inaccessibility to material resources while poor living conditions may actually represent the most impediments to being adequately nourished and healthy.

In EDHS 2000 and 2011, Negera et al (2013) indicated higher levels of childhood mortality among the poor/poorest women with the rich and more economically endowed women having lower levels of mortality.

Belaineh et al (2007) in a study on Jimma town in Ethiopia observed that there was a significant decrease in childhood mortality as the wealth index of the family increased from poor to affluent. Looking at the households environmental and socio-economic characteristic determinants of childhood mortality, Mutunga (2007) observed a higher survival rate in rich households. They enjoyed better access to nutrition, better housing condition and better education; increasing survival probability of the children as they have an increased demand for healthcare.

2.3.2 Biological Factors

2.3.2.1 Sex of the Child

Adedini et al examined how male and female children experience mortality in Sub-Saharan Africa. They also explored how economic and social factors among women and health-care related factors influenced differences in sex differences in childhood mortality in selected countries. Results from the Cox Proportional Hazards analysis indicated that sex of the child was significant in explaining under-five mortality. Controlling for effects of healthcare related factors on sex differentials indicated that the male and female survival gap widened for Nigeria, Cameroon and Ethiopia. The third model established that there was an elevated risk of mortality among male children which remained significant in Nigeria and Ethiopia. For

Ethiopia, the odds of dying among the male children was 1.37, 1.74 and 1.80 respectively for the three models fitted in the study.

An assessment of the major determinants of childhood mortality in Ethiopia established that sex of the child was significant in childhood mortality. Female children were 16% less likely to experience mortality in relation to the male children even when other variables were considered (Bedada, 2017).

Buli (2013) established that female children had 16.5 percent less risk of mortality in childhood in relation to their male counterparts. He was examining the relationship socioeconomic, health, demographic and environmental situation in a household.

2.3.2.2 Birth Order

Childhood mortality and birth order have related in a J- or U- shape. The relationship indicates that elevated mortality risks are seen in first and later born children.

The survival of children is positively related to birth order. Buli (2013), indicated that in rural Ethiopia, children born of birth order 4 and higher had more risk of mortality compared to first born children. They have an elevated risk of mortality of 89.4 percent compared to first born children.

Negera et al (2013) confirmed that higher mortality was experienced among children in the lower and higher birth orders. The childhood risk was lower among the middle-aged children. The study corroborated the U-shaped pattern between childhood mortality and birth order.

2.3.2.3 Mother's age at child's birthday

Children born to women below 18 years and above 35 years have children who are exposed to higher risks of mortality. Women delivering children in their teenage years have elevated risk of mortality for their children as they are inexperienced and are physically immature. Consequently, women delivering while aged above 35 years expose their children to age related problems during pregnancy and delivery. Hobcraft et al. (1985) and Mosley and Chen (1984) indicated that childhood mortality is elevated for very young women (<18 years), reduces for women aged between 25 and 30 and then rises steadily after woman attains 35 years.

Buli (2013) indicated that in rural Ethiopia, children born to women aged 21-34 years and 35 years and above had a higher survival rate to their fifth birthday compared to children whose maternal age at child's birth was less than 20 years. Their survival advantage was 23.6 percent and 32.6 percent respectively.

2.3.2.4 Preceding Birth Interval

Preceding birth intervals refers to the time between one birth to another. Susuman (2012) hypothesised that women who gave birth more than three years between each other had increased survival in childhood in relation to women who gave birth less than three years from the previous birth. The findings of the study indicated that children born within 2-3 years birth interval were 2.7 times less likely to experience mortality compared to children born within two years preceding birth interval.

In analysing 52 DHS surveys from developing countries, Rustein (2005) indicated that birth intervals of less than twenty-four months were associated with increased diseases in pregnancy, adverse pregnancy outcomes, and increased childhood mortality. He argued that birth spacing duration longer than twenty-four months improved maternal health by decreasing maternal morbidities and mortality.

2.3.3 Environmental Factors

2.3.3.1 Source of Drinking Water

Piped water supply affects the risk of under-five deaths directly by decreasing the risk chances of diarrhoea occurring from ingestion of contaminated food and water. Further, more time would be spent looking after the children instead of water collection activities.

Buli (2013) indicates that children whose mothers used protected water had higher chances of survival to their fifth birthday than those who used surface water. They had 64.6 percent less mortality risk as compared to a child whose parents use surface water.

Results from Negera et al (2013) study indicated that more risk of childhood mortality was seen in households with drinking water from non-improved sources than in households with improved drinking water sources.

2.3.3.2 Type of Toilet Facility

A study in rural Zimbabwe showed that between 1990 and 2011, children in households with un-improved facilities of toilet had an increased risk of mortality than those from homes with improved toilet facilities. Children using bush toilet facility 2.24 times higher risk of death in relation to those with improved toilet facilities. This was attributed to diarrhoea in the rural areas (Makate and Makate, 2016)

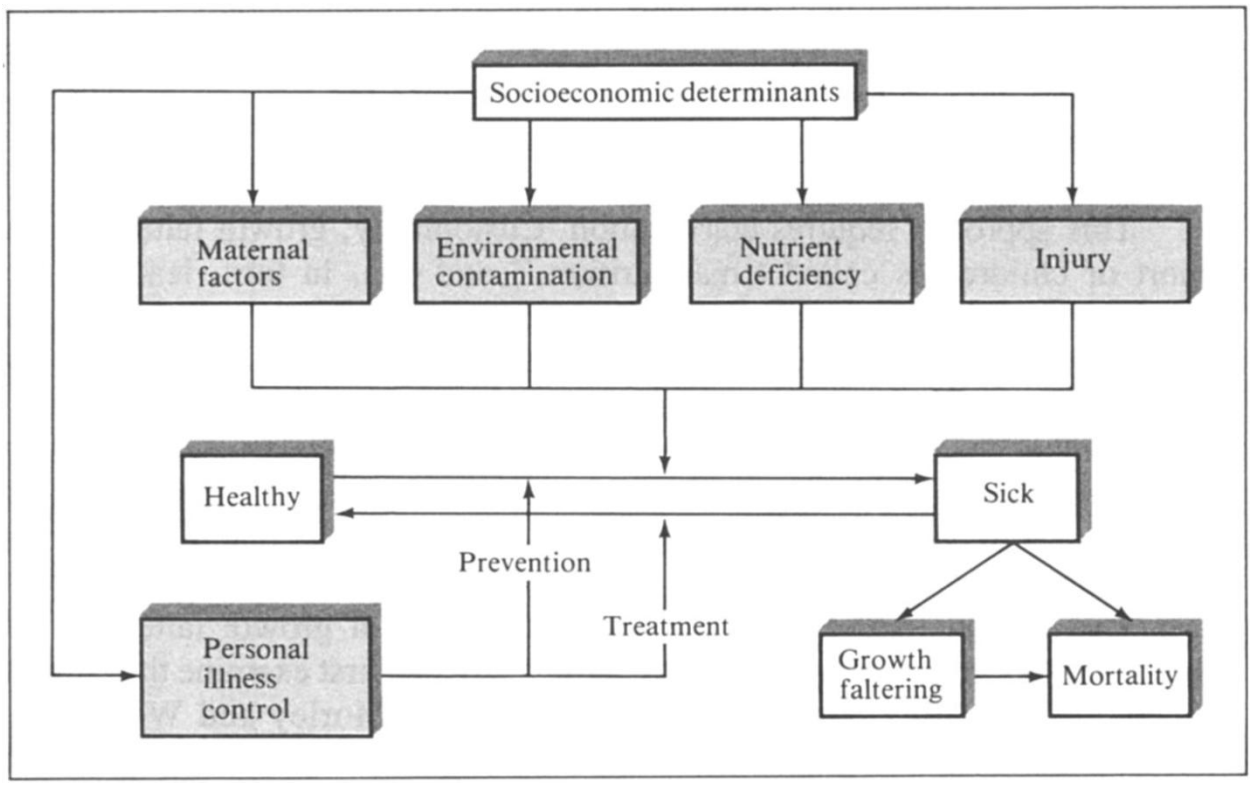
Negera et al (2013) analysed 2000-2011 Ethiopia Demographic and Health Survey. They found that childhood deaths were higher for children born and living in homes with unimproved toilet facilities.

2.4 Conceptual and Operational Frameworks

2.4.1 Conceptual Framework

This study utilised the analytic framework developed by Mosley and Chen (1984) which attempted to address the influence of health interventions on one hand and social, economic and intermediate variables on the other. Mosley and Chen (1984) framework contains a proposition that socioeconomic factors such as region of residence operate through the proximate determinants to influence child mortality.

Figure 1: Mosley and Chen Analytic Framework.

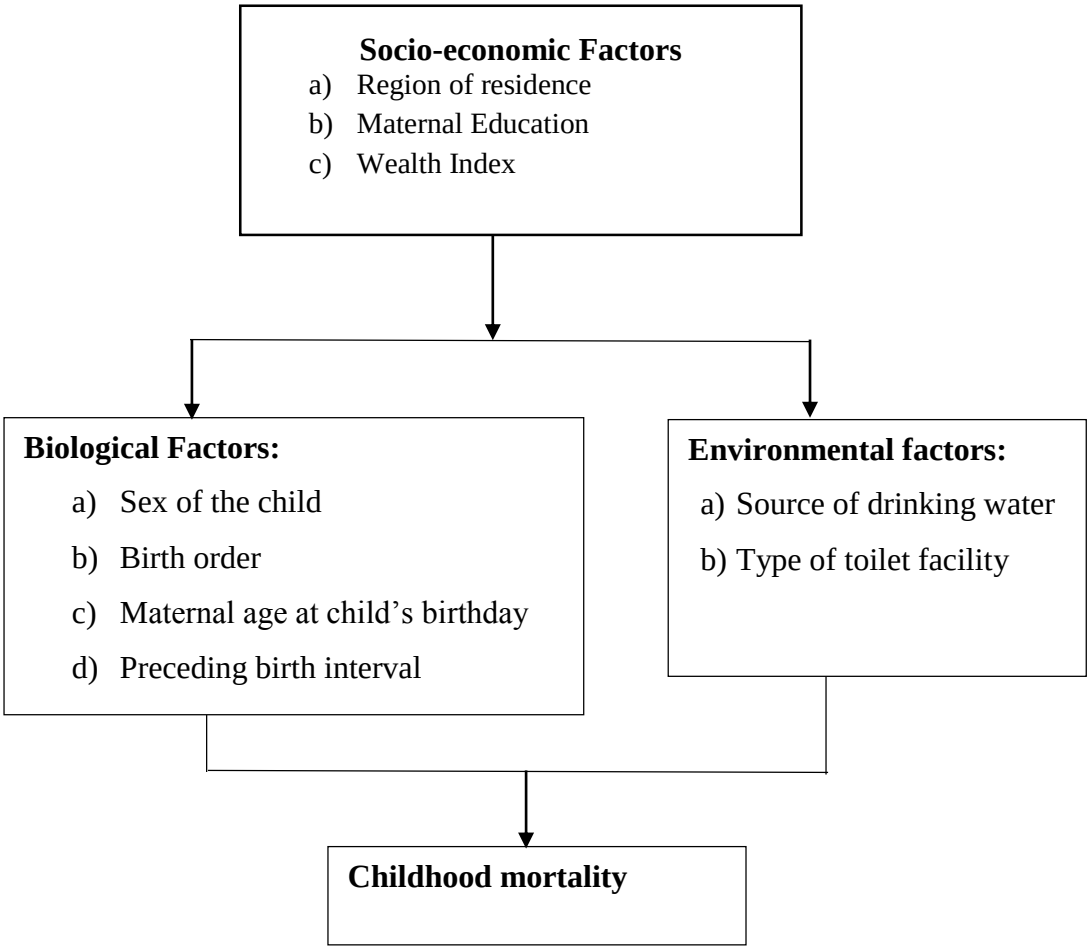


Source: Mosley, W. and L. Chen. (1984)

2.4.2 Operational Framework

The figure below represents the operational framework used in the study. The proximate determinants included in the study were based on previous literature and especially Ethiopia. Socio-economic variables included region of residence, maternal education and wealth index; biological factors included maternal age at child's birthday, sex of the child and birth order while environmental factors included drinking water source and toilet facility type.

Figure 2: Operational Framework



Adapted from: Mosley, W. and L. Chen. (1984).

2.5 Definition of Variables

The dependent variable in the study was the risk of death during childhood (0-59 months). The socioeconomic variables were region of residence, maternal level of education and wealth index. Region of residence represented the mother's regions of residence at the time of the study. The study hypothesises that due to the environmental, economic and cultural endowments among the regions, there are differences in the under-five mortality rate. Maternal education was the highest education attained by the mother. The study hypothesizes that higher level of education translates to better healthcare to the children by the educated mothers. The risk of mortality is expected to reduce with the presence of education. Wealth index defined the measure of household's cumulative living standards. The household wealth index is expected to show availability of resources in a household to better the living condition of a child. It is therefore expected in this study that infants born in households with low wealth index will show a relatively higher risk of under-five death.

The biological factors in the study composed of both the maternal and child factors. They were: age of the mother at the birth of the child, sex of the child, birth order and preceding birth interval. Age of the mother at the birth of the child was defined as the current age of the mother at the birth of the child. It is expected that children born to mothers aged 18-34 years have a reduced risk of mortality. Sex of the child was defined as either male or female. It is expected that male children will have a higher risk of mortality compared to the female children. Birth order defined the order the child was born in a family. It is expected that lower and higher birth orders will have higher mortality risks. Preceding birth interval defined the difference between birth date of child and that of the preceding child. It is expected to measures the effect of short and long duration before the next birth on under-five mortality. The study hypothesizes that children with longer preceding birth intervals have a lower risk of mortality.

The environmental factors considered were source of drinking water and type of toilet facility. The source of drinking water defined the origin of drinking water for the household. Safe sources of drinking water composed of piped, tube, protected well, protected spring and bottled water while unprotected water composed of unprotected well, surface, unprotected spring and trucked water. The variable is also expected to measure the hygienic condition of the household. The expectation is that infants born to households with a safe source of drinking water will experience relatively lower risks of childhood mortality.

Type of toilet facility defined the mode of disposal for human waste. Improved types of toilet facility composed of flush toilet and pit latrine while un-improved types composed of no toilet facility, composting toilet, bucket and hanging toilets. This variable is expected to capture the hygienic condition of the household. It is therefore expected that children born to households with a toilet facility will have relatively lower risks of dying.

Table 2.1 Definition of variables

Variable	Variable Code	Operational Definition	Role of Variable
Child is dead	U5D	0= Alive 1= Dead	Dependent variable
Region of residence	REGION	1= Benishangul-Gumuz 2= Gambela 3= Affar 4= Somali 5= SNNP 6= Harari 7= Amhara 8= Oromiya 9= Tigray 10= Dire Dawa	Independent socioeconomic variable
Mother's level of education	MEDUCATION	0= No Education 1= Primary +	Independent socioeconomic variable
Wealth Index	WINDEX	0= Poorest 1= Poorer 2= Middle 3= Rich	Independent socioeconomic variable
Maternal age at child's birth	MAGE	0= <18 1= 18-34 2= 35+	Proximate determinant-biological factor
Sex of the child	SEX	0= Male 1= Female	Proximate determinant-biological factor
Birth Order	BORDER	0= 1-2 1= 3-4 2= 5+	Proximate determinant-biological factor
Preceding birth interval	BINTERVAL	0= <24 months 1= >=24 months	Proximate determinant-biological factor
Source of drinking water	WSOURCE	0= Unsafe 1= Safe	Proximate determinant-environmental variable
Type of toilet facility	TFACILITY	0= unimproved 1= Improved	Proximate determinant-environmental variable

CHAPTER THREE
DATA AND METHODS

3.1 Introduction

This chapter presents a description of the sources of data, sample selection and data quality. It also explores the computation of under-five mortality rates and logistic regression analytical methods used in the study to determine the effect of region of residence on under-five mortality in rural Ethiopia.

3.2 Data and Rationale

3.2.1 Data Source

The study utilised data obtained from the Ethiopia Demographic and Health Surveys (EDHS) 2011. EDHS (2011) is a nationally representative survey collected data from 16,515 women aged 15-49 and 14,114 men aged 15-59. The exercise provided information on knowledge and attitudes toward HIV/AIDS and other Sexually Transmitted Infections (STIs), trends in fertility and mortality, maternal and child health and approval and uptake of family planning.

3.2.2 Survey Design

Seventeen thousand, eight hundred and seventeen households selected for the survey saw successful interviews conducted in 16,702 households. The survey identified 17,385 women eligible for the survey with 16,515 interviews being completed. In the rural areas, 11,186 women were interviewed yielding a response rate of 95 percent.

3.2.3 Survey Questionnaires

The survey questionnaire utilized 3 types of questionnaires: a woman's questionnaire, a household questionnaire and a man's questionnaire. This study utilised the women questionnaire captured in the births file.

3.3 Data Analysis

3.3.1 Estimation of Under-five Mortality

Indirect and direct methods have been proposed and used in the estimation of childhood mortality. Limited information is needed in the indirect methods of childhood mortality, a few precise, simple queries are required regarding total number of children born to a woman, her age, and total number of children deceased (Rutstein and Rojas, 2006).

Brass estimation techniques assume that the duration of exposure of the children born to a woman to the risk of mortality could be related to mother's age as it could serve as a proxy for her children's age. Also, the age of the mother does not reflect the mortality of the children as the time period when the children are born (Brass, 1964; Brass, 1975).

There are inherent challenges with indirect estimation techniques. General population data for the age pattern of mortality is adjusted using model life tables. On the other hand, it is essential to pick a life table which is fundamental to a specific population for accurate estimation (Ahmad et al., 2000). Locating mortality estimates in time for the children in Africa has been a challenge as the Coale and Demeny life tables have been derived largely from European experience (Child Mortality Coordination Group, 2006). Experiences of mothers on the death of their children could extend for as many as twenty years whose probability is estimated by the indirect methods. Thus, the methods assume that fertility experience remains the same as well as patterns of age with mortality declining in a linear way (Rutstein and Rojas, 2006).

Estimation of childhood mortality for this study was done using the direct method. Data on the date of birth of children, their status of survival, and the dates of death of deceased children were used. The data required are usually obtained in specifically designed surveys with birth histories or from vital statistics systems. Direct methods of childhood estimation suffer from data errors. Information for deceased children omitted some critical information on determinants of child survival such as care of sick children and injury that are gathered on children found alive at the time of survey. Detailed description of direct estimation of under-five mortality using demographic and health survey datasets is well documented by Rutstein and Rojas (2006).

3.3.2 Computation of Childhood Mortality Rates

This section describes five steps taken to compute under-five mortality rates by region of residence and other study background characteristics. The computations were based on survival status of births born to women in the duration period five years prior to the survey.

Step 1: Estimation of proportions of children dead/alive

This is to calculate the number of children who died before celebrating their fifth birthday.

U5D=0

U5D$= 1\ if\ B5 = 0 \& B7 \leq 59$

Where U5D= Under-five deaths

B5= child is alive

B7= age at death in months

Step 2: Estimation of the risk of exposure toU5M

9,668 children were born in the ten rural regions of Ethiopia five years before the survey they were all exposed to the risk of death but their exposure duration was at different times.

Children alive: $U5E = B7\ if\ B5 = 0\ \&\ B7 \leq 59$

U5E$= 0.5\ if\ B5 = 0\ \&\ B7 = 0$

Children dead: U5E$= V008 - B3\ if\ B5 = 1\ \&\ (VOO8 - B3) \leq 59$

U5E=$0.5\ if\ B5 = 1 \& (VOO8 - B3) = 0$

Where:

U5E= under-five exposure to the risk of mortality

B7= age at death in months

B5= child is alive

VOO8= date of the interview

B3= date of birth (CMC)

Step 3: Estimation of the risk of death

The risk of death is calculated by dividing the number of proportions of children dead/alive and the number of exposure months to risk of mortality.

U5R=$\frac{TU5D}{TU5E}$

Where:

U5R= under-five risk of mortality

TU5D= aggregated under-five deaths

TU5E=aggregated under-five exposure to the risk of mortality

Step 4: Computation of the survival probability

The exposure to the risk of mortality is transformed to a life table function to calculate the probability of survival for the children

U5SP= $e^{-(U5R*60)}$

Where:

e= exponent

U5R= under-five mortality risk

Step 5: Computation of under-five mortality

U5MR= 1-U5SP

Where:

U5MR= under-five mortality rate

U5SP= under-five survival probabilities

The computation of under-five mortality assumed uniformity of mortality age pattern during childhood from birth to age 59 months. Estimates of under-five age segments mortality for the various regions of Ethiopia were therefore not computed in this study. Estimates obtained are also sensitive to the number of cases in each variable category. Variable categories with fewer cases tend to yield unstable estimates.

3.4 Logistic Regression

Logistic regression is a statistical method for analysing a dataset in which there are one or more independent variables that determine an outcome. The outcome is measured with a dichotomous dependent variable in which there are only two possible outcomes: success or failure of an event occurring. Logistic regression employs binomial probability theory in which there are only two values to predict: that probability (p) is 1 rather than 0, i.e. that mortality will occur or not.

The goal of logistic regression is to find the best fitting model to describe the relationship between the dichotomous characteristic of childhood mortality and a set of independent variables. Thus, logistic regression generates coefficients of a formula to predict a logit

transformation of the probability of the presence of childhood mortality. The best fitting equation maximizes the probability of classifying the observed data into the appropriate category given the regression coefficients.

The logistic regression function is shown as:

$$\mathbf{P=}\frac{e^{a+bx}}{1+e^{a+bx}}$$

Where:
P= the probability of an event happening
E= natural logarithm, which is equal to 2.71828…….
α and b= the model coefficients
x= independent variable

Logistic regression is a fundamental predictor of membership of different factors to groups. Consequently, since the results are presented as odds ratio, it provides information on the direction and strength among the variables as regression also explores the probability of failure over success.

Assumptions by logistic regression are that the dependent and independent variables do not exhibit a linear relationship; a dichotomous nature is shown by the dependent variable; the outcome variable need not be linearly related, distributed normally, of equal variance within each group, and does not need to be interval; mutual exclusivity among the categories and membership of a group is restricted to one group.

CHAPTER FOUR
REGIONAL VARIATION IN UNDER-FIVE MORTALITY IN RURAL ETHIOPIA

4.1 Introduction

This chapter has four sections. The first section describes the distribution of the study population by different characteristics, the second section presents the under-five mortality rates by socioeconomic and proximate determinants, the third section presents the determinants of childhood mortality in the high and low mortality regions of rural Ethiopia while the last section represents three models fitted to show the effect of region of residence on under-five mortality in rural Ethiopia.

4.2 Background Characteristics of the Study Population.

Table 4.1 depicts the background characteristics of the study population. Five years prior to the DHS survey, 9,668 children were born in rural Ethiopia where 725 of them did not survive to celebrate their fifth birthday. The results indicate that highest proportions of the deaths occurred to children whose mothers resided in Benishangul-Gumuz and Gambela regions estimated at 9.6 and 8.0 percent respectively. The least proportions of child deaths were among women residing in Tigray and Dire Dawa estimated at 6.5 and 5.9 percent respectively. About 8.3 percent of the child deaths were among women with no formal education while women with primary and above education had 7.7 percent. The results also show that as the wealth index increased then the risk of under-five deaths decreased. Highest proportion of the child deaths occurred to women in the poorest wealth index category estimated at 8.3 percent while the least were to women in the rich wealth index category estimated at 6.3 percent.

Children born to mothers aged less than 18 years experienced under-five deaths estimated at 12.1 percent while those with mothers aged 18-34 years experienced the least deaths estimated at 7.1 percent. Higher proportion of deaths occurred among the male children estimated at 8.0 percent while the female children experienced 7.0 percent. A larger proportion of under-five deaths were among children of lower birth order (1-2) estimated at 8.0 percent and the least were among the 3-4 birth order category estimated at 6.9 percent. Children born within short preceding birth interval experienced higher proportion of death estimated at 12.5 percent while those with longer birth intervals had lower death proportion estimated at 6.3 percent.

On environmental factors, higher proportion of child death was experienced in households with access to un-safe drinking water sources estimated at 7.7 percent. Similarly, higher proportion of child death occurred in households with un-improved toilet facilities estimated at 7.7 percent.

Table 4.1 Study Under-five Population by Background Characteristics

Variable	Survival status		Total	
	Percent dead	Percent alive	Percent	Number
All under-five	**7.5**	**92.5**	**100**	**9668**
Socioeconomic factors				
Region of residence				
Benishangul-Gumuz (RC)	9.6	90.4	100	937
Gambela	8.0	92.0	100	747
Affar	7.9	92.1	100	989
Somali	7.4	92.6	100	756
SNNP	7.7	92.3	100	1527
Harari	7.1	92.9	100	435
Amhara	7.0	93.0	100	1194
Oromiya	7.2	92.8	100	1605
Tigray	6.5	93.5	100	1057
Dire Dawa	5.9	94.1	100	421
Mothers level of education				
No education	8.3	92.4	100	7373
Primary+	7.7	92.7	100	2295
Wealth index				
Poorest	8.3	91.7	100	3521
Poorer	7.7	92.3	100	2094
Middle	7.3	92.7	100	1845
Rich	6.3	93.7	100	2208
Biological factors				
Mothers age at child's birthday				
<18	12.1	87.9	100	645
18-34	7.1	92.9	100	7627
35+	7.7	92.3	100	1396
Sex of the child				
Male	8.0	92.0	100	4945
Female	7.0	93.0	100	4723
Birth order				
1-2	8.0	92.0	100	3210
3-4	6.9	93.1	100	2675
5+	7.5	92.5	100	3783
Preceding birth interval				
<24 months	12.5	87.5	100	1842
>=24 months	6.3	93.7	100	7826
Environmental factors				
Source of drinking water				
Unsafe	7.7	92.3	100	5443
Safe	7.2	92.8	100	3957
Type of toilet facility				
Non-improved	7.7	92.3	100	5838
Improved	7.2	92.8	100	3597

4.3 Under-five Mortality Rates by Socioeconomic and Proximate Determinants in Rural Ethiopia

Results from Table 4.2 indicated that Benishangul-Gumuz, Gambela, Affar and Somali regions recorded childhood mortality rates of 193, 160, 156 and 154 deaths out of 1000 live births respectively which were higher than in other regions. On the other hand, Dire Dawa and Tigray recorded the lowest rates of mortality at 119 and 127 deaths out of 1000 live births respectively. Mothers with no formal education recorded U5MR of 149 deaths out of 1000 live births compared to mothers who had attained some level of formal education of 153 deaths per 1000 live births. Being born to rich mothers had reduced childhood mortality rates of 124 out of 1000 live births while those born to mothers from the poorest wealth index had a mortality rate of 165 deaths per 1000 live births.

Biological factors indicated that children born to women of below than 18 years were at the highest risk of under-five mortality compared to those born to older mothers (above 35 years) while those born to mothers aged 18-34 years had the lowest risk of under-five mortality. Male children had a higher rate of under-five mortality compared to their female counterparts at 159 deaths per 1000 live births. Children of lower and higher birth orders experienced higher rates of childhood mortality at 159 and 150 deaths per 1000 live births respectively while those of birth order 3-4 had the lowest under-five mortality rate at 138 deaths per 1000 live births. Children with shorter preceding birth intervals short of less than two years had a childhood mortality rate of 220 deaths per 1000 live births while those with longer preceding births intervals had a lower childhood mortality rate of 130 deaths per 1000 live births.

Environmental factors indicated that children born to women without access to safe drinking water had a higher rate of under-five mortality compared to those whose parents had access to safe drinking water at 155 deaths per 1000 live births. Consequently, children born to parents with improved toilet facilities had a lower rate of mortality at 143 deaths per 1000 live births compared to those without access to improved toilet facilities.

Table 4.2 Results of Under-five Mortality Rates by Socioeconomic and Proximate Determinants

Background Characteristic	Under-five mortality rates per 1000 live births
National	150
Socioeconomic characteristics	
Region of residence	
Benishangul-Gumuz	193
Gambela	160
Affar	156
Somali	154
SNNP	151
Harari	147
Amhara	145
Oromiya	138
Tigray	127
Dire Dawa	119
Mothers level of education	
No education	149
Primary+	153
Wealth Index	
Poorest	165
Poorer	153
Middle	148
Rich	124
Biological factors	
Mothers age at the birth of the child	
<18	221
18-34	142
35+	157
Sex of the child	
Male	159
Female	140
Birth order	
1-2	159
3-4	138
5+	150
Preceding birth interval	
<24 months	220
>24 months	130
Environmental factors	
Source of drinking water	
Unsafe	
Safe	155
	141
Type of toilet facility	
Non-improved	
Improved	154
	143

4.4 Bivariate Analysis of Determinants of Under-five Mortality

Bivariate regression analysis sought to establish the influence of individual variables on under-five mortality.

Table 4.3 illustrated that among the socioeconomic determinants, region of residence and wealth index had a significant effect on U5M. Amhara, Oromiya, Tigray and Dire Dawa regions were significant when compared to Benishangul Gumuz region. Children from these regions had 0.726, 0.712, 0.657 and 0.594 times less risk of death in childhood compared to children in Benishangul-Gumuz region at p-value<0.05. Children born in Dire Dawa region had 0.406 higher chances of survival to their fifth birthday compared to those born in Benishangul-Gumuz region.

At p-value<0.01, children in the rich wealth index category had 0.746 times less chance of death in their childhood compared to those born to mothers in poorest category. The results indicate that the wealth index category of the mother increases then the risk of mortality decreases.

A significant effect on U5M was seen in birth spacing and maternal age at child's birthday. 18-34 years aged mothers were more likely to have children who survived to their fifth birthday compared to younger mothers (less than 18 years). Their children had 0.446 times more chances to survive in childhood in relation to those from <18 years aged mothers p-value<0.001. Further, the results indicated that at p-value<0.001, the odds of dying for children from 35+ year old women were 0.603 compared to children from younger mothers. Children born to younger mothers had a higher level of risk to under-five mortality due to their inexperience in bringing up children.

Longer preceding birth intervals of two years and over had a significant influence on under-five mortality. Children born two years and over after the preceding birth had 0.473 times less risk of dying compared to those born less than two years from the previous birth at p-value<0.001.

Table 4.3 Results of the Bivariate Logistic Regression Analysis

Variables	β	SE	Exp(β)
Socioeconomic Factors			
Region of residence			
Benishangul-Gumuz (RC)			
Gambela	-.196	.174	.822
Affar	-.216	.162	.806
Somali	-.284	.178	.753
SNNP	-.247	.147	.781
Harari	-.326	.217	.722
Amhara	-.320	.147	.726*
Oromiya	-.339	.158	.712*
Tigray	-.420	.167	.657*
Dire Dawa	-.521	.234	.594*
Mothers level of education			
No education (RC)			
Primary+	-.042	.092	.958
Wealth index			
Poorest (RC)			
Poorer	-.079	.102	.924
Middle	-.140	.109	.869
Rich	-.293	.107	.746**
Biological factors			
Mothers age at the birth of the child			
<18 (RC)			
18-34	-.591	.129	.554***
35+	-.505	.157	.603**
Sex of the child			
Male (RC)			
Female	-.145	.078	.865
Birth order			
1-2 (RC)			
3-4	-.164	.100	.849
5+	-.070	.090	.933
Preceding birth interval			
<24 months (RC)			
>24 months	-.748	.084	.473***
Environmental factors			
Source of drinking water			
Unsafe (RC)			
Safe	-.085	.080	.919
Type of toilet facility			
Non-improved (RC)			
Improved	-.076	.081	.927

Note: ***p-value<0.001; **p-value<0.01; *p- value<0.05

4.5 Determinants in High and Low Mortality Regions of Rural Ethiopia

Due to limited number of cases for different variables, the ten rural regions of Ethiopia were divided into high and low mortality regions. The 40:60 rule was applied in categorising the regions. The high mortality regions composed of Benishangul-Gumuz, Gambela, Affar and Somali regions while the low mortality regions composed of SNNP, Harari, Amhara, Oromiya, Tigray and Dire Dawa regions. For both the high and the low mortality regions, two models were fitted. The first established the socioeconomic effects on factors of under-five mortality while the second was to establish the effect socioeconomic variables in the presence of the proximate determinants of under-five mortality.

4.5.1 Determinants in the High Mortality Regions of Rural Ethiopia.

Table 4.4 showed determinants of childhood mortality in the high mortality regions. Results from both models indicated that socioeconomic variables did not have a significant effect on under-five mortality.

In the second model, birth spacing and maternal age at child's birthday had a significant effect on under-five deaths. The risk of death in childhood for children born to women of 18-34 years were 0.470 times less in relation to those born to mothers aged below 18 years at p-value<0.001. Children born two years and over from the preceding birth had 0.630 times more chance of survival in childhood compared to those born two years and below from the preceding birth at p-value<0.001.

A study by Gebretsadik and Gabreyohannes (2016) in the high mortality regions indicated that preceding birth interval was crucial in explaining childhood mortality. Longer preceding intervals of 2-3 years and above 3 years increased the chances of survival by children by 39 and 69 percent respectively compared to those born short of two years from the previous birth.

Table 4.4 Determinants in High Mortality Regions of Ethiopia

	Model 1			Model 2		
Variables	**β**	**SE**	**Exp(β)**	**β**	**SE**	**Exp(β)**
Socioeconomic factors						
Mothers level of education						
No education (RC)						
Primary+	.149	.150	1.161	.214	.162	1.238
Wealth Index						
Poorest (RC)						
Poorer						
Middle	-.090	.188	.914	.179	.206	.836
Rich	-.016	.201	.984	.054	.227	1.055
	.130	.167	1.139	.246	.212	1.279
Biological Factors						
Mothers age at the birth of the child						
<18 (RC)						
18-34				-.756	.208	.470***
35+				-.309	.292	.735
Sex of the child						
Male (RC)						
Female				-.007	.128	.993
Birth Order						
1-2 (RC)						
3-4				-.340	.177	.712
5+				-.360	.185	.698
Preceding birth interval						
<24 months (RC)						
>=24 months				-.995	.136	.370***
Environmental factors						
Source of drinking water						
Unsafe (RC)						
Safe				.029	.141	1.030
Type of toilet facility						
Unimproved (RC)						
Improved				-.207	.195	.813
Constant	-2.445	.086	.087	-.914	.229	.401
Model Fit	-2 log likelihood=1956.480 df= 4			-2 log likelihood=1833.479 df= 8		

Note: ***p-value<0.001; **p-value<0.01; *p-value<0.05

4.5.2 Determinants in the Low Mortality Regions of Ethiopia.

Table 4.5 showed logistic regression results of the determinants of childhood mortality in the low mortality regions of Ethiopia. Results from Model 1 indicated that wealth index had a significant effect on under-five deaths. Children born to women in the rich wealth index category had 0.606 times less risk of dying in childhood in relation to children whose mothers were in the poorest wealth index category at p-value<0.01.

Model 2 indicated that wealth index, mother's age at the child's birthday, sex of the child and preceding birth intervals had a significant effect on U5M. The odds of dying for children in the rich wealth index category were 0.583 times less in relation to those in the poorest wealth index category at p-value<0.01.

Children born to women of 18-34 years had 0.632 less risk of mortality in childhood in relation to those born to mothers of less than 18 years at p-value<0.05. While barely significant, children born to women aged over 35 years were 0.400 times more likely to survive in childhood compared to children born to mothers aged 18 years and below. Female children were 0.798 times less likely experience mortality before attaining age five compared to male children at p<0.05. Children born two years and more from the previous birth had 0.518 times less risk of mortality before celebrating in their childhood compared to those born less than twenty-four months from the preceding birth at p<0.001.

Table 4.5 Determinants of Under-five Mortality in the Low Mortality Regions of Ethiopia

	Model 1			Model 2		
Variables	**β**	**SE**	**Exp(β)**	**β**	**SE**	**Exp(β)**
Socioeconomic factors						
Mothers level of education						
No education (RC)						
Primary+	-.054	.119	.948	-.046	.124	.955
Wealth Index						
Poorest (RC)						
Poorer	-.089	.131	.915	-.097	.136	.907
Middle	-.193	.138	.825	-.201	.147	.818
Rich	-.500	.147	.606**	-.539	.164	.583**
Biological Factors						
Mothers age at the birth of the child						
<18 (RC)						
18-34				-.459	.209	.632*
35+				-.511	.262	.600
Sex of the child						
Male (RC)						
Female				-.226	.102	.798*
Birth Order						
1-2 (RC)				.008	.142	1.008
3-4				.077	.140	1.081
5+						
Preceding birth interval						
<24 months (RC)						
>=24 months				-.659	.188	.518***
Environmental factors						
Source of drinking water						
Unsafe (RC)						
Safe				-.024	.108	.977
Type of toilet facility						
Unimproved (RC)						
Improved				.123	.108	1.131
Constant	-2.380	.093	.093	-1.388	.234	.249
Model Fit	-2 log likelihood=3172.262 df= 4			-2 log likelihood=3034.175 df= 8		

Note: ***p-value<0.001; **p-value<0.01; *p-value<0.05

The results from the high and low mortality regions indicate that maternal age at the child's birthday and birth spacing had a determining effect on under-five mortality. The results indicated that children born to women aged 18-34 years had better chances of survival to their fifth birthday. Further, longer preceding birth intervals positively affected the chances of survival of children to their fifth birthday.

4.6 Influence of Region of Residence on Under-five Mortality in Rural Ethiopia

The section represented the logistic regression results where three models were fitted. The first model was fitted with only region of residence as a determinant of childhood deaths in rural Ethiopia, the second model was fitted with other socioeconomic variables while controlling for the region of residence while the third model was fitted with socioeconomic and the proximate determinants while controlling for region of residence.

Model 1 was significant in explaining regional variation in under-five mortality in rural Ethiopia. Amhara, Oromiya, Tigray and Dire Dawa regions had a significant effect in explaining the regional variation in U5M. Children born to women living in these regions had 0.726, 0.712, 0.657 and 0.594 times respectively less risk of mortality in childhood compared to children born to mothers residing in Benishangul-Gumuz region at p-value<0.05.

The study resonated with findings from Getiye (2011) who found that regional variation in under-five five mortality existed in Ethiopia. Under-five mortality risks increased when region of residence was added in his analysis. He attributed the variation to differentials in the environment, culture and lifestyle in the different regions.

In the second model, region of residence maintained its significance in the presence of maternal education and wealth index. While other socioeconomic variables did not significantly capture the effect of the region of residence, its effect on U5M slightly reduced. Children born to women living in Amhara, Oromiya, Tigray and Dire Dawa regions had 0.744, 0.708, 0.651 and 0.590 times respectively less chance of dying in childhood to those born to mothers residing in Benishangul-Gumuz region at p-value<0.05.

Wealth index also had a significant effect on under-five mortality. Children born to women in the rich wealth index category were 0.736 times less likely to die in relation to those born in the poorest wealth index category at p-value<0.01. The results also indicated that as the wealth index of the mother increased then the risk of childhood mortality decreased.

The study findings were consistent with a study on Jimma town in Ethiopia by Belaineh et al (2007) who found that there was significant decrease in childhood mortality as the wealth index of the family increased from poor to affluent. Mutunga (2017) in his study on environmental determinants of child mortality in Kenya also observed a higher survival rate in rich households. He attributed this to better access to nutrition, better housing condition and better education; increasing survival probability of the children as they have an increased demand for healthcare.

Results from the third model indicated that when proximate determinants were added to the model, the effect of region of residence on ender-five mortality was mixed. Amhara region maintained its significance while Affar and Somali regions became significant. The odds of dying for children from Affar, Somali and Amhara regions were 0.714, 0.624 and 0.733 times respectively less compared to children born to mothers residing in Benshangul-Gumuz region at p-value<0.05. Children in the rich wealth index category were 0.762 times less likely to die compared to those in the poorest wealth index category at p-value<0.05. As the wealth index of the mother increased, the survival chances of children increased.

Mother's age at the child's birthday and birth spacing had a significant effect on under-five mortality in rural Ethiopia. Children born to women of 18-34 years were 0.526 times less likely to experience mortality in relation to those born to mothers aged of than 18 years at p-value<0.001. On the other hand, children born to women of over 35 years had 0.589 times less risk of mortality in their childhood in relation to those born to mothers of 18 years and below at p-value<0.01. The study findings conformed with Mosley and Chen (1984) who posited that indicated that childhood mortality is elevated for very young women (<18 years), reduces for women aged between 25 and 30 and then rises steadily after woman attains 35 years.

Children born after long preceding birth intervals had 0.447 times less chance of dying in their childhood compared to those born within short preceding birth intervals at p-value<0.001.

Rustein (2005) also found that birth intervals of less than twenty-four months were associated with increased diseases in pregnancy, adverse pregnancy outcomes, and increased childhood mortality. He argued that birth spacing duration longer than twenty-four months improved maternal health by decreasing maternal morbidities and mortality. He had analysed DHS data from 52 countries.

Other studies in Ethiopia (Kumar and Gemechis, 2010; Negera et al, 2013; and Getachew and Bekele, 2016) established that preceding birth intervals; region of residence; region of residence and preceding birth intervals had significant effect on childhood mortality. Negera et al. (2013), and Getachew and Bekele (2016) found that maternal education was significant in determining under-five mortality. This finding was not evident in the study.

Buli (2013) and Negera et al (2013) indicated that there were higher childhood mortality risks among children residing in homes without access to safe drinking water. On the other hand, Makate and Makate (2016) showed posited that children in households with un-improved facilities of toilet had an increased risk of mortality than those from homes with improved toilet facilities. These findings were inconsistent with the study as environmental factors did not have a significant effect on under-five mortality.

Table 4.6 Results of the Logistic Regression for three Models Fitted to Explain the Determinants of Under-five Mortality in Rural Ethiopia.

	Model 1			Model 2			Model 3		
Variables	**β**	**SE**	**Exp(β)**	**β**	**SE**	**Exp(β)**	**β**	**SE**	**Exp(β)**
Socioeconomic factors									
Region of residence									
Benishangul-Gumuz (RC)									
Gambela	-.196	.174	.822	-.230	.178	.794	-.146	.181	.864
Affar	-.216	.162	.806	-.296	.166	.743	-.336	.172	.714*
Somali	-.284	.178	.753	-.321	.179	.725	-.471	.188	.624*
SNNP	-.247	.147	.781	-.240	.147	.787	-.184	.152	.832
Harari	-.326	.217	.722	-.212	.221	.809	-.326	.230	.722
Amhara	-.320	.147	.726*	-.295	.148	.744*	-.310	.153	.733*
Oromiya	-.339	.158	.712*	-.345	.159	.708*	-.217	.163	.805
Tigray	-420	.167	.657*	-.430	.167	.651*	-.333	.172	.717
Dire Dawa	-.521	.234	.594*	-.527	.235	.590*	-.469	.241	.626
Mothers level of education									
No education (RC)									
Primary+				-.008	.097	.992	-.010	.101	.990
Wealth Index									
Poorest (RC)									
Poorer				-.067	.107	.935	-.122	.113	.914
Middle				-.137	.115	.872	-.113	.125	.893
Rich				-.306	.116	.736**	-.272	.133	.762*
Biological Factors									
Mothers age at the birth of the child									
<18 (RC)									
18-35							-.642	.146	.526***
35+							-.529	.192	.589**
Sex of the child									
Male (RC)									
Female							-.141	.079	.869
Birth Order									
1-2 (RC)									
3-4							-.122	.111	.885
5+							-.069	.111	.934
P receding birth interval									
<24 months (RC)									
>=24 months							-.804	.089	.447***
Environmental factors									
Source of drinking water									
Unsafe (RC)									
Safe							-.013	.087	.987
Type of toilet facility									
Unimproved (RC)									
Improved							.007	.100	1.007
Constant	-2.242	.111	.106	-2.129	.124	.119	-.848	.195	.428
Model Fit	-2 log likelihood=5140.381 df= 9			-2 log likelihood=5132.509 df= 13			-2 log likelihood=4886.788 df= 21		

Note: ***p-value<0.001; **p-value<0.01; *p-value<0.05

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The final chapter represents summary, conclusion and recommendations arrived at with respect to how the study was carried out. The recommendations are focused on policy, programmes and research.

5.2 Summary of Findings

Background characteristics of the study population depicted that higher proportions of child death were experienced by women living in Benishangul-Gumuz and Gambela regions, among women with no formal education, among women in the poorest wealth index category and among women aged below 18 years. It was also experienced among male children, children of birth order 1-2, children born within short preceding birth intervals, households with no access to safe drinking water and households with un-improved toilet facilities. Computed under-five mortality rates indicated regional variation in childhood mortality with Benishangul-Gumuz having the highest mortality rates. Elevated under-five mortality rates were also obtained for children born to women with formal education, women in the poorest wealth index category and women who had given birth while below 18 years. Higher under-five mortality rates were also found among male children, children of birth order 1-2, children born less than two years from the preceding birth and households with unsafe drinking water and unimproved toilet facilities.

Bivariate logistic regression results indicated that region of residence, wealth index, mother's age at the child's birth and preceding birth interval had a significant effect on under-five mortality in rural Ethiopia. The multivariate logistic regression results established that age of the mother at the birth of the child and preceding birth interval had significant effect on under-five mortality in the high mortality regions while wealth index, age of the mother at child's birth, sex of the child and preceding birth interval in the low mortality regions had significant effect. Region of residence was found to have mixed effects on under-five mortality in the multivariate models fitted involving other socio-economic and proximate variables. The proximate variables in the multivariate regression models were not able to completely capture the effects of region of residence on under-five mortality. The multivariate regression results

also established that wealth index, age of the mother at the birth at child's birth and preceding birth interval had significant influence on under-five mortality in rural Ethiopia.

5.3 Conclusion

The effects of variables considered for the study on under-five mortality was mixed. Four of the nine variables considered did not influence childhood mortality significantly. Sex of the child was only significant in the low mortality regions. Region of residence, wealth index, age of the mother at the birth of the child were found to have significant effect on under-five mortality in rural Ethiopia.

Region of residence influences different aspects of the lives of the mothers. There are differences in cultures, access and utilisation to education and healthcare services and allocation of resources by the government. These factors influence the lives of children born in the different regions. Increase in wealth ensures that there are more resources dedicated to the care of the children. They will have access to better healthcare and also the mothers have access to more education which is necessary for the upbringing of their children. The age of the mother is important at the birth of the child. Mothers who are not too young have limited knowledge on the upbringing of children while older mothers are exhausted physiologically from child birth. The older mothers may also not have time to take care of the children. Birth spacing gives mothers time to recover from their previous births. They also have more time to take care of their children.

5.4 Recommendations

This section provides recommendations based on the findings of the study both for research and policy.

5.4.1 Recommendations for Policy and Programmes

Policy and programme makers need to develop programmes aimed at addressing specific determinants of under-five mortality in the different regions. In the low mortality regions, programmes should focus on household wealth creation to improve the survival chances of the children born in these regions.

Reproductive health programs should encourage increasing the age of the mother at the birth of the child and birth spacing. This will sure that more children are born to knowledgeable mothers while also allowing enough time for the mothers to recover after their previous birth.

5.4.2 Recommendations for Further Research

The research established that region of residence, wealth index, maternal age at child's birth and spacing between births are significant determinants. Further research should be focused on why region of residence maintains its significance even in the presence of the proximate determinants of under-five mortality.

This study recommends that more research should be carried out to establish the cause of the consistent high under-five mortality rates in Benishangul-Gumuz, Gambela, Affar and Somali regions.

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