Determinants of Under Age Five Mortality in Ethiopia: Evidence from 2000 Demographic and Health Survey

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Abstract

Ethiopia is one of the highest under age five mortality countries in the world. Accordingly, the aim of this study was to investigate the important influences of proximate and socioeconomic factors on under age five mortality. In addition, the study examined the probability of survival and dying of under age five children in the country.

In order to identify proximate and socioeconomic risk factors, the study used the Mosley and Chen's (1984) theoretical framework and the 2000 Ethiopian Demographic and Health Survey data. Kaplan-Meier methods and multivariate logistic regression analysis were used to differentiate the influential factors on mortality of children.

The results of the study documented that among proximate determining factors- short preceding birth interval, high birth order, use of surface water/river, lake/, poor toilet facility, dirt housing floor, home delivery, mothers' without tetanus toxoid immunization and children without breastfeeding were significantly increased the odds of under age five mortality. Similarly, of socioeconomic determinants, mothers with no education, rural place of residence, preference of female child and mothers working far away from home were negatively associated with survival chance of under age five children. Moreover, in some of regional states such as Tigray, Amhara, Oromia, Benshangul, Gambela and Dire Dawa have shown a statistical significant relationship with under age five mortality. Also, the study found that the highest probability of under age five mortality was concentrated before age 12 months; and female child has better survival chance than male child in this infancy period. However, for this study, mother's age at birth, source of fuel for cooking, mother's ethnicity, mother's type of religion, access to radio messages did not appear as a factor to affect under age five mortality.

We concluded that appropriate policy intervention should be required for the above mentioned influential factors to improve survival chances of under age five children in the country. At last, we suggested that further research is essential to examine the causes of highest mortality at infancy period by incorporating other risk factors such as birth weight, preterm birth, asphyxia, prenatal care, infections, and many others.

CHAPTER I INTRODUCTION

1.1 Statement of the problem

Ethiopia is one of the poorest countries in the world, which is frequently attacked by natural disasters, infectious disease and rapid population growth, which in turn result in poverty, household food insecurity and low access to health care. UNICEF (2005) documented that 500,000 Ethiopian children die annually of preventable disease-including malaria and malnutrition.

The recent and first round 2000 Ethiopian Demographic and Health Survey results revealed that the country has recorded excess under age five mortality, which amounted to be 166 per 1000 (CSA and ORC Macro, 2001). This level of under age five mortality is higher even compared to experiences of its neighboring poor countries (e.g. Kenya, Eritrea and Sudan). Along this fact, the UN (1988) projection on infant and under five mortality shows that Ethiopia is in the fourth place among the highest under five mortalities of 191 countries and regions in the world.

World Bank (2005) had provided a press release on situation of infant and child mortality and progress of Millennium Development Goals (MDGs) in the world. The press release revealed that Sub Saharan Countries (including Ethiopia) have the highest infant and child mortality in the world. In Sub Saharan Africa, one of the MDGs target for reducing under age five mortality rates has set to 62 deaths per thousand live births by 2015. Because of high poverty and infectious diseases, Sub Saharan Africa countries (e.g. Ethiopia) have a problem to reduce under age five mortality to achieve the Millennium Development Goals, where mortality declined with very low magnitude from 187 child deaths in 1990 to 171 deaths per thousands in 2003.

In addition, due to the presence of tremendous poverty- in particular the current crisis of food shortages, acute child malnutrition, spread of infectious disease, rudimentary living conditions such as low access to pure water, inadequate health facilities and the UN (1988) future under five mortality projections indicate that Ethiopia has a great challenge to improve the level of under age five mortality or to meet the millennium development goals by 2015.

Given the aforementioned facts; however, currently no research has appeared at national level that aimed at identifying and understanding the causes of under age five mortality, as of this researcher's point of view. Therefore, the issue at hand is obviously timely. The problem is so serious that it prompted the researcher to carry out this study to scrutinize the influential factors as well as to fill research gaps through evidences obtained from survey results, UN projections and the World Bank reports on the high rate of under age five mortality in the country. The outcome of this research is useful for concerned agencies to alleviate barriers on survival status of under age five children. In particular the findings will contribute to the Ethiopian government's plan of action to reduce the level of infant and child mortality to close the two-third reduction of child mortality of the Millennium Development Goal.

1.2 Objectives of the study

The general objective of this study is to examine and differentiate the important influences of proximate and socioeconomic determinants on mortality of under age five children in Ethiopia. In addition, the study aimed to insight the probabilities of survival and probabilities of dying of under age five children.

1.3 Research questions

The determinants of mortality differentials are exhibited into proximate and socioeconomic factors to address our objectives. Thus, the materials that have used to identify determining factors as well as formulating research questions are the Mosley and Chen (1984) analytical framework and the 2000 Ethiopian Demographic and Health Survey results. Accordingly, the following general and specific research questions have been posed to meet the purpose of this study.

1. How the probabilities of survival and dying looked for under age five children across in the country?
2. Which proximate determinants or direct factors influence under age five mortality? Specifically,
    - Which maternal factors affect survival of under age five children?
    - Which environmental contaminating factors influence survival of under age five children?
    - Which personal illness control factors contribute to mortality of under age five children?
    - Does nutrient deficiency factor affect under age five mortality?
3. What are the socioeconomic factors or indirect factors that contribute to under age five mortality? In particular,
    - Which individual levels, household levels and community levels variables affect under age five mortality?

1.4 Background information

1.4.1 Overview of under age five mortality

Since a long time, researches documented that under age five mortality has been the main problems of developing countries. World Bank (2005) estimated that about 11 million children die in each year before celebrating their fifth birthday in developing countries. The World Bank added that the main causes that influence the lives of children are acute respiratory infection, diarrhea, measles and malaria, which account about 48 percent of causes of death.

Similarly, World Bank (2004) documented that under age five mortalities in developing countries are extremely higher than developed countries, which die annually about 1 in 10 births in developing countries as compared to 1 in 143 births in developed countries. The major causes of under age five mortalities can be prevented through good care, nutrition

and medical treatment. In general, World Bank argued that increasing health service expenditure, access to safe water, better sanitation facilities, use of modern fuels for cooking food and improvements in girl's and mother's education are a means to reduce under age five mortality in developing countries.

Besides, infant as well as under age five mortality are associated with the degree of socioeconomic development of nations, that is, mortality of children in Sub Saharan Africa is higher than other regions in the world. For instance, in the 1960s the level of infant and child mortality rate in the Middle East, North Africa, South Asia and Sub Saharan Africa were in similar position or stages. However, due to low level of GNP per capita and low literacy rate, Sub Saharan Africa has twice under age five mortality as of the Middle East since 1990's (Hanmer et al, 2003). Because of a large amount of under age five mortality in Sub Sahara Africa, in particular in Ethiopia, many developed countries and international organizations have given attention to save lives of Ethiopian children, for instance, the G-7 submit established the Child Survival Partnership and passed a resolution as Ethiopia is the first country to be part of the alliance of the partnership (USAID, 2003).

In general, the premises of Mosley and Chen (1984) showed that about 97% or more of new born babies can be saved from under age five mortality in the developed world. In contrary, due to low socioeconomic status as well as poor environmental conditions of the developing countries, the probability of dying for new born infants before reaching their fifth birth day is increased by more than 3%.

1.4.2 Facts: Socio-demographic, geographical and cultural features of the country

Ethiopia is one of the largest countries in Africa in terms of size of population and surface area. The first and second round Population and Housing Census of 1984 and 1994 documented that the country had a total population of 42.6 million and 53.5 million with corresponding growth rates 3.1% and 2.9%, respectively (CSA and ORC Macro, 2001). According to the 2003 population projection, the country is the third populous in Africa with size 71 million inhabitants (UN, 2003 cited in Weeks, 2005). The country divided into 9 administrative Regional States (namely-Tigray Region, Afar Region, Amhara Region, Oromia Region, Somali Region, Benshangul Region, Southern Nations and Nationalities People Region, Gambella Region and Harari Region) and 2 Administrative City Councils (Addis Ababa and Dire Dawa).

Agriculture is the dominant economic sector of the country. It is engaged by 80% of population. It accounts about 54% of the gross domestic product and 90% of the country's export. Accordingly, 85 % of the population resides in rural areas and the remaining proportions are in urban areas (CSA and ORC Macro, 2001).

Ethiopia has started to implement population policy since 1993. Before 1993 it had not population policy as well as strong family planning policy to use modern contraception. Because of lack of these policies, female contracted marriage starting from at age 15 years.

Similarly, the country has experienced high total fertility rate, low contraceptive prevalence rate, high infant and child mortality rate (Transitional Government of Ethiopia, 1993). The 2000 DHS result revealed that the total fertility rate and contraceptive prevalence rate were estimated to be 5.9 children and 8%, respectively (CSA and ORC Macro, 2001).

Ethiopia has low standard health provisions. The country has four tiers of health services, namely, community based health centers (health posts), district clinics/ hospitals, regional hospitals and central referral hospitals. Moreover, WHO (2004) indicated that Ethiopia has limited number of health institution, inadequate supplies of medicine and small number of hospitals about 0.2 beds per 1000 population. Also the country allocates small amount of budgets for health expenditure about less than $5.6 per capita per year.

In addition, the Ethiopian DHS documented that the majority of the people have low access to electricity, pure water, toilet facilities and modern housing floors. The corresponding proportions of households with electricity, piped water, flush toilet and floor with brick/cement are 13%, 18%, 0.3% and 0.6%, respectively (CSA and ORC Macro, 2001)

Ethiopia is one of the countries in the world highly affected by HIV/ AIDS since 1980's. According to the report of UNAIDS, UNICEF and WHO (2002), the average prevalence rate of HIV infection in adults population (15-49 years) was estimated to be 6.4%. On the other hand, it was estimated at 2.2 million people, which are living with HIV/AIDS, including 200,000 children by end of 2001. In addition, it was resulted about a total of 160,000 deaths with the same year.

Illiteracy rate in Ethiopia is very high. The 2000 DHS result showed that the majority of population, which is 77% of females and 62 % of males, has no education while only 23% of female and 38% of male population have access to some elementary and secondary or higher education. The main religion of the country is Christian, followed by Islam and other faiths. Christian accounts for 61% of population; Muslim is estimated at about 33% and remaining proportions are allotted to other beliefs (CSA and ORC Macro, 2001). Moreover, Ethiopia consists of more than 80 ethnic groups (e.g. Tigray, Amhara, Oromo, etc.) with diversified cultural norms within the 11 administrative regional states.

1.4.3 Trends in under age five mortality

Examining the mortality trends of under age five children is important to evaluate the health development, mortality conditions and social wellbeing of the country. Thus, this section presents the levels and trends in under age five mortality using data from Ethiopian Demographic and Health Survey and the United Nation's projection on under age five mortality. Table 1.1 and Figure 1.1 present trends in under age five mortality in Ethiopia.

The 2000 Demographic and Health Survey estimated levels of under age five mortality for the past three years with five year periods-from 1985 to 1990, 1990 to 1995 and 1995 to 2000. The corresponding rates of under age five mortalities are 216 per thousands, 211 per

thousands and 166 per thousands, respectively (CSA and ORC Macro, 2001). The over all pictures of these estimates indicate that level of under age five mortality has shown a slight declining trend from 1985-1990 to 1990-1995 by 5 deaths per thousands, whereas it declined rapidly from 1990-1995 to 1995-2000 by 45 deaths per thousands (see Figure 1.1).

Moreover, UN (1988) estimated and projected under age five mortality by five years period from 1950 to 2025 in the world- including Ethiopia. The results showed that mortality of under age five Ethiopian children was larger at the beginning of the period 1950 to 1955, which were 318 deaths per 1000 live births. Figure 1.1 depicts that trend or levels in under age five mortality will not show a rapid decline for next years 2020 to 2025. In general, a slowdown decline is observed from 318 deaths per 1000 by 1950-1955 to 130 deaths per 1000 by 2020-2025.

Table 1.1 Projection of under five-mortality rate per thousands in Ethiopia from 1950 to 2025

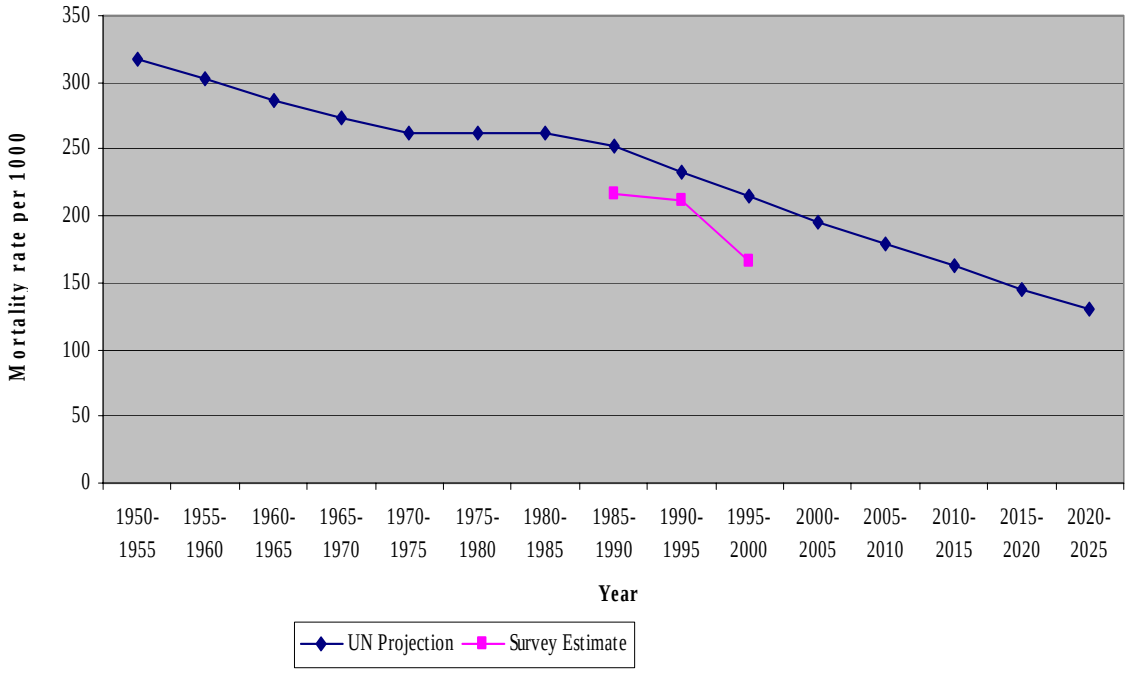
Year	1950-1955	1955-1960	1960-1965	1965-1970	1970-1975	1975-1980	1980-1985	1985-1990
Under five mortality rate	318	302	286	273	262	262	262	252

"Table 1.1 continued"

Year	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025
Under five mortality rate	233	215	196	179	162	145	130

Source: UN, 1988

Figure 1.1. Mortality trends in under age five children from 1950-2025 in Ethiopia



Source: UN (1988) and CSA and ORC Macro (2001)

1.5 Organizations of the thesis

This research is composed of six main chapters. The next chapter, chapter two provides reviews of previous studies on mortality of children with associated determining factors in developing countries. Chapter three presents the Mosley and Chen (1984) theoretical and conceptual framework to differentiate proximate and socioeconomic determinants. This framework helps us to find answers to research question as well as conceptualizing the whole research process.

The fourth chapter presents study materials (data and quality) and methods of analysis, namely, Kaplan-Meier and multiple logistic regressions. In addition, chapter five focused and explained results of the study. The last chapter provides discussion and conclusions along with possible recommendations.

CHAPTER II REVIEW OF LITERATURES

In this chapter, we reviewed outcomes of previous studies on determinants of under age five mortality across developing countries. Some of these studies were conducted in Philipines, Indonesia and Pakistan (Martine et al, 1983; Agha, 2000); Sri Lanka (Trussel and Hammerslough ,1983); Ethiopia (Ali et al, 2005; Ezra and Gurmu ,2002); Brazil Merrick, 1985); India (Basu and Stephenson,2005; Whitworth and Stephenson ,2002); Gupta and Baghel,1999); Bangladesh (Alam and Islam,1998); Mexico, Nepal and Zambia (Levine et al, 1994); Morocco and Tunisia (Obermeyer and Cardenas, 1997); and several DHS and World fertility survey data of developing countries (UN, 1985; UN, 1991; Desai and Alva, 1998; Hobcraft et al, 1984, Rutstein, 2000 and in 2005). Each of these studies has been discussed separately to help us understand the role of influential factors on survival of children as well as the methods and materials applied in each research for each country; and the findings are presented below.

Agha (2000) investigated determinants of infant mortality in Pakistan using logistic regression. He found that mother's level of education has a significant effect on infant survival, that is, infants born from mothers having 6-10 years of schooling are as likely to die as children of mothers have no schooling; children of mothers with 11 or more years of schooling are lower mortality than children of mothers with no schooling. Similarly, environmental conditions such as flush toilet facilities and poor sanitation have a significant and negative impact on infant mortality. In addition he noted that age of mothers at birth and birth intervals have effect on mortality of children**.** Thus young maternal age at birth increases the odds of infant death, that is, infants born to teenage mothers are more likely to die than infants born to older mothers. A longer birth interval substantially decreases the risk of dying in infancy. Similarly, because of sex discrimination, male infants are more likely to die as female infants.

Martine et al (1983) studied in Pakistan, Philippines and Indonesia on effects of socio-demographic covariates on child mortality using hazards model. They examined that education of mother has the highest effect in Pakistan and Philippines on survival of children. Moreover the investigators found that presence of electricity and quality of facilities (modern toilet) are associated strongly and negatively with mortality in all countries. They stated that mother's age at birth on survival of child has different effect in each country. They suggested that children born to women less than 20 years of age has higher mortality than children born to women with age 20 to 34 years. Their findings show that in Indonesia and Philippines boy has higher mortality than girl, whereas in Pakistan the reverse is reported. Similarly, in Indonesia and Pakistan, urban area had lower mortality than rural area, whereas the opposite was found in Philippines.

Trussel and Hammerslough (1983) had carried out their study in Sri Lanka to show the relationship between infant and child mortality with intervening variables (covariates) using the hazards model. Similar to Martin and his colleagues' findings in Pakistan, Philippines and Indonesia, they investigated that mother's education, urban/rural residence, ethnicity, sex of child, birth order, age of the mother at birth and type of toilet facility are strongly associated with mortality of children.

Desai and Alva (1998) had conducted study on Demographic and Health Survey results of 22 developing countries to investigate effects of maternal education on infant mortality, and related factors such as immunization using logistics regression. They revealed that maternal education serves as a proxy for socio economic status so that it has statistically significant impact on infant mortality in some of the countries, while it is statistically significant for status of immunization in half of the countries. However, they suggested that their results show little empirical justification to accept Caldwell's findings" *mother's education has an independent, strong and positive impact on the survival of her children*".

Ali et al (2005) had carried out a longitudinal study in Northern part of Ethiopia, South zone of Tigray Regional States within two districts from 2000 to 2002 under auspices of World Health Organization. They found that the major causes of Ethiopian child mortality are vaccine preventable diseases, diarrhea, acute respiratory infections (pneumonia), malaria and malnutrition. Similar with other studies, the investigator stated that male child has high mortality rate than female child. Another study was conducted by Ezra and Gurmu (2002) in Southern part of Ethiopia on effect of breastfeeding and birth interval on child survival. They documented that short birth interval (less than 18 months) in absence of breastfeeding increased mortality of children age 1-12 months whereas it appeared to have less impact on children age 1-4 years.

United Nations (1985) examined the socioeconomic differentials on infant and child mortality in 15 developing countries based on univariate and multivariate regression techniques. The UN found that child mortality is negatively related with level of maternal education in both urban and rural areas. It is found that religion of mothers has effect on child health, for instance, in African countries Christian has lower child mortality than other religions, in Indonesia Muslim women have higher child mortality rate than catholic mothers, in Nepal Hindu women have higher mortality than Muslim mothers. In addition ethnic differentials have impact on mortality of children in rural areas of some countries (e.g. Kenya, Nigeria and Peru). The result indicated that women in the labor force and not in the labor force has not significant difference on the level of child mortality except in Nigeria, Sri Lanka, Thailand and Jamaica. UN also found that child living with low or traditional amenities such as housing materials, lavatories, water supply and presence of electricity has high chance of mortality than that lived in modern amenities. The findings revealed that urban-rural residence and regional variation has significant impact on child mortality in some countries, for instance, in Kenya, Sudan, Tanzania, Peru, Chile, Nepal and Sri Lanka, where urban areas had lower mortality than rural areas and similar mortality variations had shown for region of residence.

The same study by UN (1991) in Kenya, Costa Rica, Hondurans, Paraguay, Jordan and Thailand showed that maternal education, place of residence, ethnicity, religion, water supply and availability of lavatories have significant effect on child mortality. Another study by Ross and Frankenberg (1993); UN (1994) of the 25 DHS countries studies showed that teenage child bearing before age 18 years and older mothers over 34 years have higher under five mortality. The relative risks of children born from mothers aged below 18 years contributes to a 46 percent excess mortality risk as compared to children who died from mothers aged between 20 to 34 years. Also UN (1994) found that children

born with preceding birth interval of 18 to 23 months and shorter than 18 months showed excess mortality as of children born with intervals 24 to 47 months.

Merrick (1985) carried out studies in Brazil on effect of piped water on early childhood mortality. He concluded that increasing mother's education had a primary and direct effect to decrease in child mortality, whereas access to safe water had a significant but secondary impact on decreasing mortality.

Basu and Stephenson (2005) investigated the effect of low levels of maternal education on the proximate determinants of childhood mortality using the 1992 Indian family health survey data. They found that maternal education is significantly associated with child mortality and morbidity- including illness management, service utilization and health behavior. They noted that low level of education increase child survival except for neonatal mortality and management of diarrhea disease. In addition, using same data Whitworth and Stephenson (2002) carried out study to examine effect of short preceding birth interval on under two year mortalities using multilevel modeling on three stages of mortality - neonatal, early post neonatal and late post-neonatal and toddler. They concluded that short preceding birth intervals (below 18 months) are associated with an increased risk of mortality in all three age groups, and the effect is particularly strong in the early post-neonatal period.

Similarly, Gupta and Baghel (1999) examined differentials of infant mortality in Indian two cities- Calcutta and Raipur City. They documented that female infants were more susceptible to die than male infants. They argued that age of mother, birth order, birth interval, place of delivery and housing condition had smaller effect than other factors on infant mortality. In addition their results contradict other findings on effect of mother's education. They found that education of middle school or lower level is not an effective tool for controlling infant mortality; they proposed that ten years or more schooling of women might be necessary for reducing mortality.

Hobcraft et al (1984) carried out studies in 28 countries of World Fertility Surveys on socioeconomic differentials on infant and child mortality using log linear analysis. They documented that mother's education is important to influence survival of children beyond the first year of life in Latin America (e.g. Peru), South East Asia (e.g. Indonesia and Philipins) and Africa (e.g. Kenya). Similarly, they stated that mother's working status appear least to influence on mortality in most countries but occurs twice in Thailand and Sri Lanka. Also high mortality differentials are observed in rural areas in most countries as compared to urban areas.

Alam and Islam (1998) studied on differentials of infant and child mortality in Bangladish using regression analysis. They found that infant mortalities in rural areas are higher than in urban areas, which amounted within 20 % to 60%. The study also revealed that children of mother with secondary or higher education had experienced 43% and 33% lower child mortality than mother with illiterate. Mother's religion is important variable to survival of children. They documented that Muslim mothers had lower mortality compared with

mortality of children in non Muslim mothers. In addition, they noted that mortality of children is lower in households possessing flush toilet and electricity as compared to poor facilities.

Levine et al (1994) carried out study on the effect of maternal literacy and health care on child survival in Mexico, Nepal and Zambia. They found that in Mexico and Nepal, maternal schooling was significantly related to prenatal care, hospital delivery and contraceptive use; in Zambia maternal schooling has also shows relationship with all health risk indicators. They investigated that unschooled and illiterate women are incapable to understand radio health messages, which contributed to mortality of children.

Obermeyer and Cardenas (1997) investigated the links between son preferences and differential treatment using DHS data of Morocco and Tunisia. They found that in both countries, sex differences in breastfeeding is non significant while differences in immunization coverage and treatment of diarrhea favor boys, which reflects survival of females children are in disadvantageous.

The studies by Rutstein (2000) of 56 countries DHS data revealed that high infant and child mortality appeared to teenage mother's age below 18 years and older mother's over 34 years. He noted that high infant and child mortality is reported with preceding birth interval less than 24 months. Similar study by same author in 2005 of the 17 DHS data showed that children born under 18 months and 18 to 23 months of preceding birth intervals, are in that order exhibit 3 and 1.9 times to die before reaching age 5 as compared to birth interval 36 to 59 months. The 2005 study of Rutstein showed that in most countries male children have greater chance of mortality than females due to cultural influences. In contrary, the findings of Hill and Upchurch (1995) of the 38 DHS of 35 countries showed that male mortality is lower than female mortality at age 1-4 years in 21 of 38 surveys; though, in under age five mortality girls have a greater chance to survive. They argued that female disadvantageous in 1-4 years is due to influence of social factors rather than genetic factors.

To conclude, all different studies documented that proximate determinants or intermediate variables such as maternal age at birth, birth order, birth spacing, breastfeeding, access to safe water, etc. and socioeconomic factors such as level of maternal education, place of residence, mother's normative notions (religion, ethnicity), etc. have effect on survival chance of infants, child as well as under age five children of developing countries.

CHAPTER III THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 Theoretical framework

This study incorporates the Mosley and Chen (1984) theoretical framework to seek answers to our research questions. Further, this framework is indispensable for differentiating as well as explaining determinants of under age five mortality. The Mosley and Chen (1984) framework, as Boerma (1996) documented, is a standard instrument for analyzing and understanding under age five mortality. He noted that this framework serves as instrument for collecting Demographic and Health Survey data of the developing countries to produce determinants of child health and related indicators.

Mosley and Chen (1984) established a well-known framework (See Figure 3.1) for analyzing the determinants of under age five mortality in developing countries. The framework consolidates the biological and social factors to measure the risk of under age five mortality. They distinguished fourteen proximate determinants or direct factors and six socioeconomic determinants or indirect factors.

The fourteen proximate or intervening variables are grouped into the following five major categories. These are: -

a) Maternal factors. This category includes age of mother at birth, parity and birth interval. These variables are influenced by mother's reproductive practices. The maternal factors cause to create synergism between variables such as short birth intervals and young maternal age.

b) Environmental contamination. This group comprises contamination of air, contamination of food/ water/fingers, contamination of skin/soil/inanimate objects and insect vectors. The environmental contaminating factors influence survival of children through hygienic practices. This factor is a means for transmitting infectious agents such as spreading of diarrheas and other intestine diseases to children or mothers.

c) Nutrient deficiency. This factor includes the three major food components (calories, protein and micronutrients). The Nutrient deficiency factors operate with feeding practices. The survival of children is affected by availability of nutrient foods to children as well as mothers during the period of pregnancy and lactation.

d) Injury. This proximate includes accident and intentional injury. It links with childcare practices to influence survival of children.

e) Personal illness control. The personal illness control factor comprises personal preventive measure (to avoid disease) and medical treatment (to cure disease). The preventive measure includes modern health practices (e.g. immunization, prenatal care and childbirth) and traditional health remedies (e.g. obeying for taboos).

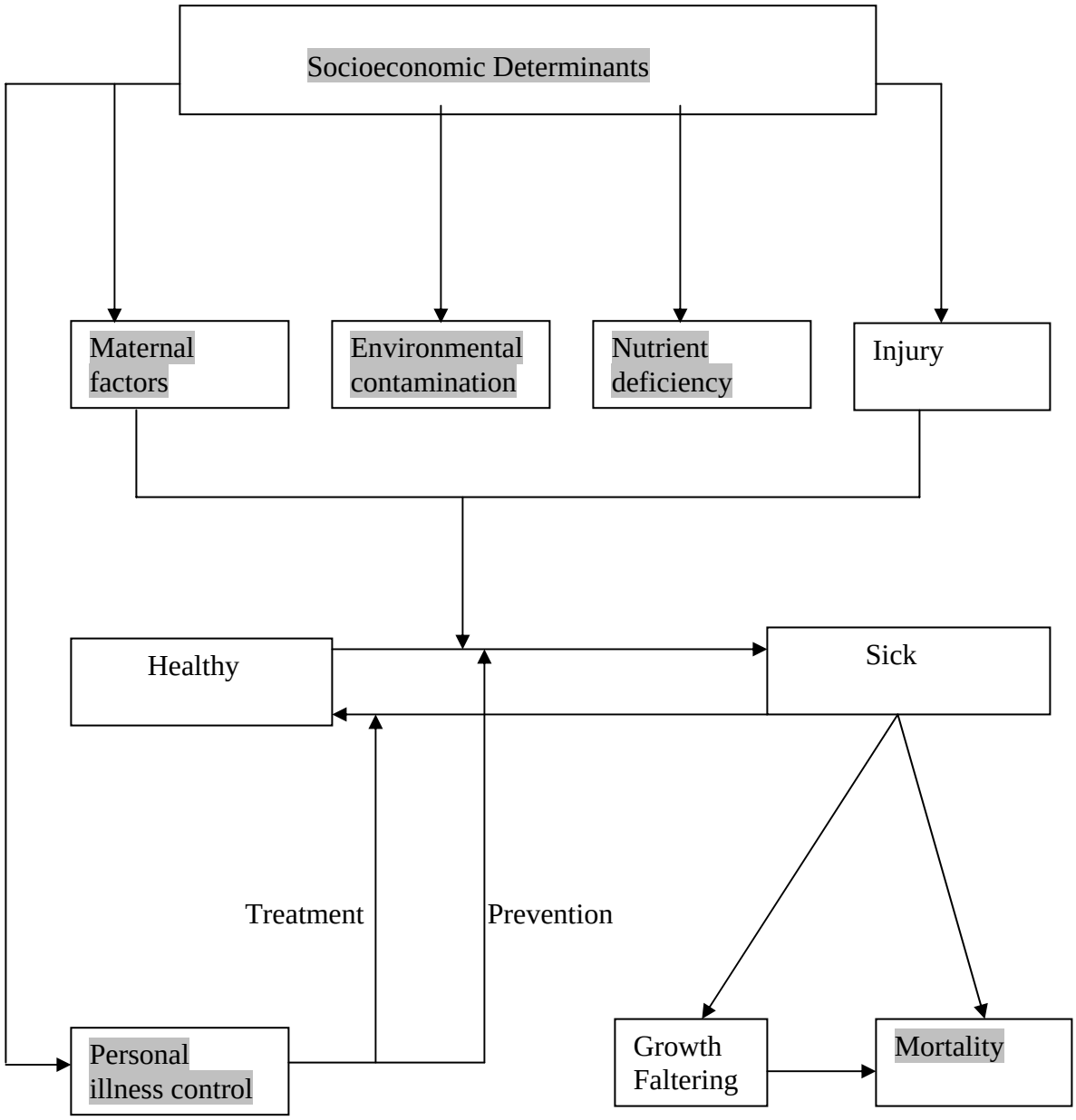
Moreover, Mosley and Chen (1984) regrouped the six socioeconomic determinants into three broad categories, which are:

a) Individual level variables. This group includes individual productivity (fathers, mothers) and traditions (norms or attitudes). The individual productivity factors affect the production of healthy child through educational levels, occupation, mother's time for prenatal care, breastfeeding, attending baby clinic, food preparation and hygienic practices. The traditions or norms or attitude factors determine survival of children through cultural tradition and norm of societies such as power relation within household, giving value to children, belief about causes of disease and preferences of food.

b) Household level variables. The component of household level variable is income or wealth. The household facilities such as availability of food, quality of water, housing, fuel or energy, preventive care and other properties are determined by income or wealth of household. Subsequently, type and quality of these household assets and amenities affect the health of children.

c) Community level variables. The categories of community level variables to influence health of children are ecological setting, physical infrastructure, political situation, political economy and health system.

Figure 3.1. Operation of the five groups of proximate determinants on the health dynamics of a population



Source: Mosley and Chen, 1984

Legend: These shaded regions are covered by this study.

In general, the Mosley and Chen (1984) framework (Figure 3.1) clearly shows that the proximate determinants directly influence the survival of children whereas the socioeconomic factors operate indirectly through the proximate or intermediate variables.

3.2 Conceptual framework

The aim of this study is to examine and differentiate socioeconomic and proximate determinants, which influence survival of children. In order to meet this objective our conceptual framework has a great role for managing and guiding analysis of socioeconomic and proximate determinants simultaneously.

To understand the conceptual model (Figure 3.2) and results of study, it is important to provide definitions and concepts of independent variables/ socioeconomic factors and proximate determinants/ and dependent variable /under age five mortality/. Thus, the definitions and concepts of determinants, under five mortality and structure of the model are presented in the following sub sections.

3.2.1 Conceptualization of proximate determinants

a) Maternal factors

i. Age of mother at birth

The Studies of several researchers showed that age of mother's at birth and under age five mortality are significantly associated. For instance, Pebly and Millman (1986) noted that maternal age at birth is strongly associated to infant and child mortality. Similarly, Cantrelle et al (1986) revealed that under age five mortality and mother's age at birth is a U- shaped curve, that is, mortality is higher at extreme ages of mothers between 15 to 49 years.

In addition, an infant born from teenage mother is more expected to be born before normal gestation period and to have little weight. This premature baby is 24 percent more likely to die in the first month of life than is an infant born to mother aged 25-34 years. Postponing the first birth to teenage women until 18 years old would reduce the risk of death for the first born children by up to 20 percent (WHO, 1997).

The mechanisms of maternal age at birth on under five age mortality is biological; that is, having to do with reproductive maturity, where birth occurring at the extreme ages of mother has higher under five mortality (Wolpin, 1997). Similarly, Davanzo (1984) argued that effects of maternal age at birth on mortality shows that birth of young age relate to maternal immaturity, whereas births from old age reflects the increase likelihood of birth defects.

ii. Preceding birth intervals

Generally, birth interval is defined as the time between successive live births with excluding stillbirths and abortion (Newell, 1988). The length of preceding intervals between births is decisive for survival of infant and child health (Sweemer, 1984; Northrup, 1986; Ewbank et al, 1986; Miller, 1991; UN, 1994;). Sweemer (1984) studied

effects of preceding birth interval and subsequent birth interval on infant and child mortality. He distinguished that preceding birth interval is highly correlated with survival of children while subsequent interval is shown to have limited influence on mortality of children.

WHO (1997) reported that birth interval is powerful and closely associated with infant and child mortality. In order to have healthy children the time gap between consecutive children's is not to be less than twenty-four months. The short birth interval below 12 months increases the average chance of under age five mortality by approximately 60 –70 %; for short birth interval below 18 months raises the chance of dying for under age five children by 50 %. The reason for this is that children born with short intervals after a previous delivery are more likely to be premature and have low birth weight and increase the risk of dying (Hobcraft, 1987 cited in WHO, 1997)

Boerma and Bicego (1992) had shown the possible mechanisms of influencing short birth interval on mortality of children. They distinguished prenatal and postnatal mechanisms. The prenatal mechanism is related with maternal depletion due to pregnancy and lactation and the postnatal mechanism is sibling competition (competition with foods, clothing, living space, sharing parental time and spread of infectious disease among children). Moreover, many researchers (Sweemer,1984; Pebley and Millman, 1986) argued that close spaced birth depletes maternal reproductive system and nutritional status (protein, calories and iron), which leads to the baby to be premature, to have low birth weight and less normal healthy child.

Similarly, Miller (1991) well documented that maternal depletion associated with closed following pregnancies (short birth intervals) that results from her physiological stress of the previous pregnancy. He noted that the mother's poor health conditions causes to create preterm births (births before 37 weeks), intrauterine growth retardation and finally to deaths.

iii. Parity

Parity refers to the number of children born alive to women (Newell, 1988). Pebley and Millman (1986) examined that number of children born are associated with survival chance of children. WHO and UNDP (1994) documented that excess under age five mortality is caused by additional childbearing or parity. For the health of mothers and survival of children, they suggested that mothers do not have to have additional pregnancy if she had given four or more children previously. Along this, Hobcraft (1991) as cited in Ross and Frankenberg (1993) suggested that high parity with well birth spaced results a 35% excess mortality while with close spaced increases mortality by 117%. Similarly, WHO (1997) argued that the cause of mortality of children related with higher parities are the likelihood of scarce resources and exposure to infectious diseases.

Ross and Frankenberg (1993) noted that under age five mortality is more exhibited with children born after four or more births, which has 20 % higher mortality chance than

children born from birth order two to three. Hence, Gupta and Baghel (1999) argued that birth order/parity/ has a direct correlation with age of mother at delivery.

b). Environmental contamination factors

The proxy factors to contaminate the living environment are source of water, type of lavatories, quality of housing and fuel or energy for cooking. Children's growth and development are heavily dependent up on the aforementioned living conditions of the family. These conditions facilitate the transmission of various infectious disease that act directly on the health of both mothers and children (UN, 1991; Mosley and Chen, 1984).

WHO (2002) revealed that environmental hazards and poor living conditions of the developing countries are major contributors to under age five mortality, illness and disability from acute respiratory disease, diarrhea disease, insect born diseases and other diseases.

Furthermore, WHO (2004) declared that environmental related hazards killed about three million children under the age of five every year. The organization reveals that:-

> *Forty percent of the environment-related disease burden falls on under five children. Unclean water causes diarrhea, which kills an estimated 1.8 million people worldwide each year, 1.6 million of whom are children under five. It's also responsible for many diseases including cholera, dysentery, guinea worm, typhoid and intestinal worms. Nearly one million children die each year from diseases caused by air pollution inside their own homes. Over 75% of households in most Asian and African countries cook with solid fuels, such as wood, dung, coal or crop waste, which produce a black smoke that, when inhaled, may give rise to, or worsen pneumonia and other respiratory infections.*
> *(http://www.who.int/mediacentre/news/releases/2004/pr43/en/)*

Similarly, Hardon et al (2001) and Rutstein (2000) documented that in developing countries, children are influenced by poor water, sanitation and living conditions such as type of toilet facilities and flooring of house. They argued that impact of poor hygienic practices is likely to manifest spread of infectious diarrhea. This diarrhea is easily transmitted and killed children through fecal oral root, contaminated food and water.

c) Personal illness control

The lives of children can be saved under preventive measure as well as medical treatment to control the disease. Because of lack of information in our data for curative measures (see section 4.1.2), we consider proxy preventive factors relate to pregnancy and childbirth. These determinants are place of delivery and mother's injection with tetanus toxoid.

Mosley and Chen (1984) argued that traditional practices and modern scientific medicine are a mechanism to prevent health of children from disease. They also stated that

causation of diseases and its prevention practices in the traditional societies are associated with the choice of traditional therapies for the sick children

Foster (1984) revealed that place of delivery and mother's immunization of tetanus toxoid are factors for under age five mortality. He verified that infants born at home are more likely exposed to high risk of neonatal tetanus. Similarly, lack of tetanus immunization of mother is a greater risk for infant to develop tetanus. On the other hand, immunization of mothers with two dozes of tetanus toxoid prevent child from neonatal tetanus disease with 100%. According to Foster's explanation, "*neonatal tetanus is a killer disease, which is caused by infections of the newborn (usually at umbilical stump) with tetanus organisms, p. 119"*.

Similarly, UNICEF and others (2002) documented that tetanus organism transmitted to infants if mothers give birth in unhygienic place and cut umbilical cord with unclean knife or tools.

d) Nutrient deficiency

i. Breastfeeding

The intake of solid foods such as calories, protein and micronutrient foods are not available in our data for the dead child (see section 4.1.2). In order to investigate impact of nutrient foods on child health, we use duration of breastfeeding as a proxy variable.

Huffman and Lamphere (1984) argued that breastfeeding influences survival of children in terms of its nutrient content, in birth spacing and its anti-infective mechanisms. Brown et al (1982b) cited in Huffman and Lamphere (1984) suggested that breast milk offered 50 % of calories of children's food.

Breast milk has anti-infective character that helps children to develop immunologic defense system and prevent them from infectious diseases. In order to achieve these significant effects, children should intake breast milk for at least six months. In addition, breastfeeding is confounded with birth spacing, health status and environmental factors, which in turn affects survival of infant and child (Huffman and Lamphere, 1984).

In addition to immunological content, amino acids and long chain polyunsaturated fatty acids are found in breast milk. These components of food items contribute to develop child brain (WHO, 1998).

UNICEF and others (2002) documented the importance of breastfeeding on the health of children. They stated, "*Babies who are breastfed have fewer illnesses and are better nourished than those who are fed other drinks and foods. If all babies were fed only breast milk for the first six months of life, the lives of an estimated 1.5 million infants would be saved every year and the health and development of millions of others would be greatly improved" (* www.unicef.org/ffl/pdf/factsforlife-en-part5.pdf).

3.2.2 Conceptualization of socioeconomic determinants

a) Individual level factors

i. Maternal education

Several studies show that level of maternal education is inversely related to under age five mortality. Mosley and Chen (1984) examined that mother's educational level has effect on use of health services during pregnancy and appropriate care of her child in its lifetime. They observed that maternal educational level increases her proficiency to attend health care practices such as use of contraception, nutrition, hygiene, preventive care and disease treatment. They argued that various proximate determinants (e.g. reproductive practices, hygienic practices) are directly influenced by educational level of mothers, which affects survival of children. They concluded that educated mothers have awareness to focus on the health of the baby in terms of selecting baby clinic, breastfeeding, child nutrition, washing cloths, bathing the child and cleaning the house.

Cochran et al (1980), Caldwell (1994) and Boerma (1996) documented that maternal education has an independent, strong and positive effect on survival of children. Caldwell asserted that reduction of child mortality is achieved by mother's awareness with preventive and curative measures to health services or appropriate feeding and care of child in each day of life.

Similarly, Pebley and Millman, (1986) noted that maternal education is strongly related with survival of children. They described that children of educated mothers appear to be more likely to use health and family planning services to control the spacing between births than less educated mothers.

Ewbank et al (1986) noted that level of maternal education is inversely associated to under five mortality. They argued that the inverse relationship of mortality and maternal educational is attributed to *"a) breaking traditional child raise parents b) increases use of modern medical facilities c) better utilization of available foods and increases availability of higher quality foods by increasing income"p.48.*

Furthermore, UN (1991) documented that the knowledge gained from education directly affects child survival, where educated mother appropriately uses modern health services during pregnancy and takes proper care of the growth of her children. Similarly UN (1985) pointed out that infant and child mortality in developing countries is more associated with maternal education than the other socioeconomic determinants. The reason is that education has a greater correlation with several factors such as for generating household income, use of health care services, action to take on basic preventive and curative measures as well as undermined traditional beliefs about the cause of disease.

ii. Maternal working place

The place of maternal working activity either within home or far away from home has effect on child survival. The maternal working environment shares the timing of maternal activity that she allots to her child rearing. If the mothers' working environment is far away from home during the infancy period, it appears to be a greater risk for the health of infant (UN, 1985).

UN (1991) stated that in developing countries agriculture is the survival of the family and mother has forced to work in this sector far away from home. This working condition has a worsening effect in the care of the child that he/she is exposed in the risky condition in the home. Briefly, breastfeeding for the child is difficult for mothers when she works outside home. Pupkin and Kumar (1977) cited in Mosley and Chen (1984) revealed that poor mother working out side home leaves her child to unskilled sibling where as rich mother cared her child with skilled and concerned nursemaid. Therefore, many studies (e.g. UN, 1985) showed that children of working women outside home have higher mortality rate than children of housewives or working within home.

iii. Ethnicity and religion

The socio economic differences and accessibilities of health service inequalities between ethnic groups are associated with the differences in child survival (UN, 1991). Similarly, UN (1985) pointed out that the effects of ethnicity on the health of children is not innate differences rather imbalance distributions of services and infrastructures. It is also shown that religion influences modernization, that is, individuals' material living and changing to modernization is determined by the beliefs and attitudes of preachers, which indirectly influences the health of children.

Mosley and Chen (1984) argued that beliefs about disease, differences of culture and tradition within societies determine the survival of children. This cultural variation may attribute to have high mortality rates of children.

iv. Preference of child sex

To investigate relation between under age five mortality and parental preferences of child sex (gender discrimination), we use sex differences in mortality as a proxy variable. Parents prefer either boys or girls according to their cultures and values to children. Ewbank et al (1986) noted that sex differentials in mortality indicates differences in child care practices such as nutritional status and health care delivery for boys and girls. Along this, Okore (1986) described that preference of child sex influences child survival. He suggested that parents prefer child sex in need of assistance in the house, business or farm, care of siblings, old age security and desire for combination of sexes among children.
Schultz (1997) argued the economic values of sex of child as the following reasons.

1. *Net economic productivity of boys may exceed that of girls given their perspective child rearing and human capital investment costs.*

2. *The remittance rate to parents from the economic productivity of boys and girls may differ such that the old age insurance value for parents of an investment in boys exceeds that of an investment in girls.*
3. *The non economic value to parents of boys may exceed that of girls, perhaps because boys can perform customary rituals at the death of parents or maintain the family line (P.386)*

Studies in developing countries such as in Kenya show that girl preferred to boy to earn bride price. As result she has higher chances to survive than boy. However, excess in female child mortality over male child mortality were observed in India and other South Asia countries. The proximate mechanisms for sex differential of under five mortality is due to discrepancy allocation of nutrition and medical care treatments (Mosley & Chen, 1984; Schultz, 1997).

Ware (1986) also noted that the major casual factors of sex differentials in mortality are social rather than biological. He justified that unwanted female or male child is disadvantaged at feeding and medical attention.

b) Household level

i. Access to information

Households that have access to information through radio, television, newspapers, magazines or books increase behavioral change of families. A conscious mother knows about proper handling of children, feeding nutritious food, hygiene, use of contraception, immunization, attending prenatal and postnatal care (Mosley & Chen, 1984).

The consequent effect of messages through the above channels increased use of family planning, which in turn reduces under age five mortality. Similarly, studies noted that literate woman to health information is more likely to have low risk of under age five mortality than children of mothers who have no access to any information.

c) Community level

i. Geographical region, urban and rural differentials

Studies show that in Africa the existence of geographical variations between regions, rural and urban areas increase the incidence of infectious disease and its risks to morbidity and mortality. Because of cultural, social and economic variations among these geographical settings, differences of infant and child mortality are observed in these environmental surroundings. In developing countries like Africa, industrialization, public services, political decisions and other infrastructures are more distributed in the urban areas. The impact of inequity distribution of facilities has inclined to rural areas to have high infant and child mortality (UN, 1985; UN, 1991).

Ewbank et al (1986) examined that differential of infant and child mortality appeared in urban and rural areas of developing countries. They observed that well educated people, high-income population and medical facilities are more concentrated in urban areas. Similarly, Cantrell et al (1986) visualized that effect of region of residence on mortality are caused by coverage of different epidemiologic environment, rainfall variation and fluctuation and ethnic diversification.

Mosley and Chen (1984) suggested that the differences of ecological settings such as rainfall, climate changes and seasonality affect the production of crops in rural areas. The inadequate production of crops is strongly influenced on survival of children, which is a hindrance to use medical services.

3.2.3 Conceptualization of dependent variable

Death is a biological process, which is influenced by socioeconomic and proximate or biomedical factors. To examine influences of these determinants on mortality, survival status of under age five children has been considered as a dependent variable. This dependent variable comprises different levels of mortality that occurred between birth and five years. For the purpose of collecting DHS data in all over the world, ORC- Macro-International (CSA and ORC Macro, 2001) defined and disaggregated under age five mortality into four components. These are:

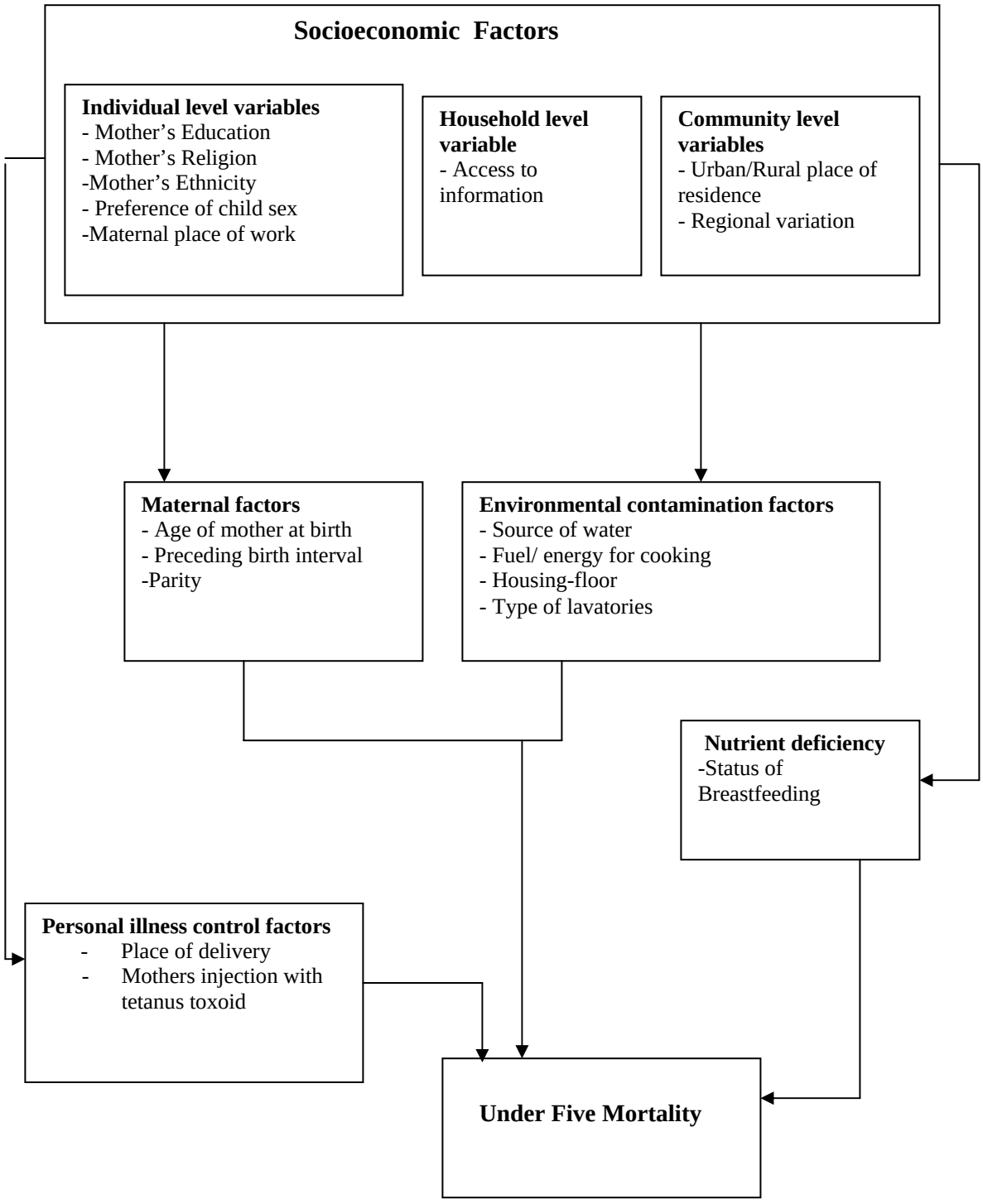
a) Neonatal mortality: mortality occurs within the first month of life;
b) Postneonatal mortality: the difference between infant and neonatal mortality;
c) Infant mortality: mortality of infants between birth and exact age 1;
d) Child mortality: mortality of child between exact ages of 1 and 5.

3.2.4 Conceptualization of the model

The conceptual model is schemed according to theories and literatures that presented in previous sections. Due to insufficiency of information in our research data for all determinants (see section 4.1.2); this conceptual model (Figure 3.2) consists of five major components of the Mosley and Chen (1984) framework. These are socioeconomic factors, maternal factors, personal illness control factors, nutrient deficiency factors and environmental contamination factors.

The model generally reveals that socioeconomic factors have influenced the proximate determinants of maternal factors, nutrient deficiency, personal illness control factors and environmental factors to affect survival of children. In particular, the socio economic variables (individual level, household level and community level variables) have a determining power on the mothers' health, nutritional status and reproductive behavior. Because of biological relationship between mothers and children beginning from gestation and child rearing activities, all patterns of maternal status influences survival chance of children.

Figure 3.2. Conceptual model–The linkage between socioeconomic factors and proximate determinants to under five mortality



Source: adapted from Mosley and Chen, 1984 framework

3.2.5 Research hypothesis

The 2000 Ethiopian Demographic and Health Survey results, theoretical framework and literatures, mentioned in previous sections, are assisted us to formulate the research hypothesis. Accordingly, we proposed the following basic research hypothesis in line with proximate and socioeconomic determinants.

a) Proximate determinant hypothesis

i. Girls can contract marriage in their teens (before 18 years) in Ethiopia, in particular rural areas. Similar researches showed that age of mother at birth influences survival of children **(**e.g. Agha, 2000; UN, 1994; Rutstein, 2000). Therefore, combining the facts presented in our conceptual model and early marriage as well as low rate of contraceptive use in Ethiopia, it is hypothesized that teenage mothers and old mothers are at greater risk to record under age five mortality as compared to mothers in primary reproductive age group (18 to 34 years).

ii. The Ethiopian DHS shows that 19.7% of births occurred below 24 months of preceding birth interval, whereas 37.7% and 32.7% of births were in preceding birth intervals of 24-36 months and over 36 months, respectively. In addition, by considering previous studies (e.g. UN, 1994; Agha, 2000), it is hypothesized that children born with short preceding birth interval are more likely to die than children born with long preceding birth interval.

iii. The Ethiopian DHS revealed that on average, Ethiopian mother has given 5.9 children throughout her reproductive time. In addition, using research results (e.g. Ross and Frankenberg, 1993), it is expected that as mother increased her birth order/parity/, under age five mortality is increased too.

iv. The Ethiopian DHS documented that most Ethiopians are living with rudimentary housing, using poor quality of water, low level of lavatories and low coverage of electricity (see chapter 1). In addition to these facts and considering other research outcomes (e.g. Agha, 2000; Alam and Islam, 1998; Martin et al, 1983), it is expected that children living in these poor facilities and amenities are more likely to die than children living in better living condition.

v. It is well documented by several researchers (e.g. Huffman and Lamphere, 1984) about effects of breastfeeding on child survival. Similarly, we expected that children with never breastfeeding are as likely to die as more children with breastfeeding.

b) Socioeconomic determinant hypothesis

i. Maternal level of education is significantly important to have better job and income, to practice better hygiene, to use appropriate contraception, long birth spacing, limiting family size; preferring modern health services, better nutritious food, child caring and many others. However, the Ethiopian DHS indicates that the majority of women are illiterate. Combining these facts with outcome of other researches (e.g. Agha, 2000; Alam and Islam, 1998; Martin et al, 1983;), it is hypothesized that children born from educated mothers have low risk of mortality than children born with low level educated mothers.

ii. There is a high cultural and ethnic difference on feeding and family formation in Ethiopia. Girls are more preferred by most of the citizens as they think as she serves the mother in home, cared her siblings and earn bride price during her marriage. Thus, she might have received better care than boy. Due to these traditional factors and other research outcomes (e.g. Rutstein, 2005; Ali et al, 2000; Agha, 2000), it is hypothesized that boys are more likely to die than girls.

iii. Modern health facilities, skilled human resources and other infrastructures such as telephones, electricity, pure water supply and others are more concentrated in urban areas of the country. Besides, the Ethiopian DHS reveal that 84% of rural women are illiterate and 85% of population is residing in rural areas. Including these facts with other research findings (e.g. Alam and Islam, 1998; UN, 1985; Hobcraft et al, 1984), it expects that children living in rural areas have a greater risk of dying than children living in urban areas.

In addition to these hypothesizing factors, this study will also examine the impact of religion, ethnicity, regional variation, mother's place work, place of delivery, mother's immunization with tetanus toxoid and access to information on survival of under age five children.

CHAPTER IV DATA AND METHODS OF ANALYSIS

4.1 Data

This research is based on the 2000 Ethiopian Demographic and Health Survey (DHS) data of all regional states of the country. The DHS is the first round large-scale survey in the country, where governmental and non-governmental organizations have used for planning and formulating health policies to date. The responsible organization for collecting the data was Central Statistical Authority (CSA) in collaboration with Ethiopian Ministry of Health and US- ORAC Macro under measure DHS project (CSA and ORC Macro 2001).

The objective of the Ethiopian Demographic and Health Survey was "*…to provide current and reliable data on fertility and family planning behavior, child mortality, child nutritional status…and knowledge of HIV/AIDS. It provides national and regional estimates on population and health, comparable to similar surveys conducted in other developing countries, p.181"* (CSA and ORC Macro 2001).

The DHS was based on scientifically selected representative samples of households and women of reproductive age groups 15-49 years and men with age 15-59 years of same household. The sample of the survey was based on a two stage stratified sampling design, that is, the first stage was selection of sample enumeration areas (EAs) and the second stage was selection of households within the sampled EAs. The first stage sampled enumeration areas were selected from the 1994 Ethiopian Population and Housing Census sampling frame using the principle of probability proportional to measure of size (households). A total of 540 EAs were sampled and distributed into urban areas (139 EAs) and rural areas (401 EAs). In order to select the second stage-sampled households, all households were registered within each sampled EAs before beginning of data collection. Twenty-seven households were selected per enumeration areas in all regions of the country. Accordingly, the survey covered 14,167 households and collected information from 15,367 women and 2,607 men starting from February 2000 to May 2000. Of 15, 367 women, about 10,873 women have reported under age five children. The data were gathered in face-to-face interviews using a total of 312 interviewers (CSA and ORC Macro 2001).

The DHS had used standard instruments for collecting data on fertility, infant and child mortality, child and reproductive health, nutritional status, family planning, household facilities and other health related issues. The main instruments for gathering this information are household's questionnaires and women's questionnaires.

The household questionnaire was used for collecting information on all household members- relationship to the head of the household, educational back ground, sex and age of members; place of residence of members, housing characteristics, source of water, type of toilets facilities, assets, source of energy and many others.

The women questionnaire is the largest questionnaire that focused on women and children's health. The questionnaire consisted of women's background characteristics, reproduction history, contraceptive knowledge, child survival status, age of child, infant feeding practices, child immunization and health, fertility preferences, immunization of mother's on tetanus, place of delivery, prenatal care, knowledge of HIV/AIDS, and many others.

In this study only some of the items in both women and household questionnaires were employed. From women's questionnaire:- age of mother at birth, sex of child, preceding birth interval, mother's religion, mother's ethnicity, mother's place of residence, mother's educational level, access to listening radios, children ever born, status of under five children, age of child, place of delivery, breastfeeding status, mother's working status and mother's tetanus injection. Similarly, source of drinking water, type of toilet facilities, type of fuel for cooking food and main material of housing floor are extracted from household's questionnaire.

4.1.1 Quality of the data

Data quality is an important concern for validity of our study. The DHS data is the highest standard in its quality on births, infant and child deaths and related variables in the developing countries (Rutstein, 2005). Among other things, reliability of data is determined by size of samples that have been covered in the survey. Vaessen (1997) suggested that the DHS have used sample sizes from 3,000 to 10, 000 of women aged 15-49 years to have national estimates. However, sample sizes of DHS data for this research is much higher than the aforementioned range of sample sizes.

In order to reduce non-sampling errors (misreporting, improper interview, miscoding, inconsistencies, refusals, etc) of DHS data; skilled trainers, supervisors, enumerators and editors were involved in the survey process. Accordingly, enumerators were recruited based on their local language ability, academic qualification and survey work experience. Along this, senior demographers and statisticians thoroughly trained interviewers and supervisors for one month at the head quarters in Addis Ababa. Close supervisions were implemented to control quality of DHS data through field visits, observation of interviewers and spot-checking of filled questionnaires. To avoid inconsistency of DHS data within related questions, data editing and coding was carried out both in the field and head office by senior editors. Moreover, the DHS data were entered and cleaned using Microcomputer and Integrated System for Survey Analysis Program that developed for DHS survey (CSA and ORC Macro, 2001).

The over all response rates of DHS data for eligible women and men are about 98 % and 94%, respectively. The remaining proportions are allotted to non- response rate, which was accounted by households' refusals or moving to other places or accidents. Moreover, the data might suffer from omitting or underreporting of deaths for early infancy as the mother might not be interested to discuss about dead child due to her culture or sorrow (CSA and ORC Macro, 2001).

Furthermore, to realize the quality of DHS data, the data was thoroughly investigated and filtered from inconsistencies and missing values before starting analysis of this research (e.g. inconsistency of survival status and age of child, incompleteness of maternal age at birth and missing values of breastfeeding status). It was found 9 missing cases for status of duration of breastfeeding. Because of a few number of missing cases in breastfeeding, it preferred to impute by the most occurrence value. In addition, maternal age at birth is estimated from differences of date of birth of child to date of birth of mother. The misplaced of survival status and age of child were corrected using manual editing.

4.1.2 Appraisal of determinants in DHS data

The Ethiopian Demographic and Health survey data does not provide complete information on determinants that listed in Mosley and Chen (1984) analytical framework Because of these shortcomings, essential explanatory variables of under age five mortality such as personal illness control factors (prenatal care, morbidity, therapy and status of child immunization), nutritional deficiency factors (availability of solid nutritious foods) and parental (father) background characteristics were not included in this study. However, variables, presented in conceptual model, are drawn from DHS data and used for this analysis.

In general, the reasons for incompleteness of aforementioned data are: - information on coverage of vaccination or status of child immunization was collected for living children only. Also, information on prenatal care was collected for recent birth to the date of survey, that is, if a mother had two births in the past five years preceding survey, information on prenatal care was available for recent child. In addition, the Ethiopian DHS was restricted to collect data on therapy, morbidity (diarrhea, fever, etc) and nutritional status (intake of solid foods) for living children.

Similarly, the current husband of a mother does not necessarily imply the biological father of the dead child. Moreover, some of the mothers were in different marital status such as married, divorced or widowed. Thus, parental characteristics excluded in this analysis due to differences in marital status and inconsistency of information.

4.1.3 Operationalization of variables

In order to have common understanding for analysis of this research, the study has categorized the dependent and independent variables based on nature of data, theoretical and conceptual framework. To be consistent with other studies, mother's age at birth and preceding birth intervals are categorized using concepts of determinants discussed in previous section. The measurement or operational descriptions of variables are presented below.

i. Classification of dependent variable

As mentioned earlier, the dependent variable for this analysis is survival status of under age five children. Information on child survival status and risk factors were collected for

all children who born from March 1995 to date of survey (March 2000). However, for analysis of this study we considered March 1995 birth cohort- under age five children, which are selected from total recorded children (from March 1995 to March 2000). Thus, the dependent variable is dichotomous, which classified as child dying versus not dying. On the other hand, if a child died within the cohort period (1995-2000) it classified as 1; whereas if a child is alive within the cohort period, it assigned a value 0 (see Lexis diagram, section 5.1).

ii. Classification of independent variables

Operational definition and classification of each independent variable provides in the following Table 4.1.

Table 4.1 Operational definitions and classifications of independent variables

Variables	Operational measurement
Proximate factors	
1. Maternal factors	
1.1 Mother's age at birth	-Age of mother's at birth obtained by considering differences from date of birth of child with date of birth of mother. It is measured in years, and coded as 1= less than 18 years; 2= 18 to 34 years; 3= 35 years and over
1.2 Preceding birth interval	- It is measured in months. It is coded as 1= less than 23 months; 2= 24 months to 36 months 3= over 36 months
1.3 Parity	-It is actual number of births that a mother had. The numbers of children are considered without classification.
2. Environmental factors	
2.1 Source of water	- This represents the main sources of drinking water, which is coded as: 1= piped water; 2= Surface water/ river, well or others

"Table 4.1 continued"

2.2 Toilet facility	- Type of lavatories most household members used, which is coded as: 1= Flush toilet 2= No facility/bush/field/others
2.3 Housing floor material	-It is the main material of housing floor, which is coded as 1= Modern or improved floor; 2= earth /sand/mud, others
2.4 Energy for cooking	-It uses for cooking household food, which is coded as 1= Electricity; 2= Fire wood/cow dung/ kerosene or others
3. Personal illness control factor	
3.1 Place of delivery	-It is the place where mother had given birth, which is coded as 1= Health centers; 2= Home or others
3.2 Mother's with tetanus toxoid	- It protects against tetanus, which is coded as 1= Immunized; 2= Not immunized
4 Nutrient deficiency factors	
4.1 Status of breastfeeding	- It indicates either child had intake breast milk or did not take breast milk, which is coded as 1= Breastfed; 2= Never breastfed
Socioeconomic factors	
1 Individual level factors	
1.1 Mother's education	- Mothers were asked at what level of education they attended and highest grade completed. Thus, it is coded as, 1= Secondary or higher education; 2= Elementary education; 3= No education
1.2 Preference of child sex	- It approaches to gender differences in mortality, it coded as 1= Female 2= Male
1.3. Mother's religion	- It is coded as 1= Christian; 2= Muslim; 3= Other faiths

"Table 4.1 continued"

1.4 Mother's ethnicity	- it is mother's ethnic group; which is classified as 1= Amhara ethnic; 2= Oromo ethnic; 3=Tigray ethnic 4=Others ethnic
1.5 Mother's working area	- it is classified as 1=Within home; 2= Far away from home
2. Household level factor	
2.1 Access to information	-It relates to mother's exposure to radio messages. It coded as: 1= Listening radio; 2= Not listening radio
3. Community level factors	
3.1 Place of residence	- Current place of resident of mother, which is coded as: 1=Urban 2= Rural
3.2 Geographical regional places	- Mother's current resident of regional states, it coded as 1= Addis Ababa ; 2= Afar; 3=Amhara; 4= Oromia ; 5= Somalia; 6= Benshangul ; 7= Southern nations 8= Gambella; 9= Harari; 10= Dire Dawa; 11= Tigray

4.2 Methods of analysis

4.2.1 Introduction

The preferred statistical methodologies to meet our objective and answering research questions are Kaplan-Meier and multiple logistics regressions. The Kaplan-Meier method is used to estimate probability of survival, probability of dying (hazards) and related statistics. It is a means to address our first research question, that is, "How the probabilities of survival and dying looked for under age five children across in the country?

The multiple logistics regression analysis is applied to fit a model for investigating answers of the second and third research questions; where the second question asks, "*Which proximate determinants or direct factors influence under age five mortality?* And the third asks, "*What are the socioeconomic factors or indirect factors that contribute to under age five mortality?"*

4.2.2 Kaplan-Meier method

The Kaplan-Meier method, in addition to estimating survival probability and probability of dying (hazards), it provides median survival time and survival curves to insight trends or patterns of under age five children. We used the variable sex of child as a factor to examine differentials and inequalities of mortality levels between male and female children.

The Kaplan-Meier technique considered for two groups of children, that is, for March 1995 birth cohort to March 2000 (under age five children) and for period births of March 1995 to March 2000 (children who born but either alive or died within the period March 1995 to March 2000). Thus, age of child is a time variable and child survival is a status variable. This method also helps to visualize graphical trends/curves/ of the survival probabilities of under age five children as well as for all children who born through the five year periods.

A survival curve is a statistical picture that depicts survival experiences of children in the form of graph- with survival probability versus survival time of children. The advantageous of Kaplan Meier method is that it gives estimates for survival and hazard probabilities of each group of children at specified death time.

Collett (1994) presents a statistical formula to compute the Kaplan-Meier estimates of survival function (survival probability after any time t) and hazard function (risk of death per unit time) as follows.

$$\mathbf{S_i(t)} = \prod_{j=1}^{k} \frac{n_j - d_j}{n_j} \quad \textbf{and} \quad \mathbf{H_i(t) = d_j / \{n_j (t_j - t_{j-1})\}}$$

where, $S_i(t)$ is the survival function, with survival probability $\{n_j - d_j\} / n_j$ in the interval $(t_j - t_{j-1})$;

$H_i(t)$ is the hazard function/hazard rate/; and probability of dying is equal to hazard rate multiplied by time interval $(t_j - t_{j-1})$;

d_j is number of children who died up to j^{th} time;

n_j is number of children at risk just prior to t time t_j ;

t_j is duration of individuals or life time of children;

In addition, Collett (1994) described the estimated median survival time, t(50%), which is defined as the smallest observed survival time for which the value of estimated survival probability is less than 0.5. Thus, the median survival time indicates that 50% of individuals among studied children were survived before median time t. Collett (1994) has given the following formula.

$t(50\%) = \min\{t_i / S(t_i) <= 0.05\}$, where t_i is the observed survival time for the i^{th} individuals, i=1,2… n.

However, Collett suggested that if the estimated survival probabilities are greater than 0.05 for all values of time t, then the median survival time cannot be estimated or meaningless. Also, Collett presented the Log rank technique to test group of survival curves (survival

time of male versus female children). The null hypothesis of Long rank test is that there is no difference in survival experience of male and female children. Accordingly, if the Log rank statistic is larger then null hypothesis is rejected.

4.2.3 Multiple logistics regressions

Agresti (1996) presents a statistical formula to build the multiple logistics regression model for binary dependent variable. The model is given by the following logit function.

$$Logit(y) = \alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k$$

and its probability estimates is given by

$$P(y=1) = \frac{EXP\{\alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k\}}{1 + EXP\{\alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k\}}$$

where, y is a dichotomous dependent variable defined by ;

y={1, if a child is died ; 0 if a child is alive}

X_i is covariates (socioeconomic and proximate determinants) ;

β_i is coefficients of the covariates to measure effect of X_i on the log odds that a child died (y=1) after controlling other independent variables ;

EXP is exponential value = 2.71

The odds ratio is useful for comparing two or more distinct levels of risk factors or covariates to the base or reference group. In order to estimate this parameter, Agresti (1996) also suggests using the following formula.

$$OR^{(i)} = \mathbf{EXP}(\beta_i),$$

Where $OR^{(i)}$ is the odds ratio for the i^{th} levels of covariates

If $OR^{(i)} < 1$, it indicates that the odds of being children died decreased to the associated independent variable as compared to reference group

$OR^{(i)} > 1$, the odds of under five mortality is greater for the corresponding covariates as of the reference group

$OR^{(i)} = 1$, the odds of death of children is not influenced by the corresponding covariates

The study sets the level of significance at 5 % for testing the null hypothesis of the parameter $\beta_i = 0$; and can be formulated the 95% confidence intervals of odds ratio, which is given by (Agresti, 1996):

$$\text{Exp}\{\ \beta_i \pm 1.96 * s.e(\beta_i)\ \}$$

Moreover, the two important statistical terms for improving model adequacy are confounding and interaction effects. Woodman (2005) defined confounding and interaction as *"confounding is an extraneous factor that wholly or partially accounts for observed effects of the risk factors… that it is causing the relationship to appear or it is masking a true relationship, whereas interaction occurs between risk factors when the effect of one risk factor up on outcome/disease or mortality is different at different levels of the second risk factors (p.164)"*. His suggestion to control confounding variables is that, first- it is

essential to fit univariate model for each independent variables, secondly it should fit multivariate model for important variables or building multivariate model with all variables at a time. For details, included variables are depicted in Table 4.2.

According to Woodman's (2005) recommendation for controlling effects of confounding, univariate and multivariate logistic regression models were constructed. For instance, several researchers (e.g. Huffman and Lamphere, 1984 ; Boerma,1996) documented that breastfeeding is a confounding factor that affects both birth interval and child survival. In addition, two way or first order interaction effects were assed in the multivariate model. Though, fitting a model with higher order interaction is not manageable to interpret results. Therefore, several studies indicate that maternal education (UN, 1991; UN, 1994) and maternal age at birth (Gupta and Baghel, 1999) have a potential power to interact with many determining factors. In addition to testing these interaction variables, other possible interaction effects had been tested according to this researcher's perception and opinion.

Furthermore, in all model fitting activities tests of model adequacy, such as residual diagnosis, Hosmer and Lemshew test, Nagelkerker R square and all other procedures were examined. The fitting of the model was implemented using statistical software package called SPSS version 11.5.

Table 4.2. Summaries of model types and included covariates in analysis

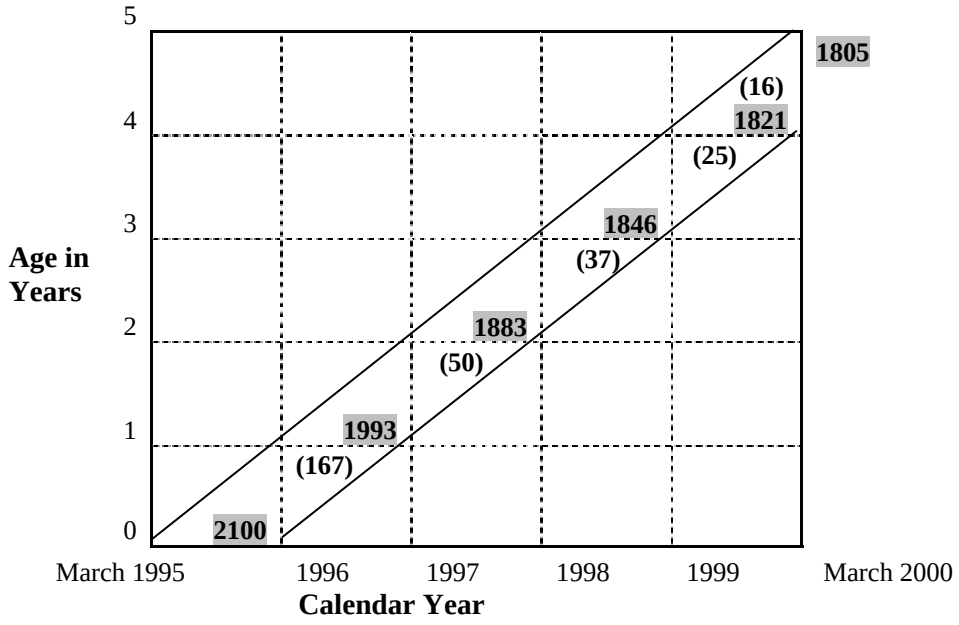
Type of models	Dependent variable	Independent variables to be included
Univariate and multivariate models- for proximate determinants	Binary –child died or alive	***Maternal factor*** -Age of mother at birth - Preceding birth interval - Parity ***Environmental Contaminating factor*** - Source of water - Type of lavatories - Type of energy for cooking - Type of housing floor material ***Personal illness control factors*** - Mother injection tetanus toxoid - Place of delivery ***Nutrient deficiency factor*** - Breastfeeding status
Univariate and multivariate models- For socioeconomic factors	Binary –child died or alive	***Individual level factors*** -Mother's educational level - Religion - Ethnicity - Preference of child sex, - Place of working area ***Household level factor*** - Access to information ***Community level factors*** - Place of region - Urban/rural place of residence
Proximate and socioeconomic multivariate model- combined effect model	Binary –child died or alive	-Includes all proximate and socioeconomic variables that have statistical significant in univariate analysis

CHAPTER V RESULTS OF THE STUDY

5.1 Introduction

In this section, we describe results of descriptive statistics, Kaplan-Meier estimates and logistic regression analysis, which have given clues to the linkage between under age five mortality and its determinants. In order to realize this study, we considered March 1995 birth cohort of 2100 children (under age five children). These children were selected from March 1995 to March 2000 period births (10,873 children). The total exposure and occurrence /event of death/ of birth cohort children were depicted in Lexis diagram Figure 5.1. The Lexis diagram reveals that the highest event /mortality/ occurred before age 1 year, and followed by age 2 years and so on (see area of each parallelogram/. In general, descriptive statistics, Kaplan-Meier estimates and regressions analysis were carried out using observations in Lexis diagram. The results are presented in the following sub sections.

Figure 5.1. Lexis diagram-March 1995 birth cohort of under age five children in Ethiopia



Note: 1. Numbers in brackets refer to children who died
2. Numbers in shaded regions refer to survival of children at last birth day

5.2 Descriptive results of proximate determinants

Table 5.1 presents differences of under age five mortality for each proximate determinant. The descriptions are given below.

i. Maternal factors

The results reveal that the highest numbers of children (77%) were born to mothers' age 18 to 34 years, followed by old age mothers over 34 years (16%). Only 6% of children were recorded for teenage mothers below 18 years. Thus, mortality differentials by age of mothers' at birth has shown a wide gap from 137 deaths (mother age 18-34 years) to 179 deaths (for teenage mothers) per thousands. Therefore, very young age at birth (below 18 years) mothers were highly vulnerable for under age five mortality, followed by old aged mothers (over 34 years) and mothers aged 18 to 34 years.

Table 5.1 indicates that most children (41%) born with short birth intervals (below 24 months). About 31% and 28% of children were born after short birth intervals 24-36 months and over 36 months, respectively. Children born over 36 months of birth interval are advantageous to survive (96 deaths per 1000 live births), whereas children born with birth interval 24 to 36 months (156 deaths per 1000 live births) and short birth interval below 24 months (159 deaths per 1000 live births) had highly been exposed to mortality.

Similarly, 64% of children reported to have been within four or more birth orders while 31% and 5% of children were in 2-3 birth orders and in single birth order, respectively. Mothers with single birth order had low under five mortality rates (97 per 1000) as compared to mothers with higher order births (155 per 1000).

ii. Environmental contaminating factors

The highest under age five mortality rate with respect to households living conditions were reported with lack of pure water (151 per 1000), poor lavatories or sanitation (149 per 1000), poor housing floors (150 per 1000) and low access to electricity (141 per 1000). Similarly, the highest proportions of children were born in these low facilities households.

iii. Personal illness control factors

Our result depicts that the highest proportion (90%) of children were born at home and the remaining proportion of children were born in health facilities. As a result, a large number of children died due to home delivery (146 deaths per 1000) and health centers delivery (85 per 1000 mortality). Similarly, about 67 % of children recorded to mothers who had tetanus toxoid immunization. Children of mothers with toxoid immunization had relatively lower under age five mortality rates (127 per 1000) than mothers who did not have any immunization (168 per 1000).

iv. Nutrient deficiency

About 97% children were reported to have been breastfed. The mortality rate for these children was found to be 119 per 1000. However, 3% of children did not feed on breast milk. Accordingly, they had the highest mortality rate, which are 791 deaths per 1000 live births.

Table 5.1. Under age five mortality rate and number of under age five children by proximate factors, for March 1995 birth cohort-March 2000, Ethiopia

Proximate Variables	Total Number of Children		Mortality rate per 1000
	N	%	
Maternal Factors			
Age of mother at birth			
Over 34 years	1623	16	140
18 to 34 years	343	77	137
Below 18 years	134	6	179
Preceding birth Interval			
Over 36 months	593	28	96
24 to 36 Months	647	31	156
Below 24 months	860	41	159
Number of children (party)			
One child	103	5	97
2 -3 children	660	31	118
4 or more children	1337	64	155
Environmental contaminating factors			
Source of water			
Piped	365	17	90
Surface water	1735	83	151
Toilet facilities			
Flush water or pit latrine	405	19	104
Bush or field or others	1695	81	149
Housing floor material			
Modern or improved	192	9	47
Natural/earth or others	1908	91	150
Energy for cooking			
Electricity	3	0.1	0
Fire wood/Natural gas or others	2097	99.9	141
Personal illness control			
Place of Delivery			
Health center	200	10	85
Home	1900	90	146
Mother's with tetanus toxoid			
Immunized	1416	67	127
Not immunized	684	33	168
Nutrient Deficiency			
Breastfeeding status			
Breastfeed	2033	97	119
Never breastfeed	67	3	791
Total	**2100**	**100**	**140**

5.3 Descriptive results of socioeconomic determinants

The impacts of socioeconomic factors on under age five mortality have been shown in Table 5.2. The results are described at three levels: individual level factors, household level factor and community level factors.

i. Individual level factors

About 6%, 12% and 82% of children reported with mothers who had secondary/higher education, elementary education and no education, respectively. The results indicate that children of mother's with secondary or higher education had the lowest under age five mortality, which accounts for 48 per thousand live births. However, mother's with elementary and no education had excess under age five mortality, which is estimated at 92 per 1000 and 155 per 1000, respectively.

The magnitude of under age five mortality rates by causes of parental preferences of gender has shown some variations. Female child is relatively advantageous as of her male counterpart to survive. The result also shows that children of Christian mother's experienced low under age five mortality as of Muslim mothers and mothers with other faiths. Similarly, the types of mothers' ethnicities have shown slight variations on under age five mortality.

The influence of mother's place of work within home contributes to 117 deaths per thousands while children of mothers working far away from home amount greater under age five mortality rate (159 per thousands).

ii. Household level factor

Children of mothers listening to radios had lower under age five mortality (123 per 1000) than children of mothers who did not have access to listen radio messages (147 per 1000).

iii. Community level factors

About 83% and 17% of children were born in rural and urban areas, respectively. Thus, children of mothers living in urban areas recorded 97 per 1000 while children of mothers in rural area accounted excess mortality (149 per 1000). Similarly, it is observed that regional variations on under age five mortality range from 53 per thousands in Addis Ababa (capital city) to 186 per thousands in Benshangul region.

Table 5.2. Under age five mortality rate and number of under age five children by socioeconomic factors, for March 1995 birth cohort-March 2000, Ethiopia

Socioeconomic Variables	Total Number of Children		Mortality rate per 1000
	N	%	
Individual level			
Mother's education			
Secondary or higher	126	6	48
Elementary	262	12	92
No education	1712	82	155
Preference of sex of child			
Female preference	1046	50	118
Male preference	1054	50	163
Religion			
Christian	1181	56	132
Muslim	847	40	151
Others	72	3	153
Ethnicity			
Amhara ethnic	530	25	136
Oromo ethnic	569	27	151
Tigre Ethnic	237	11	135
Others	764	36	137
Mother's working area			
Within home	908	43	117
Outside home	1192	57	159
Household level			
Access to information			
Listening Radio	608	29	123
No access	1492	71	147
Community Level			
Place of residence			
Urban	349	17	97
Rural	1751	83	149
Region			
Addis Ababa	95	5	53
Tigray	224	11	147
Afar	129	6	101
Amhara	318	15	164
Oromia	380	18	155
Somali	152	7	132
Benshangul	156	7	186
Souther Nation	327	16	125
Gambela	104	5	163
Harai	109	5	83
Dire Dawa	106	5	160
Total	**2100**	**100**	**140**

5.4 Kaplan-Meier results

The Kaplan-Meier estimates of survival probabilities and hazards as well as survival curves were computed for March 1995 birth cohort and March 1995-March 2000 period births. These approaches would help us to clarify mortality trends or differentials of survival status of male and female children in the country. Summaries of results are presented in Table 5.3a-Table 5.3c (birth cohort), Table 5.3d-Table 5.3e (period births), Figure 5.2a-2b and Figure 5.2c-6.3d.

The selected birth cohort results documented that the highest probability of dying and hazard rate are observed at infancy period of female as well as male children. The probability of dying for female children is 6.1% at infancy period 0-12 months, followed by 2.3% for age 12-24 months. The probability of dying for male children accounts about 9.8% within infancy period 0-12 months and 2.8% after infancy period 12-24 months. When considering both sexes at a time, excess probabilities of dying are exhibited at infancy period 0-12 months (8%) and 12-24 months (2.6%). In addition, the same trends can be observed for the period births data. Accordingly, the probability of dying of both sexes is 9.6%, for female child is 8.8% and for male child is 10.3%. In general, our results indicate that in the cohort as well as in period data, the survival probabilities of female children are slightly higher than male children.

Further, our result reveals that the survival probabilities of children are higher than 0.5 in all time intervals. According to Collett's (1994) premises, median survival time of under age five children does not exist if all survival probabilities exceed 0.5. However, we considered descriptive median time as a proxy for estimating survival median time of children. In the 1995 birth cohort, the median time is estimated at 7 months for both sexes, whereas the median duration for female and male children is 10 months and 5 months, respectively. For the period birth data, the median survival time is too small as compared to the median time in the birth cohort. Thus, 50% of female children died before celebrating 4 months, male child died before reaching 2 months and 3 months for both sexes. Both cohort and period median values indicate that female child has twice median survival time of male child.

Besides probabilities of survival and probabilities of dying, we compared survival status of female children, male children and both sexes in Figure 5.2a-5.2b (birth cohort) and Figure 5.2c-5.2d (period births), respectively. In general, the graph showed that the survival curve starts out with 100% surviving at time zero (at birth) and gradually declines or steps down. The Log rank test statistic indicates that survival curves of male and female children is different (Log rank statistic=9.4 with degree of freedom 1; $p<0.003$). Thus, survival curve of female child is slightly above as of male child in the cohort as well as period data. The difference of duration of survival status between sexes of child indicates that social or biological factors might favor to female child in the country.

Therefore, the Kaplan-Meier estimates answered to our first research question. It is important to recall the first research question again, that is, "How the probabilities of survival and dying looked for under age five children across in the country?

Table 5.3a. Estimated Kaplan Meier- life table results for under age five children (March 1995 birth cohort- March 2000), for both sexes in Ethiopia

Survival Interval time	Number of children Entered in the interval	Number of children Withdrawn during interval	Number Exposed to risk	Number of children died	Probability Of survival	Probability of dying	Cumula tive probabil ity of survival	Hazard Rate
0-12 months	2100	0	2100	167	0.921	0.080	0.921	0.0069
12-24 months	1933	0	1933	50	.974	.026	0.897	0.0022
24-36 months	1883	0	1883	37	.980	.020	0.879	0.0017
36-48 months	1846	0	1846	25	.986	.014	0.867	0.0011
48-60 months	1821	1773	934.5	16	.983	.017	0.852	0.0014
60 months	32	32	16	0	1	0	0.852	-

Descriptive Median =7 months

Table 5.3b Estimated Kaplan Meier- life table results for female under age five children (March 1995 birth cohort- March 2000) in Ethiopia

Survival Interval Time	Number of children Entered in the interval	Number of children Withdrawn during interval	Number Exposed to risk	Number of children died	Probability of survival	Probability of dying	Cumula tive probabil ity of survival	Hazard Rate
0-12 months	1046	0	1046	64	.939	.061	0.939	0.0053
12-24 months	982	0	982	23	.977	0.023	0.917	0.0020
24-36 months	959	0	959	28	.981	.019	0.899	0.0016
36-48 months	941	0	941	11	.988	.012	0.889	0.0010
48-60 months	930	903	478.5	7	.985	.015	0.876	0.0012
60 months	20	20	10	0	1	0	0.876	-

Descriptive Median time=10 months

Table 5.3c. Estimated Kaplan Meier- life table results for male under age five children (March 1995birth cohort-March 2000) in Ethiopia

Survival Interval Time	Number of children Entered in the interval	Number of children Withdrawn during interval	Number Exposed to risk	Number of children died	Probability of survival	Probability of dying	Cumulative probability of survival	Hazard Rates
0-12 months	1054	0	1054	103	0.902	0.098	0.902	0.0086
12-24 months	951	0	951	27	0.972	0.028	0.877	0.0024
24-36 months	924	0	924	19	0.979	0.021	0.859	0.0017
36-48 months	905	0	905	14	0.985	0.015	0.845	0.0013
48-60 months	891	870	456	9	0.980	0.020	0.859	0.0017
60 months	12	12	6	0	1	0	0.829	-

Descriptive Median time = 5 months

Figure 5.2a. Survival probability of under age five children in Ethiopia, March 1995 birth cohort-March 2000

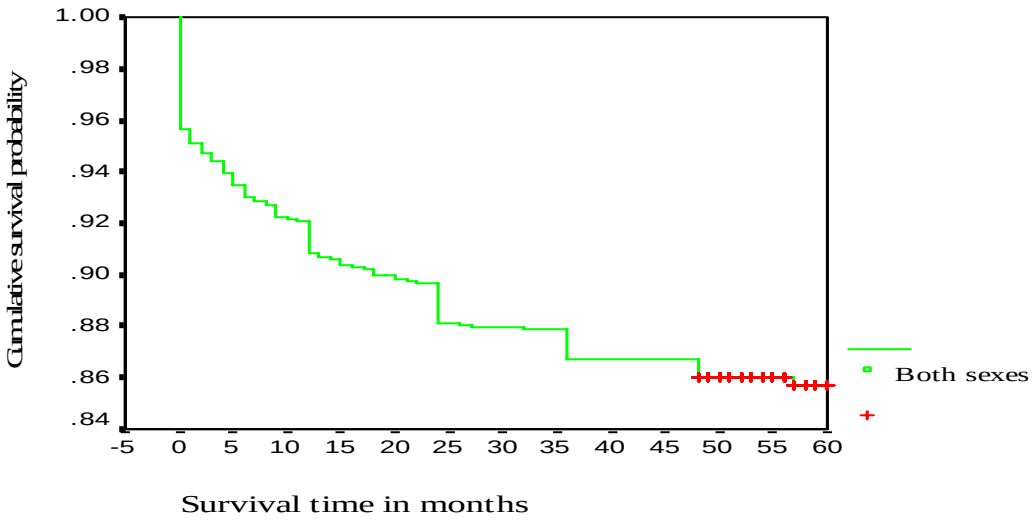
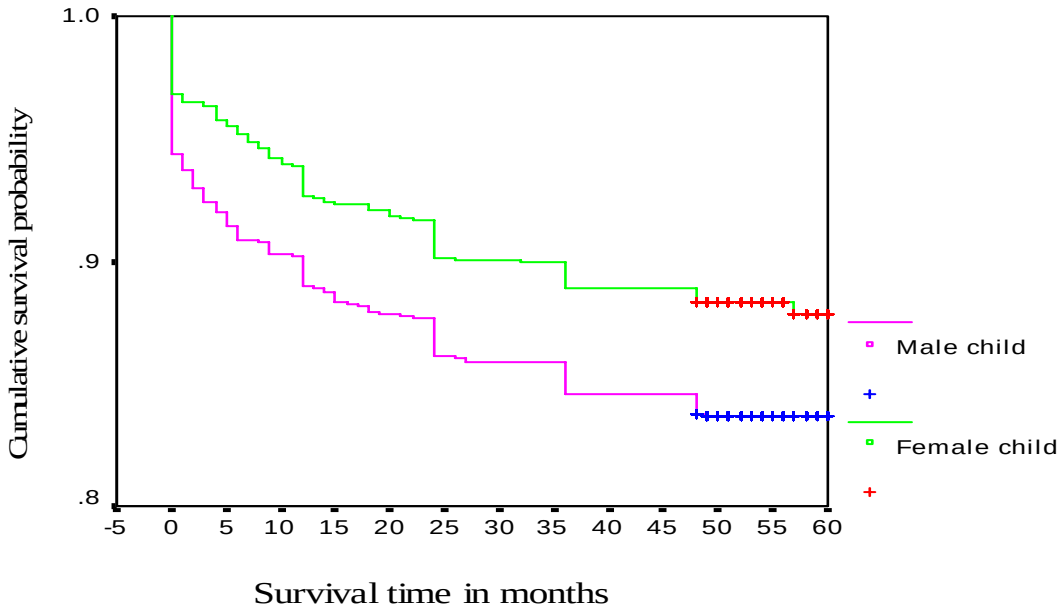


Figure 5.2b. Survival probability of under age five male and female children in Ethiopia, March 1995 birth cohort-March 2000



(Log rank statistic= 9.4; d.f =1 with p<0.003)

Table 5.3d. Estimated Kaplan Meier- life table results for all children born from March 1995- March 2000, for both sexes in Ethiopia

Survival Interval time	Number of children Entered in the interval	Number of children Withdrawn during interval	Number Exposed to risk	Number died	Probability Of survival	Probability of dying	Cumulative probability of survival	Hazard rate
0-12 months	10873	1856	9868	943	0.904	0.096	0.904	0.0084
12-24 months	7920	2010	6992	206	0.971	0.029	0.878	0.0025
24-36 months	5858	1882	4917	105	0.979	0.021	0.859	0.0018
36-48 months	3871	2007	2868	43	0.985	0.015	0.846	0.0013
48-60 months	1821	1773	935	16	0.983	0.017	0.832	0.0014
60months	32	32	16	0	1	0	0.832	-

Descriptive Median =3 months

Table 5.3e. Estimated Kaplan Meier- life table results for female children born from March 1995-March 2000, in Ethiopia

Survival Interval time	Number of children Entered in the interval	Number of children Withdrawn during interval	Number Exposed to risk	Number died	Probability of survival	Probability of dying	Cumulative probability of survival	Hazard rate
0-12 months	5341	979	4852	428	0.912	0.088	0.912	0.0077
12-24 months	3934	903	3483	90	0.974	0.026	0.888	0.0022
24-36 months	2941	927	2478	52	0.979	0.021	0.869	0.0018
36-48 months	1962	1013	1456	19	0.987	0.013	0.858	0.0011
48-60 months	930	903	478.5	7	0.985	0.015	0.846	0.0012
60months	20	20	10	0	1	0	0.846	-

Descriptive Median time = 4 months

Table 5.3f. Estimated Kaplan Meier- life table results for male children born from March 1995- March 2000, in Ethiopia

Survival Interval time	Number of children Entered in the interval	Number of children Withdrawn during interval	Number Exposed to risk	Number died	Probability of survival	Probability of dying	Cumulative probability of survival	Hazard rate
0-12 months	5532	1031	5017	515	0.897	0.103	0.897	0.0090
12-24 months	3986	953	3509	116	0.967	0.033	0.868	0.0028
24-36 months	2917	955	2439	53	0.978	0.022	0.849	0.0018
36-48 months	1909	994	1412	24	0.983	0.017	0.834	0.0014
48-60 months	891	870	456	9	0.980	0.020	0.818	0.0017
60months	12	12	6	0	1	0	0.818	-

Descriptive Median time = 2 months

Figure 5.2c. Survival probability of all children, born from March 1995-March 2000, Ethiopia

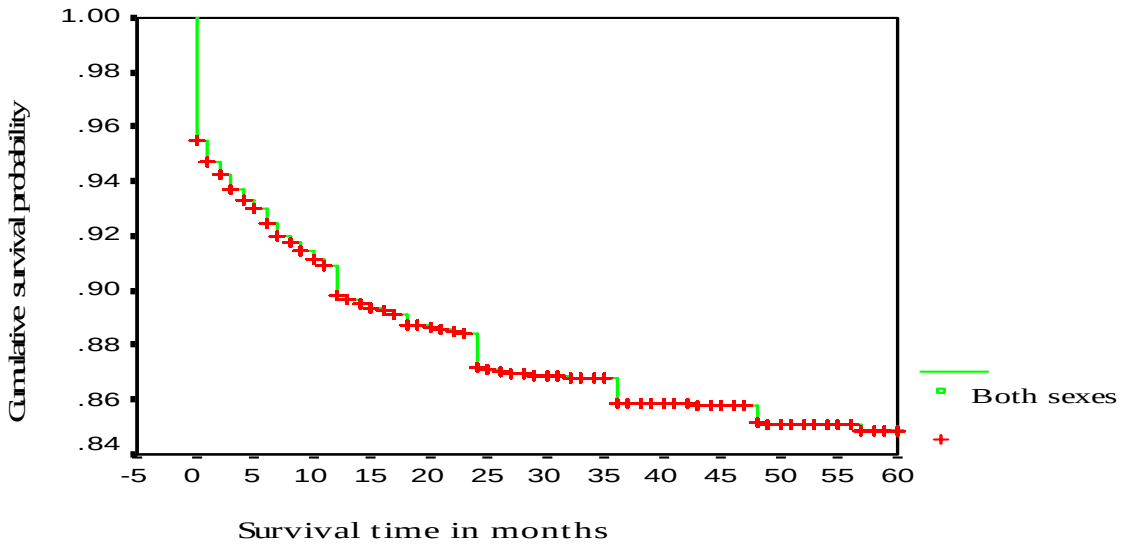
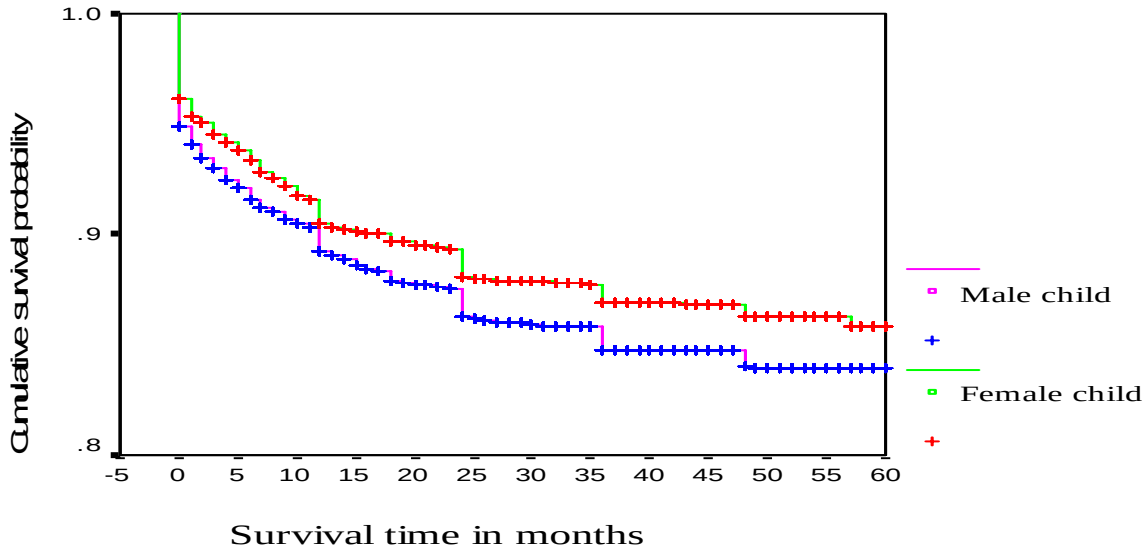


Figure 5.2d. Survival probability of male and female children, born from March 1995-March 2000, Ethiopia



(Log rank statistic=9.32; d.f =1 ; p<0.003)

5.5 Univariate and multivariate results

As mentioned in the methodology section, this study would employ regression analysis using survival status of the 1995 birth cohort/under age five children/ as outcome dependent variable. The univariate regression models, model 1 and model 3 are regressed for each proximate and socioeconomic independent variable to examine individual effects on under age five mortality, respectively. In addition, model 2 refers to a multivariate proximate model that includes all proximate variables which have shown a significant effect in univariate analysis. Similarly, model 4 depicts a multivariate socioeconomic model that consists of all statistically significant socioeconomic variables in the univariate analysis. Finally, model 5 shows the combined effect /proximate and socioeconomic/ multivariate model.

Furthermore, two way or first order interactions were tested/ fitted / between possible interaction variables in bivariate analysis; and followed by including a statistically significant interaction variables into multivariate analysis. Thus, the included interaction variables in multivariate analysis are interaction between mothers' level of education by place of residence, mothers' level of education by water supply, parity by place of residence and place of delivery by place of residence and place of delivery by water supply. However, the remaining interaction variables such as interaction between maternal education with other variables; and interactions within different possible variables were statistically nonsignificant to include in multivariate analysis (see Annex A). Since age of mother's at birth is statistically insignificant at univariate analysis, it could not do any interaction analysis with it. It is noticed that interaction variables are selected from literatures as well as researcher's point of view (see previous sections).

For all model analysis, the Lemshow-Hosmer tests indicated that all covariates significantly contribute to the fit of the model ($p>0.05$). Similarly, the corrected predictive classification of variables is more than 87%. The Results of individual models are discussed below.

5.5.1 Results of proximate determinants

This section presents results of univariate and multivariate models of proximate determinants on under age five mortality. Table 5.4, Table 5.5 and Table 5.8 depict univariate models, multivariate proximate model and combined effect proximate and socioeconomic multivariate model, respectively. Therefore, the results of univariate as well as multivariate analyses answered our second research question, that is, which proximate determinants or direct factors influence under age five mortality?

i. Maternal factors

Previous studies showed that mother's age at birth and mortality of children has a statistical relationship. Surprisingly, in this study the effect of maternal age at birth disappeared (statistically nonsignificant) in regression analysis. The possible explanation for nonsignificance is that age of mothers might not be reported properly related to

survival status of children in DHS data, which means that there is likely to be age reporting errors in the data. Even though it is nonsignificance, the relationship of mother's age with mortality is in the expected direction, that is, teenage mothers below 18 years were more likely to have under age five mortality, which increased the odds of mortality by 37% ($p<0.2$; odds ratio (OR)=1.37) and old age mothers have increased mortality by 2% ($p< 0.91$; OR=1.02) as of the primary reproductive age groups 18-34 years.

Our univariate and multivariate (model 2-regression between proximate factors and model 5-combined effect model) results indicate that preceding birth interval is strongly associated on under age five mortality. The odds of dying in each preceding birth interval increase from univariate to multivariate model. Thus, multivariate analysis (model 2) found that children born with intervals 24 to 36 months and below 24 months are as likely to die as more children born after reference birth intervals over 36 months (52%, $p<0.05$ for intervals 24-36 months and 88%, $p<0.01$ for short birth interval below 24 months). When controlling all proximate and socioeconomic factors into analysis (model 5), the effect of preceding birth interval becomes strong, that is, the odds of dying of under age five children with interval 24-36 months is 64%($p<0.01$;OR=1.64) while the odds of dying in short birth interval below 24 months raised by 101% ($p<0.01$; OR=2.01). The highest odds of preceding birth interval might appear due to the inclusion of the confounding variable (breastfeeding) into analysis. Therefore, our results indicate that short preceding birth intervals are risk for survival chance of under age five children. This suggested that short birth intervals influences maternal health status during pregnancy as well as after delivery, which has a linkage with survival status of child.

Similarly, birth order or parity is an important factor to affect mortality of children. The regression results of proximate univariate and multivariate analysis show that parity is statistically significant on under age five mortality. After controlling all proximate variables in multivariate analysis (model 2), we found that a unit increase in parity results an increase of odds of dying by 8% ($p<0.01$; OR=1.08). However, the effect of parity on under age five mortality became statistically insignificant in combined effect model (proximate and socioeconomic multivariate model). Our result indicates that high parity has a negative effect on child survival. This could be number of children/ parity/ associate with mothers' poor health status due to pregnancies and household economic levels-competition between children for food and other resources.

ii. Environmental contaminating factors

Availability of pure water determines child survival. The effect of water has shown an independent effect as well as joined effect on mortality of under age five children. The multivariate model 2 depicts that children of mothers with surface water/river are as likely to die as more children of mothers with piped water. The corresponding odds of dying are 420% ($p<0.01$; OR=5.20) for those who used surface water as compared to the reference group/ piped water/. However, when source of water included with combined proximate and socioeconomic variables in combined multivariate analysis (model 5), its effect is disappeared.

Similarly, the effect of lavatory facilities is statistically significant in univariate analysis only. The univariate analysis reveals that the odds of under age five mortality with children of mothers living with poor toilet facilities are 52% ($p<0.05$; OR=1.52) larger than mortality of children with modern lavatories.

The type of housing floor materials such as modern flooring versus floor with natural earth has shown a strong association with mortality of children in both univariate and multivariate analysis. The results of multivariate results (model 2) indicate that children of mothers residing in poor housing floor is 3.29 times ($p<0.01$) mortality of children with mothers' living in modern flooring house. When the variable housing floor is included in the combined effect model (model 5), its effect on mortality is statistically significant, such that the odds of dying is increased by 170% ($p<0.05$; OR=2.70) for children of mothers living in dirt floor. This result suggested that most Ethiopian households lived in natural floor together with animals in the same home in the country, in particular rural areas; this favors for development of fleas and other organisms, which affects child's health. On the other hand in univariate as well as multivariate analysis, the effect of fuels on mortality of children is not statistically significant though it has positive effect on mortality.

iii. Personal illness control factors

The personal illness control variables such as mother's toxoid immunization and place of delivery have shown relationship on survival chance of children. The effect of mother's immunization on mortality of children has appeared only in univariate analysis. The univariate result reveals that the odds ($p<0.05$; OR=1.39) of morality of children is increased for mothers who did not have tetanus toxoid. Similarly, place of delivery has effect on mortality of children in univariate analysis. The result indicated that mothers having birth at home increased mortality of under age five children by 84% ($p<0.01$, OR=1.84), which is higher than mortality of children with mothers' having birth in health centers/clinics. In addition, the result showed that place of delivery and water supply has an interaction effect. As presented before, the main effects of poor water supply and home delivery increased mortality. Thus, interactions between mothers who had birth at home and used surface water are negatively associated with survival of children, that is, home delivery with dirt water might affect both child's and mother's health with microorganism during delivery. Although, effect of interactions between place of delivery and water supply; interaction between place delivery and place of residence become nonsignificant in combined effect multivariate model. Our proximate regression result indicates that home delivery is one of the causes for under age five mortality in the country. It is recalled that 90% of births take place at home, which may be implemented by untrained delivery assistant and unsafe instruments. This might cause for transmission of tetanus and other organisms to infants and later it leads to under age five mortality.

iv. Nutrient deficiency factor

Among all determining factors, the effect of breastfeeding on under age five mortality is powerful in univariate as well as multivariate analysis. The Multivariate results (model 2) shows that the odds of dying due to exclusive breastfeeding are 30.56 times mortality of

children with breastfeeding ($p<0.01$; OR=30.56. While the combined effect multivariate regression (model 5) indicated that children without breastfeeding are at greater risk for mortality, which died 32.56 times the mortality of children with breastfeeding. It is noted that the value of odds ratio is too large. The possible reasons are the number of observations in never breastfeeding category is too small, which is about 3%; and also the majority of children in never breastfeeding category were not alive, which died about 791 per 1000.

Table 5.4. Results of univariate regressions - proximate determinants models-model 1

Proximate Variables	Constant	Coefficient B	S.e of B	P-value	Odds ratio EXP(B)
Maternal factors					
-Age of mother at birth					
18 to 34 years	Reference			0.412	
Over 34 years	-1.84	0.02	0.17	0.901	1.02
Below 18 years	-1.84	0.31	0.24	0.183	1.37
-Preceding birth Interval					
Over 36 months	Reference			0.001**	
24 to 36 Months	-2.24	0.55	0.18	0.002**	1.74
Below 24 months	-2.24	0.58	0.17	0.001**	1.78
-Parity	-2.16	0.07	0.02	0.003**	1.07
Environmental Factors					
- Source of water					
Piped water	Reference				
Surface water	-2.31	0.58	0.19	0.003**	1.79
-Toilet facilities					
Flush water or pit latrine	Reference				
Bush or field or others	-2.16	0.42	0.18	0.018*	1.52
-Housing floor material					
Modern or improved	Reference				
Natural/earth or others	-3.01	1.27	0.35	0.001**	3.58
-Energy for cooking					
Electricity	Reference				
Fire wood/others	-5.19	3.38	7.79	0.664	29.50
Personal Illness Control factors					
-Place of Delivery					
Health center	Reference				
Home	-2.38	0.61	0.26	0.019*	1.84
-Mother's with tetanus toxoid					
Immunized	Reference				
Not immunized	-1.93	0.33	0.13	0.011*	1.39
Nutrient Deficiency factor					
-Breastfeeding status					
Breastfeed	Reference				
Never breastfeed	-2.00	3.33	0.31	0.001**	28.02

*****Significant for p<0.01*** ****Significant for p<0.05***

Table 5.5. Results of multivariate regression -proximate determinants model –model 2

Proximate variables	Coefficient B	S.e of B	P-value	Odds ratio EXP(B)
Maternal factor				
Preceding birth Interval				
Over 36 months	Reference		0.002**	
24 to 36 Months	0.42	0.19	0.024*	1.52
Below 24 months	0.63	0.18	0.001**	1.88
Number of children (party)	0.08	0.03	0.002**	1.08
Environmental factor				
Source of water				
Piped water	Reference			
Surface water	1.63	0.62	0.008**	5.20
Toilet facilities				
Flush water or pit latrine	Reference			
Bush or field or others	-0.06	0.22	0.763	0.94
Housing floor material				
Modern or improved	Reference			
Natural/earth or others	1.19	0.42	0.005**	3.29
Personal illness control factors				
Place of Delivery				
Health center	Reference			
Home	0.96	0.54	0.074	2.62
Mother's with tetanus toxoid				
Immunized	Reference			
Not immunized	0.14	0.14	0.32	1.15
Nutrient Deficiency				
Breastfeeding status				
Breastfeed	Reference			
Never breastfeed	3.420	0.328	0.001**	30.56
Place of delivery by water supply				
Delivery clinic with piped water	Reference			
Delivery home with river water	-1.615	0.643	0.012*	0.199
Constant	-4.899	0.563	0.001**	

*****Significant for p<0.01*** ****Significant for p<0.05***

5.5.2 Results of socioeconomic determinants

The results of univariate, multivariate socioeconomic and multivariate combined effect models are presented in Table 5.6, Table 5.7 and Table 5.8, respectively. These regression results answered our third research questions, namely, what are the socioeconomic factors or indirect factors that contribute to under age five mortality?

i. Individual level factors

The effect of maternal education has shown a strong relationship with under age five mortality in the univariate as well as multivariate results. When controlling all socioeconomic factors in multivariate analysis, odds of dying are changed and increased in magnitude. This multivariate result shows that the odds of children of mothers with no education are 7 times ($P<0.01$; OR =7.23) as likely to die as more children of mothers with secondary or higher level of education. The result shows that mothers with elementary education have no statistical relationship with mortality in all analysis. On the other hand, when mothers' education added to combined effect model, the coefficients of education become nonsignificant. In the socioeconomic multivariate model, we found that mothers level of education and place of residence have interaction effect on mortality, which depicts that mothers with no education and living in rural area have a negative impact on survival chance of under age five children. However, interaction of education with water supply and place of residence did not appear to be significant in combined effect mode 5.

Besides, the univariate analysis and multivariate analysis revealed that preference of child sex is statistically significant on under age five mortality. The socioeconomic multivariate analysis indicated that because of female preference, the odds of mortality of boys are 45% ($p<0.01$; OR=1.45) higher than mortality of girls. We found same odds in the combined effect multivariate analysis. These strong relationships indicate that Ethiopian mothers have more cared or feed for female child than male child.

The effect of mothers working area on under age five mortality is statistically significant in both multivariate analyses. The socioeconomic multivariate result documented that the odds of mortality of children for mothers working far away from home are 41% ($p<0.01$; OR=1.41) higher than children of mothers working within home. In the combined multivariate model, the odds are slightly increased for mothers working far away from home, which is 48% higher than mothers working within home. In contrast, the effect of mother's ethnicity and mother's religion did not appear statistically significant but have larger percent of odds of mortality.

ii. Household level factor

This study attempted to find the impact of exposure of radio messages on survival chance of children. We found that under age five mortality and mother's access to information through radios is nonsignificant in univariate analysis. However, the odds of under age five mortality with children of mother's without exposure to radios is in the expected

direction, that is, it raised the odds of dying by 23% ($p<0.15$; OR=1.23) compared to children of mother's access to radio messages.

iii. Community level factors

The mortality differentials between urban and rural areas are nonsignificant in multivariate analyses. Instead we observed the relationship in univariate analysis. The univariate analysis indicated that living in rural areas proved disadvantageous, raising the odds of under age five mortality by 62% ($p<0.05$; OR=1.62) as compared with urban areas. This result clearly showed that rural households live with low access to safe water, low health facilities, in general, low access to infrastructures in all part of the country.

Similarly, the effects of regional mortality differentials have shown statistical relationship in univariate analysis for some regions. The effect of mothers living in Tigray region, Amhara region, Oromia region, Benshangul region, Gambella region and Dire Dawa region increased the odds of under age five mortality by 211 % ($p<0.05$; OR=3.11), 251% ($p<0.01$; OR=3.51), 230% ($p<0.01$, OR=3.30), 311% ($p<0.01$; OR=4.11) and 251%($p<0.01$; OR=3.51) and 243% ($p<0.05$; OR=3.43), respectively. However, when we include region variable in multivariate analyses (model 4 and model 5), we observed that the effect of regions are statistically insignificant.

Table 5.6. Results of univariate regressions - socioeconomic determinants models –model 3

Socioeconomic Variables	Constant	Coefficient B	S.e of B	P-value	Odds ratio EXP(B)
Mother's education					
Secondary or higher	Reference			0.001**	
Elementary	-2.99	0.70	0.47	0.136	2.01
No education	-2.99	1.30	0.42	0.002**	3.66
Place of residence					
Urban	Reference				
Rural	-2.23	0.48	0.19	0.012*	1.62
Region					
Addis Ababa	Reference			0.093	
Tigray	-2.89	1,13	0.50	0.022*	3.11
Afar	-2.89	0.70	0.54	0.198	2.01
Amhara	-2.89	1.26	0.48	0.009**	3.51
Oromia	-2.89	1.20	0.48	0.013*	3.30
Somali	-2.89	1.00	0.52	0.053	2.72
Benshangul	-2.89	1.41	0.50	0.005**	4.11
Souther Nation	-2.89	0.95	0.49	0.053	2.58
Gambela	-2.89	1.26	0.53	0.018*	3.51
Harai	-2.89	0.48	0.58	0.404	1.62
Dire Dawa	-2.89	1.23	0.53	0.020*	3.43
Preference of child sex					
Female	Reference				
Male	-2.02	0.38	0.13	0.003**	1.46
Religion					
Christian	Reference			0.456	
Muslim	-1.88	0.16	0.13	0.224	1.17
Other faith	-1.88	0.17	0.34	0.616	1.18
Ethnicity					
Amhara ethnic	Reference			0.862	
Oromo ethnic	-1.85	0.12	0.17	0.470	1.13
Tigre Ethnic	-1.85	-0.01	0.23	0,975	0.99
Others	-1.85	0.01	0.16	0.935	1.01
Access to information					
Listening Radio	Reference				
No access to listen radio	-1.96	0.21	0.14	0.150	1.23
Mother's working area					
Within home	Reference				
Outside home	-2.02	0.35	0.13	0.006**	1.43

Significant for p<0.01 *Significant for p<0.05

Table 5.7. Results of multivariate regression - socioeconomic determinants model- model 4

Socioeconomic Variables	Coefficient B	S.e of B	P-value	Odds ratio EXP(B)
Mother's education				
Secondary or higher	Reference		0.001**	
Elementary	0.68	0.75	0.360	1.98
No education	1.98	0.63	0.002**	7.23
Place of residence				
Urban	Reference			
Rural	1.557	0.874	0.07	4.74
Region				
Addis Ababa	Reference		0.304	
Tigray	0.70	0.54	0.197	2.01
Afar	0.33	0.59	0.582	1.38
Amhara	0.84	0.53	0.112	2.32
Oromia	0.92	0.53	0.083	2.50
Somali	0.70	0.56	0.214	2.00
Benshangul	1.03	0.55	0.062	2.79
Souther Nation	0.63	0.54	0.241	1.88
Gambela	1.02	0.57	0.073	2.77
Harai	0.31	0.60	0.605	1.37
Dire Dawa	0.99	0.55	0.072	2.70
Preference of sex of child				
Female preference	Reference			
Male preference	0.37	0.13	0.004**	1.45
Mother's place of work				
Within home	Reference			
Outside home	0.34	0.14	0.013*	1.41
Mother's Education by place of residence				
Secondary /higher with urban area			0.039*	
Elementary with rural area	-0.978	1.010	0.333	0.376
No education with rural area	-1.907	0.894	0.033*	0.149
Constant	-4.430	0.738	0.001**	

*****Significant for p<0.01*** ****Significant for p<0.05***

Table 5.8. Results of proximate and socioeconomic determinants multivariate regression model (combined effect model)-model 5

Variables	Coefficient B	S.e of B	P-value	Odds ratio EXP(B)
Proximate factors				
-Preceding birth Interval				
Over 36 months	Reference		0.001**	
24 to 36 Months	0.50	0.19	0.009**	1.64
Below 24 months	0.70	0.19	0.001**	2.01
-Parity	0.15	0.08	0.053	1.17
Environmental Factors				
- Source of water				
Piped water	Reference			
Surface water	1.99	1.37	0.147	7.30
-Toilet facilities				
Flush water or pit latrine	Reference			
Bush or field or others	-0.03	0.23	0.896	0.97
-Housing floor material				
Modern or improved	Reference			
Natural/earth or others	0.99	0.45	0.027*	2.70
Personal Illness Control factors				
-Place of Delivery				
Health center	Reference			
Home	0.81	0.58	0.162	2.24
-Mother's with tetanus toxoid				
Immunized	Reference			
Not immunized	0.19	0.15	0.216	1.21
Nutrient Deficiency factor				
-Breastfeeding status				
Breastfeed	Reference			
Never breastfeed	3.48	0.34	0.001**	32.56
Socioeconomic factors				
Mother's education				
Secondary or higher	Reference		0.059	
Elementary	0.26	0.96	0.790	1.29
No education	1.51	0.86	0.079	4.53
Place of residence				
Urban	Reference			
Rural	1.41	1.32	0.284	4.10

"Table 5.8 continued"

Variables	Coefficient B	S.e of B	P-value	Odds ratio EXP(B)
Region				
Addis Ababa	Reference		0.380	
Tigray	-0.06	0.63	0.925	0.94
Afar	-0.42	0.68	0.537	0.66
Amhara	0.24	0.62	0.703	1.27
Oromia	0.17	0.62	0.777	1.19
Somali	-0.08	0.65	0.906	0.93
Benshangul	0.34	0.64	0.596	1.40
Souther Nation	-0.04	0.63	0.943	0.96
Gambela	0.45	0.66	0.492	1.57
Harai	-0.23	0.70	0.746	0.80
Dire Dawa	0.54	0.63	0.395	1.71
Preference of sex of child				
Female preference	Reference			
Male preference	0.37	0.14	0.007**	1.45
Mother's place of work				
Within home	Reference			
Outside home	0.39	0.15	0.010**	1.48
Interaction Terms				
Mother education by place of residence				
Secondary/higher with urban area	Reference		0.658	
Elementary with rural area	0.07	1.44	0.959	1.08
No education versus rural area	-0.64	1.26	0.608	0.52
Mother education by water supply				
Secondary/higher with piped water	Reference		0.649	
Elementary with river/surface water	-0.75	1.50	0.618	0.47
No education with river/surface water	-1.14	1.31	0.385	0.32
Water supply by place of delivery				
Piped water with health/clinic delivery	Reference			
River/surface water with home delivery	-0.87	0.83	0.23	0.42
Parity by place of residence				
Parity with urban area	Reference			
Parity with rural area	-0.01	0.08	0.25	0.91
Place of residence by place of delivery				
Urban area with health center delivery	Reference			
Rural area with home delivery	-0.77	0.80	0.33	0.46
Constant	-6.555	1.025	0.001**	

***Significant for p<0.01** ***Significant for p<0.05**

CHAPTER VI DISCUSSION AND CONCLUSIONS

The advantage of studying on under age five mortality is to assess health development, mortality conditions and social wellbeing of the country. Unluckily 500,000 Ethiopian children die of preventable diseases and malnutrition annually, as estimated by concerned agencies. The first round 2000 Ethiopian Demographic and Health survey results documented that Ethiopia has recorded highest under age five mortality, which is estimated at 166 per 1000. Similar studies by UN in 1988 showed that under age five mortality will continue in the pace of high rate until the period 2020-2025, which makes the country the highest position in the world. Thus, Ethiopia is in hard track to reach the two-third reduction of under age five mortality of the Millennium Development Goals.

The main objectives of this study are to examine and differentiate the important influences of proximate and socioeconomic determinants on mortality of under age five children by addressing three basic research questions, namely "How the probabilities of survival and dying looked for under age five children across in the country?"; "Which proximate determinants or direct factors influence under age five mortality? " and "What are the socioeconomic factors or indirect factors that contribute to under age five mortality? "

To answer the research questions, we used the Mosley and Chen (1984) theoretical framework, which encompasses set of proximate factors such as (maternal factors, environmental contaminating factors, personal illness control factors and nutrient deficiency factors) and socioeconomic determinants such as (individual level factors, household level factors and community level factors).

The data of the first round 2000 Ethiopian Demographic and Health survey were used as material for addressing our research questions. In addition, we applied statistical models to investigate influential factors on under age five mortality. These statistical techniques are the Kaplan-Meier methods and multiple logistic regression analysis. In order to carry out these analyses we considered the March 1995 birth cohort children.

The results of descriptive statistics suggest a close under age five mortality differentials within each category of proximate determinants and socio economic factors. However, the univariate and multivariate analysis show that mortality differences on these determining factors are considerably vary. To understand the major findings of the study we have discussed the results separately under each research questions as follows.

Research question 1. How the probabilities of survival and dying looked for under age five children across in the country?

Our first research question involved the survival and hazard probabilities of under age five children across country. The Kaplan-Meier results reveal that the highest probability of dying is observed at infancy period (less than one year), which estimated to be about 0.098 for male and 0.08 for female children. These proportions of dying are extremely higher as compared with the Mosley and Chen (1984) premises, which stated that the probability of

dying for newborn babies to be less than 3% or survival probability to be more than 97% through the first five years of life. The result showed that girls have the highest survival probabilities as compared to boys in the country. In addition, we found that the median survival times of under age five male and female children are 5 months and 10 months, respectively. When considering both sexes, the 50% expected survival time of under age five children is estimated around 7 months.

Research question 2. Which proximate determinants or direct factors influence under age five mortality?

Our second research question concerned identification of proximate determining factors on under age five mortality. The logistic univariate and multivariate results indicated that most components of maternal factors, environmental contaminating factors, personal illness control factors and nutrient deficiency factor have shown a statistical relationship with under age five mortality.

i. Maternal factors:

Maternal age at birth, surprisingly, did not appear statistically significant in univariate as well as multivariate analysis. The possible reason for nonsignificant result could be age of mothers and survival status of children might be reported inconsistently in DHS data or it could be related to errors in age reporting. However, the odds of dying indicated in the expected direction, that is, teenage mothers below 18 years ($p<0.2$; OR=1.37) and old age mothers ($p<0.9$; OR=1.02) were more liable to under age five mortality. Therefore, our result is not consistent with findings of several researchers in vulnerability of teenage mothers and old age mothers on under age five mortality (e.g. Agha, 2000 in Pakistan; UN; 1994 in 25 DHS countries; Rutstein, 2000 of 56 DHS countries). On the other hand, our result contradict the priori expectation of this analysis, that is, teenage mothers are at greater risk to have under age five mortality as compared to mothers with the primary reproductive age group (18 to 34 years).

The effect of high total fertility rate contributes to high under age five mortality rate in Ethiopia. Thus, the proximate multivariate analysis showed that high birth orders have a strong statistical relationship with mortality of children. The result indicates that after controlling other factors, a unit increase in birth order raised the mortality of under age five children by 8%. When controlling proximate and socioeconomic factors into multivariate model, the effect of parity disappeared. This finding is in line with our hypothesis that as a woman increases birth order, under age five mortality increases too. Similarly, it confirms the findings of Ross and Frankenberg (1993) of 25 DHS countries.

The analyses of proximate multivariate regression and combined effect proximate and socioeconomic multivariate regression documented that preceding birth interval has a strong statistical association with under age five mortality. The proximate multivariate result revealed that the odds of dying in short birth intervals (below 24 months) is 88% higher than mortality of children from long birth intervals (over 36 months), whereas the odds of mortality in birth interval 24-36 months is lower than that of short birth intervals,

which is 52%. In combined effect proximate and socioeconomic multivariate model, the odds of dying in short birth interval and 24-36 months interval increased by 101% and by 64%, respectively. The possible mechanism for association of short birth interval and mortality of children is that short birth spacing depletes maternal reproductive system and nutritional status such as protein, calories and iron (Boerma and Bicego, 1992; Sweemer, 1984; Pebley and Millman, 1986; Miller, 1991). Our result is similar with findings of Agha (2000) in Pakistan and UN (1994) in 25 DHS countries . Moreover, this result confirms our hypothesis that children born with short preceding birth interval have excess under age five mortality than children born with long preceding birth interval.

ii. Environmental contaminating factors:

The environmental contaminating factors revealed that source of water affected under age five mortalities in proximate multivariate analysis. Thus, the result showed that the odds of under age five mortality increased by 420% for those who drink surface water as compared to those who used piped water. Similarly, the univariate analysis indicated that children of mother without lavatory facilities had 52% higher odds of dying than those with modern lavatories. These results are consistent with findings of Martin et al (1983) in Philippines, Pakistan and Indonesia; Agha (2000) in Pakistan and Alma and Islam (1998) in Bangladesh.

The effect of housing floor is statistically significant in both proximate multivariate analysis and combined effect proximate and socioeconomic multivariate analysis. The proximate multivariate result indicated that the odds of dying raised by 229% while in combined proximate and socioeconomic model, the odds of dying increased by 170% for children of mother's living in rudimentary flooring. These strong statistical relations appeared due to the fact that most households in particular, rural people live in natural floor together with animals. This might contaminate living environment, which could in turn affect child's health. We found the impact of fuel on mortality to be nonsignificant. The possible reason for this insignificant could be the sample size for use of electricity category is too small.

According to WHO (2004) recommendation's; cholera, dysentery, guinea worm, typhoid, intestinal worms and many others operate through polluted environmental factors to affect health of under age five children. Therefore, both the univariate and multivariate results are in line with our hypothesis except effect of electricity, which stated that most Ethiopians have used unhygienic water, low coverage of electricity, poor lavatories and housing, thus it was expected that children living in these poor facilities and amenities are more likely to die than children living in better living conditions.

iii. Personal illness control factors:

The impacts of place of delivery and mother's immunization with tetanus toxoid have independent effect on under age five mortality, that is, these risk factors are significantly associated in univariate analysis only. Thus, our results showed that the odds of dying due to home delivery raised by 84% and non use of tetanus toxoid increased by 39%. Our

proximate regression result indicates that home delivery is one of the causes for under age five mortality in the country. The possible explanation is that most births occurred at home, which may be implemented by untrained delivery assistant and unsafe instruments. This facilitates for transmission of tetanus and other organisms to infants and caused to under age five mortality. It is noted that we have no a priori expectation about effect of personal illness control factors on under age five mortality.

iv. Nutrient deficiency factor:

The only available variable to measure effect of nutrient deficiency on under age five mortality is duration of breastfeeding. Breastfeeding is an important variable for survival of children as well as increasing birth spacing. Our multivariate results reveal that never breastfeed child has the highest odds of mortality, which amounted about more than 30 times mortality of children with breastfeeding. The largest odds results could be due to small number of observations in never breastfeeding category; and highest mortality rate occurred for never breastfed child (791 per 1000). This result proves the argument of Huffman and Lamphere (1984), that is, breastfeeding is the main source of nutrient foods as well as anti-infective character of infant and child from pathogens. In addition, our finding confirmed our expectation and recommendation of several well documented researches on effect of breast feeding on survival of children (e.g. UNICEF and others, 2002).

Research question 3. What are the socioeconomic factors or indirect factors that contribute to under age five mortality?

Under this research question we focused on individual level factors, household level factors and community level factors to assess impacts on under age five mortality. Most variables in each factor have shown a significant association with under age five mortality.

i. Individual level factors:

The socioeconomic variable, maternal education had an independent as well as joined effect on survival of children. Our socioeconomic multivariate result documented that level of maternal education had a major influence on survival chance of children, that is, as level of education rises, under age five mortality is relatively reduced. Thus, the multivariate analysis indicated that the odds of mortality of children with no education mothers are more than 7 times that of children of mothers with secondary or higher education. Our result showed that education can change mother's attitude towards care of her child, that is, appropriate feeding, visiting health centers, keeping the living environment more hygienic and many others. This result is also consistent with findings of several studies (e.g. Agha, 2000 in Pakistan, Alam and Islam, 1998 in Bangladesh and Martin et al, 1983 in Pakistan, Philippines and Indonesia). In addition, this finding confirms our hypothesis, that is, children born to educated mothers have lower risk of mortality than children born to mothers of low level education.

The impact of gender preference on under age five mortality has shown a statistical significance in both multivariate analyses. The socioeconomic multivariate result as well as combined effect proximate and socioeconomic multivariate result showed that the odds of dying increased by 45% for boys which is higher than mortality of girls. This result indicates that girls are advantageous in feeding, medical treatment or better care. Therefore our results confirmed our hypothesis that because of bride interest and home assistance, girls are preferred to boys; as result girls are more likely to survive than boys. We found a similar result with studies of several researchers, for instance, Agha (2000) in Pakistan, Rutstein, 2005 in 17 DHS countries and Ali et al, 2000 in Ethiopia.

Similarly, we found influences of maternal working area on mortality in both multivariate analyses. The socioeconomic multivariate result showed that the odds of under age five mortality with mothers working far away from home increased by 39% as compared to mortality of children with mothers working within home. The effect of working area increased in combined effect proximate and socioeconomic multivariate results, which raised odds of mortality by 48%. The possible reasons could be most mothers work in agricultural activities farm away from home, as a result their children cared with elder siblings or old aged/disabled/ relatives or neighbors. On the other hand, we have no statistical evidence to accept the effect of mother's ethnicity and mother's religion on under age five mortality.

ii. Household level factor

Our study focused on examining effect of radio messages on survival chance of under age five children. However, mother's access to information through radios did not have statistically significant relation to mortality. This might be the majority of mothers did not have radio to listen health related information

iii. Community level factors

The mortality differentials between urban and rural areas as well as regions had shown some statistical relationship in univariate analysis. When urban-rural and region variables were included in multivariate analyses (after controlling other variables), their effects were eliminated. Therefore, the univariate analysis indicated that under age five mortality is very high in rural areas, which is 62 % higher than mortality of children in urban areas. This result documented that rural households live with rudimentary life style such as use of low access to safe water, low health facilities, in general, low access to infrastructures in all parts of the country. Therefore, our result is consistent with studies of Alam and Islam (1998) in Bangladesh, UN (1985) in 15 developing countries and Hobcraft et al (1984) in 28 World fertility survey. In addition our expected hypothesis is confirmed with this finding.

Similarly, univariate results show that living in some regional states are disadvantageous for under age five children, which increased mortality by 211%; 251%; 230%; 311%; 251% and 243% in Tgray region, Amhara region, Oromia region, Benshangul, Gambella region and Dire Dawa, respectively. The possible reasons could be some of these regions

are draught prone areas, highly populated and affected with malaria; and others (Gambella and Benshangul) are backward in modern infrastructures.

In sum, the univariate and multivariate results suggested that most proximate determinants and socioeconomic factors are strongly associated with under age five mortality. The highest mortality of under age five children is observed through infancy periods/ neonates, post neonatal or infants/. Thus, we suggest that further research is essential to examine the causes of highest mortality at infancy period by incorporating other risk factors such as birth weight, preterm birth, asphyxia, prenatal care, infections, and many others. At last, appropriate policies such as health and family planning as well as education interventions are required for the above influential factors to improve survival chances of under age five children in the country. In particular, we recommended the following preventable risk factors to have some form of policy interventions.

1. Among the maternal factors short birth interval and high parity are accountable for under age five mortality. To reduce these effects strong family planning programs such as contraception and Information Education and Communication (IEC) services should be provided at grass root levels.
2. Of the environmental contaminating factors- use of surface water, poor toilet facilities and living in dirt floor influence survival chances of under age five children. To minimize these factors, health policy or health education is essential at household as well as community level.
3. The personal control factors such as home delivery and pregnancy without tetanus toxoid contribute to under age five mortality. Therefore, providing training to traditional birth attendants, health education and family planning issues are important to save lives of children.
4. We found breastfeeding as an important factor for survival of children. Children without breastfeeding died more than children who had breastfeeding. Therefore, addressing family planning services and health information system to mothers will increase her knowledge to feed breast milk for at least six months (as recommended by UNICEF and other International Organizations).
5. We found that children born to mothers having low level of education are susceptible to under age five mortality. Since education is a key influential factor to reduce under age five mortality, it is recommended that mothers should be educated. This can be done through adult literacy campaigns.
6. We found excess under age five mortality in rural areas. Therefore, it is recommended to increase coverage of adult education (as recommended in 5) in rural areas that will improve knowledge of rural mothers to apply primary health care programs. In addition, expanding basic infrastructures such as access to pure water and health service provisions to rural areas will contribute to reduce level of under age five mortality.

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