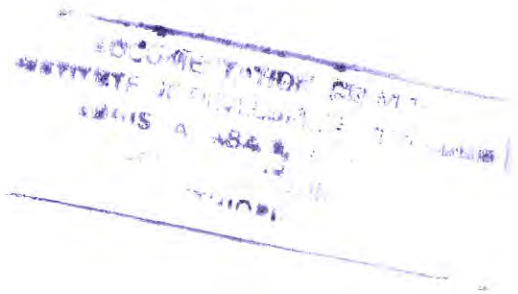
ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

DETERMINANTS OF CHILDHOOD MORTALITY IN SOUTHERN NATIONS, NATIONALITIES AND PEOPLES REGIONAL STATE (SNNPRS)

BY:
SELAMAWIT MUSSIE



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A THESIS SUBMITTED TO:
THE SCHOOL OF GRADUATE STUDIES
ADDIS ABABA UNIVERSITY

IN PARTIAL FULFILMENT OF THE REQIURMENTS
FOR THE DEGREE OF MASTER OF SCIENCE IN
POPULATION STUDIES

JULY 2007

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

Determinants of Childhood Mortaloty in Southern Nations, Nationalities and Peoples Regional State (SNNPRS): An Analysis of the 2005 Ethiopian Demographic and Health Survey

By

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Dedicated to My Late Mother W/ro SENAYIT AGONAFIR

ACKNOWLEDGMENT

I would like to thank and express my appreciation to several people who helped and guided me to bring this study to completion.

I gratefully acknowledge my advisor Dr. Assefa Hailemariam for his expert guidance, invaluable comments and provision of important reference materials that are useful for this work. I owe much to his wisdom, commitment and limitless support throughout my graduate studies.

I would like to express my appreciation to staff members of Central Statistics Agency, particularly for Ato Dawit Getnet and Ato Mekonnen Tesfaye for their material and technical support. I would also like to thank Dr Habtamu Belete for his contribution through reading and commenting the first draft. I am also grateful to all the staff members of Population Studies and Research Centre of the Addis Ababa University, especially W/ro Sara Eyassu for her kindness and continuous encouragement.

My special thanks goes to my beloved husband Dr. Asfawossen Asrat, without whose support, encouragement and love, I would not have been able to pursue this program.

I would also like to express my heartfelt appreciation to my father, Mussie Mekonnen, my brothers (Yishake Mussie and Henok Wondimu) and my sister Etsegenet Mussie for their wholehearted moral support, inspirations and encouragement throughout the completion of my study.

I am also grateful to all my friends for their continuous moral support throughout my graduate studies.

Last but not least, my inner most gratitude will be to the One Almighty God for everything he has done.

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ACRONYMS

AIDS: Acquired Immunodeficiency Syndrome

CMR: Child Mortality Rate
CSA: Central Statistics Agency

EDHS: Ethiopian Demographic Health Survey

HIV: Human Immunodeficiency Virus

IMR: Infant Mortality Rate

MDG: Millennium Development Goals

MOH: Ministry of Health

PSRC: Population Studies and Research Center, Addis Ababa University

SNNPRS: Southern Nations and Nationalities Peoples Regional State

TBA: Traditional Birth Attendant

TTBA: Trained Traditional Birth Attendant

UN: United Nations

UNDP: United Nations Development Programme

USAID: United States Agency For International Development

WFS: World Fertility Survey

WHO: World Health Organization

ABSTRACT

Reduction of under-five mortality is one of the millennium development goals. Over the past two decades the level of infant and child mortality has been declining in Ethiopia. Nevertheless, it continues to be among the highest in the world. A substantial difference in the level of childhood mortality has also been observed among regions of the country. In-depth understanding of the levels, trends, differentials and determinants of childhood mortality is, therefore, crucial in any attempt to attain the goal of reducing infant and child mortality level through any kind of intervention. In this regard, this study examines the determinants of infant and childhood mortality in the Southern Nations Nationalities and Peoples Regional State (SNNPRS) of Ethiopia.

The main objective of this study is to assess the effects of socioeconomic, demographic, maternal health care and environmental factors on infant and child mortality. Data for the study were drawn from the 2005 Ethiopian Demographic and Health Survey. A total of 1,730 children born in the past five years preceding the survey were used as a unit of analysis. Cox Proportional hazard model regression analysis was used to estimate the net effects of each of the covariates included in the model.

The study reveals that the demographic variables are important in determining child survival in the region and the risk of mortality is high for births with short preceding birth interval (<2 years), short duration of breastfeeding (<6 months), births to young women (<20 years) and first and higher order births. Survival status of the previous child at the birth of the index child is also found to have an effect on infant mortality. From the socioeconomic factors, maternal education, marital status, toilet facility and ethnicity show slight impact in determining infant and child mortality in the region, though their independent effect is not statistically significant.

Policy focus should be on promotion of breastfeeding and improvement of family planning programs in order to increase birth interval length and reduce both childhood mortality and fertility in the region.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

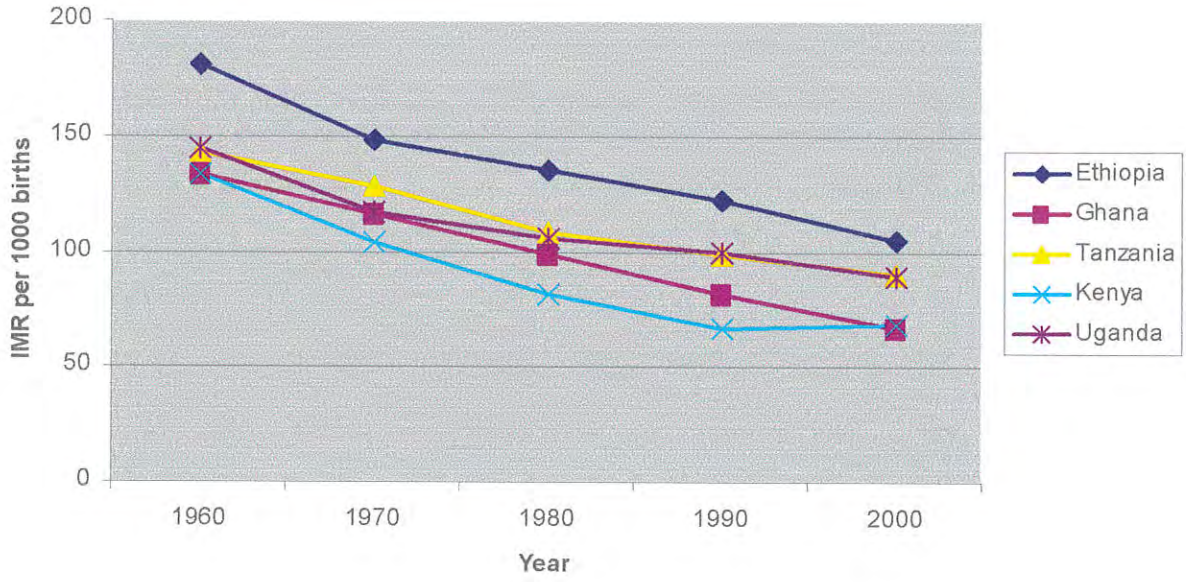
Child survival is one of the most sensitive indicators of human welfare, the comparative health of nations and the effectiveness of public policy. Reduction of infant and child mortality rate is not only a major goal but also an important strategy to achieve health for all.

Mortality among infants and children has been declining in most developing countries from the mid 1980s and throughout the 1990s. A comparative study based on Demographic and Health Survey (DHS) data on childhood mortality in developing countries revealed that under-five mortality has been declining in most Asian and Latin American countries since 1980 (Mahy, 2003). However, this decline has recently slowed, stopped, or reversed itself in some countries in sub-Saharan Africa. For instance, Zimbabwe, Zambia, Kenya, and Cote d'Ivoire experienced a significant increase in under-five mortality, much of which is related to the increasing prevalence of HIV/AIDS in the population (Adetunji, 2000).

One of the Millennium Development Goals is the reduction of under-five mortality by two-thirds between 1990 and 2015 (UN, 2000). Although there has been a substantial reduction in infant and child mortality rates in most developing countries in the recent past, child mortality remains a major public health issue in developing countries where it is estimated that over 10 million preventable child deaths occur annually (WHO, 2005). Sub-Saharan Africa is the region most affected and accounts for more than one-third of deaths of children under the age of five (Hill et al., 1999).

Figure 1 shows the variation in infant mortality rates for some Sub-Saharan African countries between 1960 and 2000 using the United Nations estimates (UN, 2006). The infant mortality level estimated for each country considered shows a declining trend except in Kenya. Despite the declining trend, the level of infant mortality in Ethiopia is the highest as compared to the other countries considered. An investigation of the level of under-five mortality during the same period in these countries also revealed that the rate is higher in Ethiopia.

Figure 1. Trend in Infant Mortality Rate (IMR) for some Sub-Saharan African countries.



Infant and under-five mortality in Ethiopia has continued to decline over the past 25 years with a more pronounced reduction in the last decade. Yet, overall infant and under five mortality rates remain very high: between 1995 and 2000, almost one in every ten newborns (97 per 1000) did not survive to celebrate its first birthday, and one in every six children (166 per 1000) died before its fifth birthday (MOH, 2004). According to the EDHS (2005), fifteen years ago 95 out of 1000 infants die before celebrating their first birthday. By 2005 this number dropped to 77; reflecting an improvement of 18 infants per every 1000 live birth in 15 years. During the same period under five mortality has improved by 25 percent; as the rate per one thousand live births declined from 166 in 1990 to 123 in 2005.This indicates that the pace of improving infant and child mortality in Ethiopia is very slow. At current mortality levels, one in every thirteen Ethiopian children dies before reaching age one, while one in every eight does not survive to the fifth birthday (CSA and ORC Macro, 2006).

1.2 Problem Statement

Given the slow pace of improvement in infant and child mortality, in order to reach the child survival MDG target by 2015, Ethiopia would have had to reduce under-five mortality at the rate

of 5.2 per 1000 live births each year since the beginning of the 1990's. However, between 1990 and 2000, the rate of decrease of under-five mortality has only been less than 2 per 1000 live births per year. Ethiopia would, therefore, have to reduce child mortality by 7.4 per 1000 live births per year between 2003 and 2015 in order to achieve the MDG goal in question (World Bank and MOH, 2004). This task would be very challenging given past trends as well as major unmet needs for child survival in Ethiopia. In-depth understanding of the levels, trends, differentials and determinants of childhood mortality is, therefore, crucial in any attempt to attain the goal of reducing infant and child mortality level through any kind of intervention.

There is substantial difference in child mortality rates in the country. Under-five mortality rate ranges from the lowest 72 per 1000 live births in Addis Ababa to the highest 157 per 1000 live births in Benishangul-Gumuz. The next higher mortality rates in the country are registered in the Amhara, Gambella and the SNNPRS regions, decreasing in that order (CSA and ORC Macro, 2006).

Over the last decade a number of studies have been conducted to understand the determinants of infant and child mortality in Ethiopia (e.g., Gashaw, 1996; Assefa and Mekonnen, 1997; Girma, 2001; Gulteneh, 2001; Mekonen et al., 2001; Messay, 2006). However, the lack of pertinent and sufficient data at national level limited the study. As a result, some of the studies had to rely on old data sources (Girma, 2001), while others have been limited to a smaller geographical unit (e.g., rural or urban setting; Assefa and Mekonnen, 1997), or had to consider a limited number of variables (Gulteneh, 2001). In addition, the determinants of infant and child mortality are not static and they vary with geographical location and they change overtime. This study, therefore, aims at addressing child mortality in the SNNPRS, using the 2005 Ethiopian Demographic and Heath Survey data.

The 2005 EDHS data indicates that under-five mortality is 142 deaths per 1000 live births in the Region and infant and child mortality are 85 and 63 deaths per 1000 live births, respectively. Comparison of the mortality estimates from the 2000 and 2005 demographic and health surveys show that infant and child mortality in the region has declined by 25 and 28 percent (from 113 to 85 and 88 to 63), respectively, for the 10-year period preceding the surveys. The decline in both infant and child mortality rate is lower as compared to that in the other regions except Amhara and

Benishangul- Gumuz. However, the decline in infant mortality is better than that at the country level.

The major reason for choosing SNNPRS as a study site is that there has been little research on the determinants of infant and child mortality in the region and the existing studies are limited to small-scale projects (Shamebo et al., 1993; Abera, 2006). Though an attempt was made by Markos and Eshetu (2002) based on the 1997 community and family survey data in southern Ethiopia, they paid special focus to breastfeeding and birth interval effects on child survival. The other reason is, despite the declining trend, the region is characterized by high infant and child mortality. Moreover, the prominent ethnic, linguistic, cultural and religious diversity makes the region an ideal setting to explore how these diversities influence infant and childhood mortality, since diversities are important for deciding on the right mix of child survival interventions. The overall goal of this study is, therefore, narrowing the gap in our current understanding of the determinants of infant and child mortality in the SNNPRS.

1.3 Significance of the study

In developing countries, where infant and child mortality are still relatively high, adopting effective intervention strategies and providing appropriate heath care could avoid the large majority of infant and child deaths.

Any attempt to attain the goal of reducing infant and child mortality level through different kind of intervention requires adequate knowledge of the problem and factors that contribute to the problem. In line with this goal, the present study has attempted to identify the major determinants of infant and child mortality in SNNPRS. The findings of the study are expected to contribute to development projects concerned with maternal and child health care in Ethiopia. It will also serve as a source of information for interested researchers who need to conduct further studies in the area.

1.4 Objective of the Study

The general objective of the study is to examine the effects of socioeconomic, demographic, maternal health care, and environmental factors on infant and child mortality in SNNPRS.

The specific objectives of the study are to:

1. assess the relative influence of demographic and socio-economic factors on infant and child mortality;
2. assess the relationship between maternal factors and infant and child mortality; and
3. suggest policy recommendation based on the study results for the region.

1.5 Review of Related Literature

The various socioeconomic, environmental, cultural as well as demographic factors affecting infant and child survival are identified and studied by different researchers. Literature related to the determinants of infant and child mortality are reviewed in this section.

1.5.1. Biodemographic Determinants in Childhood Mortality

Differences in mortality levels by biodemographic characteristics of the child and mother have been demonstrated in many studies (e.g., Bicego and Ahmed, 1996; Sullivan et al., 1994, Rutestein, 1983).

Demographic factors can basically be divided into two: maternal and child factors. Maternal factors are those affecting the health of the mother to the extent of exposing her offspring to a higher risk of death. These are the age of the mother at birth, the birth interval, the birth order of the child and survival status of the preceding child. Child factors refer to the sex of the child, age of the child, multiplicity of birth, and birth weight.

1.5.1.1 Maternal Age at Birth

Birth orders and maternal age at birth are strongly related .The relationship, however, varies across socio-cultural settings depending on levels and age patterns of fertility (Sullivan et al., 1994). For most countries, the relationship between mother's age at birth and level of infant mortality risk exhibits a U-Shaped curve. When women give birth at young age, they are at increased risk of complications and the child is at an increased risk of low birth weight and prematurity. When women give birth at older age, they are more likely to have pregnancy complications, and the baby is more likely to have birth defects, which increases the risk of dying in early childhood. In addition, the risk to children born to older women is often increased because of higher parity.

A comparative study conducted on childhood mortality in the developing world based on DHS data exhibits the expected U-Shaped relationship between mothers' age and childhood mortality in most of the countries (Mahy, 2003). In this study, mothers' age appears to have the greatest impact in the first month of life. On average, infants born to mothers under the age of 20 are 45 percent more likely to die during the first month of life than infants born to mothers age 20 to 29; and infants born to women age 40 to 49 are 30 percent more likely to die in the first month of life (Mahy, 2003). Hobcraft (1993) also demonstrated that children born to very young mothers are at a higher risk of mortality, even after controlling the effect of other variables.

Studies conducted in Ethiopia similarly show the strong relationship between mothers' age at birth and chances of infant survival. A study conducted in Sebeta town, for instance, revealed that infants born to mothers under 20 years of age had a significantly higher risk of dying (84%) compared to those born to mothers aged 20-34 years. Infants born to older mothers (35 years or more) were also at a higher risk of dying (27%; Assefa and Mekonnen, 1997).

1.5.1.2 Birth Interval

Birth spacing is generally believed to be associated with infant and child mortality. The proper spacing of births allows more time for childcare, is likely to make more maternal resources available for the care of the child, and also allows for healthier mother. Several studies have found out that maternal nutrition and maternal depletion are key factors affecting mortality levels for births following a short birth interval (e.g., Potter, 1988; Miller, 1990; Gribble, 1993; Sullivan et

al., 1994; Bicego et al., 1996). The World Fertility Survey (WFS) findings have also indicated the existence of strong associations between interval of child bearing and chances of childhood survival (Rutestein, 1983; Edward, 1985). Results from DHS comparative studies found out that the most pronounced influence of short birth interval on mortality occurs during neonatal and post neonatal periods, and the weakest effect during the 1-4 years age period (Sullivan et al., 1994).

1.5.1.3 Infant Feeding Practices

Infant feeding has an impact on the health of both the child and the mother. Feeding practices are important determinants of children's nutritional status and many studies have shown the beneficial effects of breastfeeding on the nutritional status, morbidity and mortality of infants (Hobcraft et al., 1984; Benefo and Parnell, 1991). Breastfeeding also has an indirect effect on the postpartum fecundity of mothers (Kennedy, 1990). In particular, more frequent breastfeeding is associated with longer periods of postpartum amenorrhoea, which in turn are related to longer birth intervals and lower fertility levels (Salway, 1998). The effects of breastfeeding on infant survival seem to be greater during the early months of life (Shah and Khanna, 1990).

The greatest advantage of breast milk over substitutes such as bottle-feeding is that breast milk contains antibodies against bacterial and viral agents that cause diarrhea and other infections. In addition, breastfeeding involves no food preparation or storage unlike artificial feeding and it protects against infection. The anti-infective properties of breast milk are particularly important for babies born to underprivileged mothers who have inadequate access to clean water supply and waste disposal facilities.

1.5.1.4 Child weight at Birth

A child's weight at birth is an important indicator of the child's vulnerability to the risk of childhood illnesses and the chances of survival. Children whose birth weight is less than 2.5 kilograms, or children reported to be "very small" or "smaller than average" are considered to have a higher than average risk of early childhood death (CSA and ORC Macro, 2006).

In developing countries, low birth weight stems primarily from the mother's poor health and nutrition. Three factors have most impact: the mother's poor nutritional status before conception, short stature (due mostly to under nutrition during her childhood), and poor nutrition during

pregnancy. Inadequate weight gain during pregnancy is particularly important since it accounts for a large proportion of foetal growth retardation. Moreover, diseases such as diarrhea and malaria, which are common in many developing countries, can significantly impair foetal growth if the mother becomes infected while pregnant (UNICEF and WHO, 2004).

1.5.1.5. Birth Order

The birth order or rank of the child is closely associated with chances of survival (Sullivan et al., 1994; Assefa and Mekonnen, 1997; Mahy, 2003). First births and high-order births (7+ births) carry higher than average mortality risk compared with other births. The high mortality of first and higher order births may be related to the age of the mother at the birth of the child, which is termed as high risk births for very young and older mothers. The major reason for the existence of high mortality among first births in developing countries is the fact that most of the first birth occurs before a woman is physically mature and ready to play a maternal role. While, births of high order may have mothers who are physically depleted at the time of conception and throughout pregnancy. Such births are thus more likely than other children to suffer from conditions associated with high mortality risk such as fetal growth retardation and low birth weight. Children of high birth orders are also more likely to be affected by competition from older siblings in terms of food and other family resources (Sullivan, 1994; Pandy et al., 1998; Mahy 2003).

1.5.1.6 Survival Status of Preceding Child

Children in families where an older sibling has died at a young age are likely to have heightened mortality risks themselves. They may face adverse biological conditions that affected the older sibling or a family environment associated with high risks of infant and child mortality (Pandy et al., 1998).

Studies carried out in some developing countries highlight the effect of previous child mortality on the survival of subsequent children. In Bangladesh, for instance, previous child mortality experience was clearly shown to be crucial in determining the mortality of subsequent children by shortening the birth interval through cessation of breastfeeding and the consequent early return of fecundity in the absence of contraception (Majumder et al., 1997).

Data from the Nepal Fertility Survey also showed that the risk of infant and child death is considerably higher among children of mothers whose previous child had died than among those whose previous child survived even when demographic variables are considered and this is mainly due to "family environment effect", i.e., inadequate living conditions or care, or both (Gubhaju, 1985).

1.5.1.7 Sex of the Child

In general, males have higher mortality at all ages of childhood than females. Males have higher mortality rates during the first six months of life for genetic reasons primarily because of higher vulnerability to infectious disease. Excess male mortality risk declines after six months. The world fertility survey data show excess male infant mortality in 27 of the 29 countries (Rutstein, 1983). A study using DHS data from 28 countries also showed higher under-five mortality among males than females in all of the 28 countries included in the study (Sullivan, 1994).

However, in situations where girls are considered more of a financial burden to the family than boys, health care patterns tend to favour boys. For instance, excess female mortality for infants and children has been found to be particularly high in Pakistan, Bangladesh and India. Although the reasons for excess female mortality are varied, several factors have been considered, including female infanticide, differential nutrition and differential health care (Arnold, 1992).

1.5.1.8 Multiplicity of Birth

Children from multiple births (twins, triplets, etc) experience much higher mortality than single births. It is a biological factor that plays a major role in the survival of infants. Children of multiple births are often not fully developed in the womb, resulting in low birth weight. In addition, complications at delivery and competition for resources after birth often result in greater risk of dying for multiple births.

A study based on DHS data show that in Eritrea, children of multiple births are five times more likely to die in the first year of life than children of singleton births. The same study revealed that in Ethiopia, Chad, Niger, Bangladesh and Nepal, more than half of the children born in multiple births died before their fifth birthday (Mahy, 2003). A longitudinal, community-based study

conducted in Southwest Ethiopia also showed that infant mortality among multiple births is 4 times higher compared to singletons and twins were much more likely to die than singletons, even after taking their birth weight into account (Mekonnen and Fasil, 2002).

1.5.2 Socioeconomic Determinants in Childhood Mortality

1.5.2.1 Type of Place of Residence

Place of residence of a child is one of the most important determinants in survival analysis. In developing countries, childhood mortality is often thought to be higher in rural areas than urban areas because of differences in standards of living, health conditions and availability of or access to public health facilities and services.

A study conducted in Malaysia revealed that mortality is higher for children in rural areas than in urban areas and also mortality is higher for children whose mothers' previous place of residence was rural (Da Vanzo, 1984). A study conducted in Ethiopia based on the 1994 population and housing census also found out a significant difference in the level of childhood mortality, which is higher in rural than in urban areas (Mekonnen et al., 2001).

1.5.2.2 Maternal Education

Maternal education is one of the strongest correlates of infant and child mortality because education provides women with decision making power, making them more aware of their children's welfare, and increasing their knowledge about childhood diseases and their ability to understand illness and provide timely treatment (Cleland and van Ginnaken, 1988).

Although some studies found out that the effect of mothers education was substantially reduced when controlling for other variables, the majority of the studies seem to suggest mothers education to have an independent, inverse and strong correlation with infant and child mortality (e.g., Bicego et al., 1994, Caldwell, 1979). Various studies conducted in Ethiopia also identified significant relationship between maternal education and child mortality (e.g., Gashaw, 1996; Assefa and Mekonnen, 1997; Mekonnen, et al., 2001).

1.5.2.3 Wealth

Household wealth is strongly associated with childhood mortality risk. Children born to the wealthiest households have mortality risks lower than those born into the poorest.

Similar to education, the way in which household income and wealth affect child mortality is complex. Income is often used as a proxy for children's consumption of goods and services such as shelter, nutrition, and adult supervision that may affect their health. It should be noted that, due to difficulties in monetary conversion, household wealth is often used as a proxy for income and it is primarily measured from a set of objects owned by a family, such as durable goods (UN, 1985).

1.5.3 Environmental Factors and Childhood Survival

Environmental contamination, which refers to the transmission of infectious agents to the children (Mosley and Chen, 1984), is one subset of the set of intermediate or proximate determinants through which socioeconomic factors influence child mortality. Many of the deaths in the first five years of life, especially in developing countries, are due to infections spread by environmental factors. Diarrhoeal disease including gastroenteritis, is one of the main causes of death during this period of life.

Environmental variables considered to be important in influencing child survival include source of drinking water and availability of toilet facility. A study in Bangladesh indicated that living conditions, especially water supply and sanitary conditions, directly affect contamination of the household environment, while access to these facilities is associated with low mortality risks (Kabir and Amin, 1993). Another study conducted in Malaysia revealed that the absence of modern toilet sanitation and piped water is strongly associated with mortality for babies who breastfeed little or not at all; however, the presence of these facilities makes no significant difference for the mortality of babies who breastfeed without supplementation. The reason is that babies who do not breastfeed usually have other foods mixed with water, which may be contaminated (Da Vanzo, 1984).

1.5.4 Health Seeking Behavior and Childhood Survival

Utilization and access to maternal and child health care facilities appears to be an important determinant of child mortality. The access to health care facilities is often used as an explanation why mortality in the urban areas is generally lower than in rural areas, which usually has fewer facilities. Health seeking behavior of women especially during pregnancy and at the time of childbirth has an important role to play for the health of the newborn (Mahy, 2003).

In general, in developing countries like Ethiopia, child survival is influenced by demographic, socioeconomic, Environmental and maternal health care factors that promote the use of health services. Although various studies have been conducted on childhood mortality in the country, the determinants may vary from one geographical setting to the other and change with time. This study will, therefore, try to investigate the relative influence of each factor in determining childhood survival in SNNPRS.

1.6 Analytical Framework

Various conceptual or analytical frameworks have been developed by different scholars to examine the determinants of childhood mortality. Mosley and Chen (1984) proposed an analytical framework which is based on the premise that all social and economic determinants of child mortality necessarily operate through a common set of biological mechanisms, or proximate determinants, to exert an impact on mortality. They grouped the proximate determinants into five categories. These are maternal factors (age, parity, birth- interval), environmental contamination, nutrient deficiency, injury and personal illness control. Socioeconomic determinants such as maternal education, income/wealth and health system are also believed to exert a substantial impact on child survival through the proximate determinants.

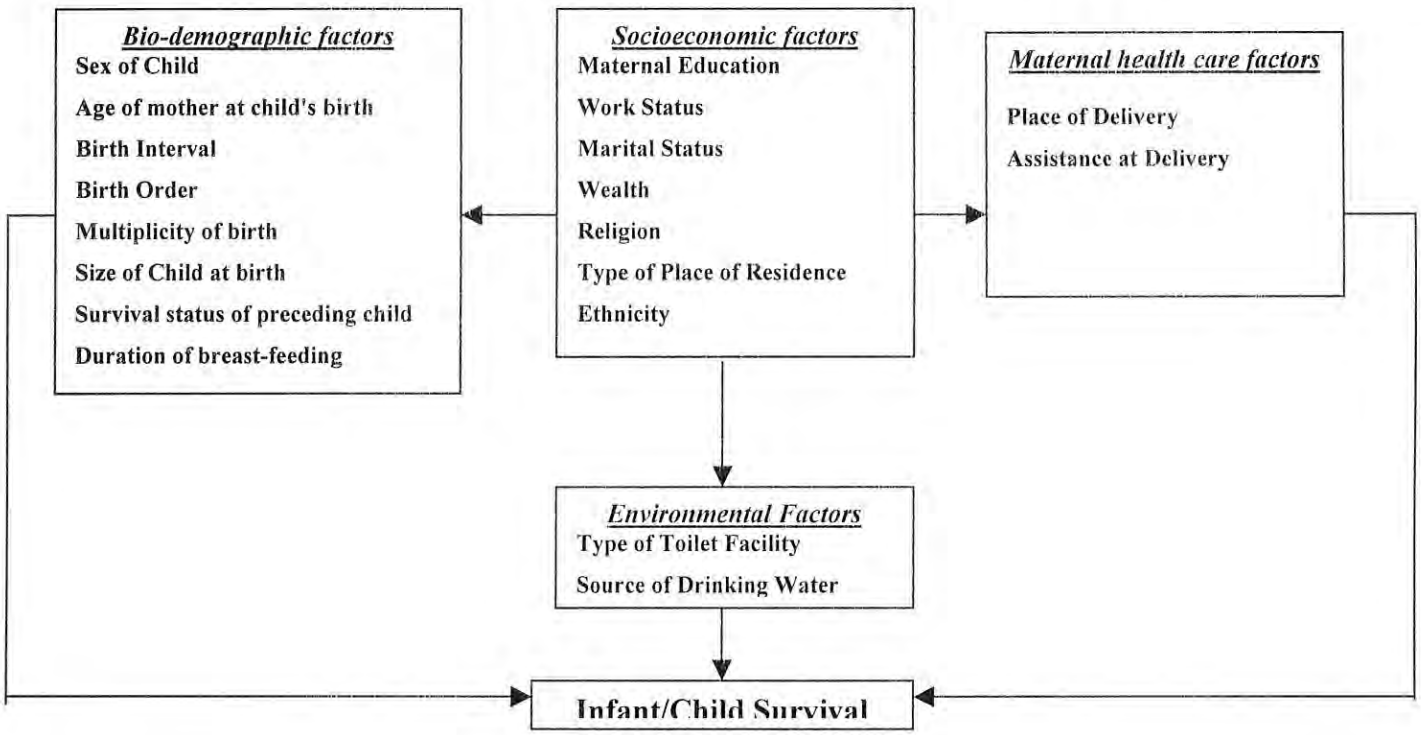
The model developed by Mosley and Chen (1984) became a classical reference for researchers in the area of childhood mortality and the current study adopts this framework with some modification.

The Dependent Variable: For the purpose of this study, childhood (infant and child) survivorship is taken as an outcome (dependent) variable. Each category is treated as a dichotomous variable (alive or dead).

Proximate Determinants: Proximate determinants or intermediate variables are those variables which directly influence mortality. In this study, maternal factors (age at child birth, birth order, birth interval, survival status of previous sibling), child factors (sex of child, size of child at birth, multiplicity of birth), environmental contamination (type of toilet facility and source of drinking water) and nutrient deficiency (duration of breast feeding) are used as proximate determinants.

Independent Variables: Socioeconomic variables and maternal health care factors are treated as independent variables.

Figure 2Analytical framework for the analysis of determinants of infant and child survival in SNNPRS (adopted from Mosley and Chen (1984) **analytical framework)**



1.7 Hypothesis

The working hypotheses in this work are:

1. Young age reflects maternal immaturity and lack of experience with childcare, while old age is associated with increased likelihood of birth defects and competition for resource due to high parity. Therefore, children born to mothers in the age group 20-34 are believed to have lower mortality risk than children born to younger (<20 years) and older (>35 years) mothers.
2. Maternal education is believed to exert an impact on infant mortality, since it provides the mother with the necessary skills for childcare, increase awareness of nutritional needs and preference of modern health facilities, and use of contraceptive for birth spacing. Therefore, the risk of dying of infants is believed to be lower among literate mothers.
3. Short birth interval has indirect effects through such factors as maternal depletion and sibling competition for resources. Therefore, it is hypothesized that the higher the length of the preceding birth interval the lower is the chance of dying.
4. First order births are more likely to be raised by parents with limited skills and experience and they are more likely to have a difficult birth process. Higher order births may also have mothers who are physically depleted at the time of conception and throughout pregnancy. Therefore, first order and higher order births are believed to have lower chance of surviving than intermediate order births.

CHAPTER TWO

METHODOLOGY

2.1 Source of Data

The data source for this study is the 2005 Ethiopian Demographic and health survey (EDHS). The EDHS is the second comprehensive survey conducted in Ethiopia as part of the worldwide demographic and health surveys (DHS) project. The EDHS covered 9 regions and 2 administrative council areas and it was conducted between April and August 2005.

Three types of questionnaires were administered under EDHS: the Household, the women's and the men's questionnaire. In the women's questionnaire information was collected regarding a woman's fertility history, maternity care, childhood mortality and some aspects of her socio-economic background. The current study uses data from the woman's questionnaire.

A total of 2012 households were selected in the SNNPRS, of which 1992 were interviewed yielding a response rate of 99 percent. A total of 2135 women of reproductive age (15-49 years) were identified in the households and interviews were completed for 2087 women with the response rate of 97.8 percent.

Details about the survey methods and sampling procedure is presented in the 2005 Ethiopian Demographic and Health survey Report (CSA and ORC Macro, 2006)

2.2 Data Quality

A major issue of concern before undertaking any analysis is to check the quality of data. Evaluation of both sampling and non-sampling errors for the 2005 EDHS has already been undertaken by the Central Statistical Authority (CSA and ORC Macro, 2006).

An attempt is, therefore made here to check the consistency and quality of the data by using information on age of women, the total number of women, total number of children ever born and children deceased in the study area, to examine age data, sex ratio of children, proportion of children dead, and trends of average parities. Although data on children born five years preceding

the survey are used in the analysis, information on children ever born, children deceased and number of women, have been used from all eligible mothers interviewed in SNNPRS for an assessment of data quality.

2.2.1 Evaluation of Age Data

Age is one of the most important items collected in all demographic enquiries. The precision of age reporting is crucial in determining the accuracy of estimates in the demographic analysis. Age of a woman is an important determinant of fertility and mortality exerting a direct influence through biological factors and indirectly being closely linked with parity, birth order, and marital status (CSA, 1997).

A common form of error in age reporting is preference of respondents for numbers ending in certain digits such as 0 and 5. Myer's' Blended index is usually used to measure degree of preference for each age digit and it provides summary index for all terminal digits. A summary index of preference for all terminal digits is derived as one half the sum of the deviations from ten percent, each taken without regard to sign. If age heaping is non existent, the index would approximate to zero. The theoretical value of Myer's summary index ranges between 0 and 90; where value 0 represents no age heaping, while value would be 90 if all ages are reported as numbers ending in the same digit (Shryock and Siegle, 1976). Table 1 shows the Myers Blended index computed for ages ranging from 20-49 years. The value of the summary index is found to be 21.3, which indicates that there is digit preference among the study population. Regarding which digits are preferred or avoided Table 1 shows a tendency of reporting ages ending in 0, 5 and 8 (positive deviation from 10) and avoiding ages ending in remaining digits 1, 2, 3, 4, 6, 7 and 9 (negative deviations from 10). This finding is in line with the 1994 census data collected for the region.

Table 1. Myers Blended Index of Terminal Digit Preference for Women aged 20-49 in SNNPRS, EDHS, 2005.

Terminal Digit	Deviation from 10 percent
0	7.0
1	-5.4
2	-1.4
3	-3.4
4	-3.6
5	10.2
6	-2.2
7	-2.5
8	4.1
9	-2.8
Summary Index	21.3

Figure 3. Age distribution of women interviewed in the 2005 EDHS, SNNPRS.

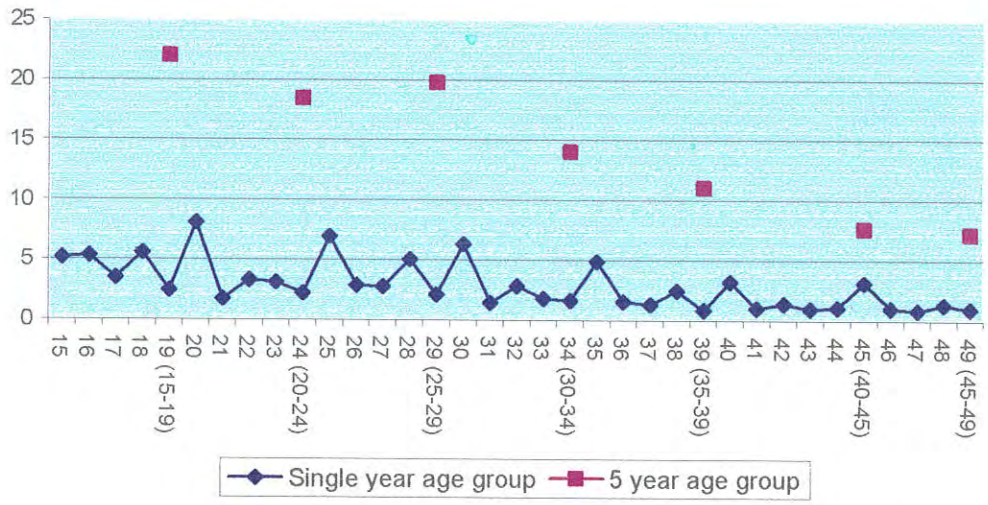


Figure 3 also confirms the tendency of reporting of ages ending in 0 and 5. Generally, the evaluation of age data shows that the single year age data are subject to digit preference. When a 5-year age group is considered the heaping of age data is smoothed except for age group 25-29. However, since the study used broader age groups, it is believed that the effect of age heaping is minimal.

2.2.2 Sex Ratio, Average Parity and Proportion Dead

It is necessary to examine the sex ratio of children ever born, average parities by sex and proportion of deceased children in order to check the consistency and quality of data.

Normally, the mean number of children ever born increases with mother's age in the absence of inconsistencies or any recorded sudden rise in the level of fertility in the past. If there is inconsistency in reporting of the number of children ever born, the trend could fluctuate up and down. Figure 4 presents average parities of women by single year of age and by sex of child. As can be seen from the graph, average parity for both sexes and total average parity fluctuates by age. For instance, it shows a high value at age 20 and it declines at age 45 for both sexes. A decline of average parity at older age might be due to underreporting of children ever born by older women, or due to omission of children everborn, or it could also be due to age shifting.

Figure 4. Average parities of males and females in the SNNPRS, in 2005 (EDHS).

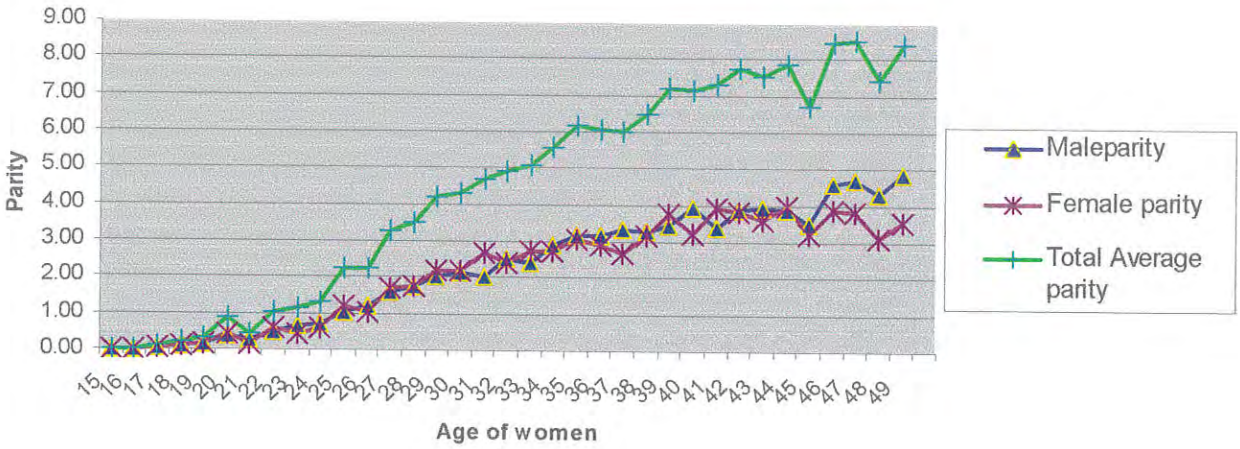
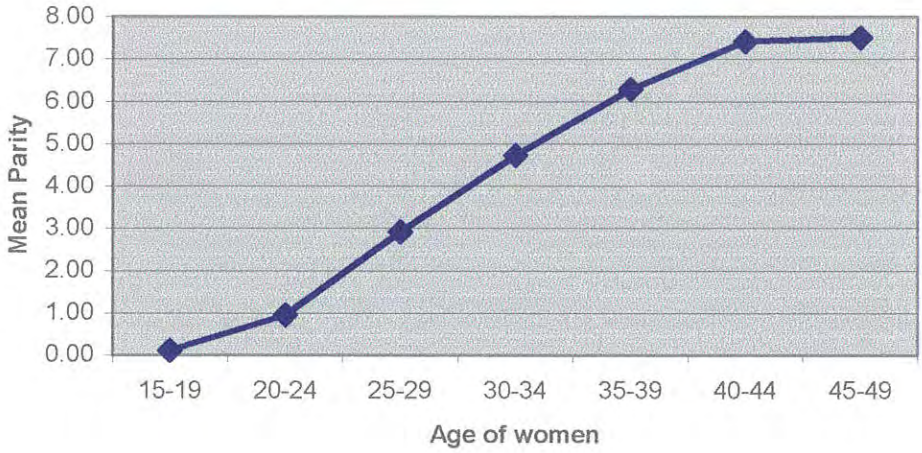


Figure 5 presents average parities by 5-year age group of mothers. The figure reveals that average parity shows an increasing trend for all age groups, implying that the data is not affected by omission of children ever born when broader age group of women is considered.

Figure 5. Mean parity by age of women in SNNPRS, 2005.



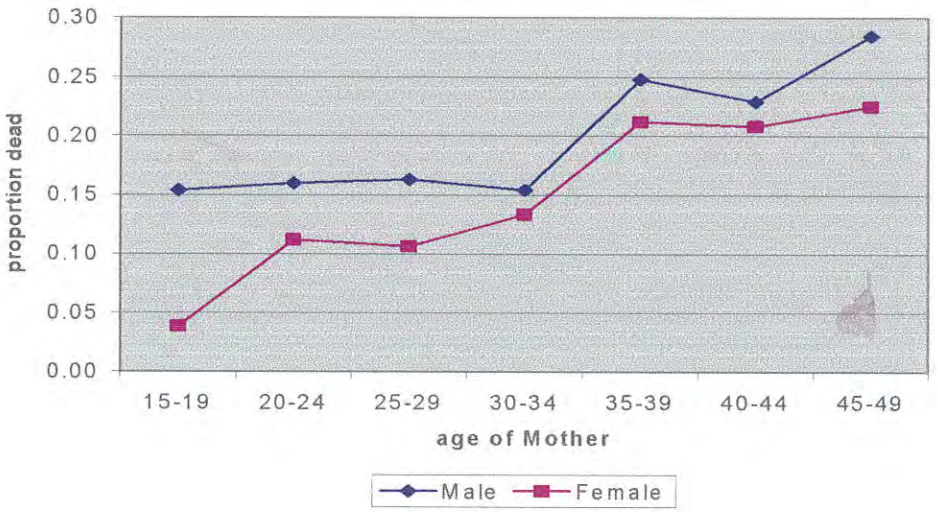
A further check on data quality is performed by calculating sex ratio of children ever born by mother's age group. Sex ratio should usually fall within the range 102 to 107 and should not vary greatly by age of mother. As can be seen from Table 2, sex ratio of children ever born classified by age group of mothers ranges from the lowest 96 to the highest 108 and the over all sex ratio for all births is 104, which falls within the expected range. The sex ratio is acceptable for age groups 20-24 and 35-39 and women in the age group15-19, 25-29 and 30-34 seem to under-report male children. On the other hand, older women (women in the age group 40-44 and 45-49) appear to under-report female children. Analysis of sex ratio of children ever born indicates that the data has minor limitations, which may be due to under reporting of children ever born by mothers.

Table 2. Children ever born and Sex Ratio by 5 year age group of women in SNNPRS, 2005.

Age group of women	Children ever born			Sex Ratio
	Male	Female	Total	
15-19	26	26	52	100
20-24	188	179	367	105
25-29	589	612	1201	96
30-34	675	705	1380	96
35-39	742	703	1445	106
40-44	611	568	1179	108
45-49	615	511	1126	120
Total	3446	3304	6750	104

Another check is also performed using data on the proportion of children dead. The proportion of female children dead increases with an increase in age of women, and proportion of male children increases with an increase in age of women except for age groups 30-34 and 40-44 (Fig. 6). The overall assessment of data using the above techniques indicates that the data is of reasonably good quality and it can be used for further analysis.

Figure 6. Proportion of children dead by sex and age of mother.



2.3 Limitations

Some limitations of the data include the following:

- Since information about the immunization status of those children who have died is unknown, in this study it is not possible to analyze the effect of immunization on both infant and child mortality.
- Since information on antenatal care was collected only for the most recent births, this study failed to analyze the effect of antenatal care services on both infant and childhood mortality.
- Some of the variables such as work status and level of education could have changed between birth and time of interview. However, detailed information on such time dependent variables is not available and thus this study is constrained by the assumption that the effect of each covariate is constant over the entire range of failure times.

- The data did not allow to make multivariate analysis on the effect of place of delivery, assistance at delivery and multiplicity of birth on both infant and childhood mortality because of fewer number of cases in some of the categories and due to problem of Multicollinearity.

2.4 Method of Analysis

The units of analysis for this study are children under 5 years of age.

There are significant differentials in mortality at different stages of childhood, and for the purpose of analysis, deaths are classified into two groups:

1. Infant mortality: The probability of dying during the first year of life; and

2. Child mortality - The probability of dying between the first and fifth birthday.

A Cox proportional hazard model is used to establish which variables have independent predictive power for mortality. A Cox proportional hazard model is the most frequently used model to study the relationship between time of death and a set of independent variables. It is the basic model for survival data and a well-known model for handling censored cases (cases with incomplete exposure). It is analogous to the multiple regression analysis where the time when an event occurs is considered rather than simply whether or not an event (death) has occurred (Cox, 1972).

Unlike the logistic regression model, in which the dependent variable takes the value 1 if the event has occurred and 0 if it has not, the Cox regression takes into account the fact that the probability of experiencing an event differs with duration of exposure to risk.

The model assumes a multiplicative relationship between the underlying hazard function (the force of mortality) and the function of covariates and it is given by equation (1):

$$\mathbf{h\ (t, z(t)) = h_0(t)*exp(\beta'z(t))} \qquad (1)$$

Where h (t, z(t)) is the hazard function for an individual with covariate vector z(t) at time t;

ho(t) is the baseline hazard;

β is a row vector of unknown regression coefficients to be estimated (it indicates the relationship between the variable and the hazard of dying(the force of mortality)).

The factor $\exp\beta_j$ is the relative risk associated with the j^{th} explanatory variable.

The arbitrary non-negative unspecified baseline hazard function ho(t) is a function of time(t) only. It is not dependent on covariates and is assumed to be the same for all subjects. The Cox model expressed in terms of the hazard function is called the Cox Proportional Hazards Model.

The Cox regression model is not a fully parametric model since it does not specify the form of ho(t). It does, however specify the hazard ratio for any two individuals with covariate vectors Z_i and Z_j, where $i \neq j$; and thus it is defined as a semi parametric model. In this study, analysis of the unadjusted effect of each variable on infant and child mortality is estimated using hazard models that include only one predictor variable.

2.5 Working Definition of Variables

The variables used in this study are defined in Box 1.

BOX 1 DEFINITION OF VARIABLES

GROUPOF VARIABLES	VARIABLE	WORKING DEFINITION
	DEPENDENT VARIABLES	
	Infant Mortality	The probability of dying during the first year of life.
	Child Mortality	The probability of dying between the first and fifth birthday.
	INDEPENDENT VARIABLES	
BIODEMOGRAPHIC	**Birth Order**	The order of birth of the index child and it is a categorical variable with four categories representing births of order 1, 2, 3-4 and 5 or above.
	Age of Mother at Birth	The age of the mother at the birth of the child and it is grouped into three age groups (less than 20 years, 20-34 years and 35+ years). This grouping is based on the assumption that births to younger mothers and older mothers have higher mortality risk as compared to births to mothers aged 20-34.
	Preceding Birth Interval	The length of the interval between the birth of the index child and its older sibling; it is categorized into four: less than 24 months, 24-36, 37-48 and 48+.
	Survival Status of Preceding Child	Treated as a dummy variable indicating whether or not an older sibling is alive or dead at the time the index child was born.
	Multiplicity of Birth	Is categorized into two: single and multiple indicating the presence of single or multiple births, respectively.
	Size of Child at Birth	Is categorized into three: large, average and small.
	Sex of Child	Is classified into two: male and female
	Duration of Breast-feeding	The length of time in which the child is breastfed; it is categorized into: never breastfed, breastfed for less than 6 months, breastfed for 6-12 months for infants, and an additional category breastfed for ≥12 months for child.
SOCIOECONOMIC	**Maternal Education**	Classified only into two categories: no education, and some education representing primary, secondary and higher levels. This is due to small number of women who attend secondary and higher education in the region.
	Marital Status	Categorized into two groups: currently not in union and in union, representing those living in conjugal union and those not in such union.
	Religion	Classified into four categories: Orthodox, Protestant, Muslim and Others.
	Work Status of Mothers	Categorized into two: not working and working, representing a woman's work status that indicates her access to resources and decision-making autonomy.
	Wealth Index	It is an index constructed using household asset data including ownership of a number of consumer items ranging from television to a bicycle or car, as well as dwelling characteristics, such as source of drinking water, sanitation facilities and type of material used for flooring.
	Ethnicity	Classified into nine groups: Sidama, Guragie, Wolaita, Keffa, Hadiya, Gamo, Gedeo, Kembata, and Others, representing all other ethnic groups in the region.
ENVIRONMENTAL	**Source of Drinking Water**	Categorized into two; protected and unprotected.
	Type of Toilet Facility	Categorized into three groups: Flush, pit latrine, and Others including no facility, bush or field.
MATERNAL HEALTH CARE SEEKING	**Place of Delivery**	Classified into two groups: health facility and traditional (representing a birth delivered at home).
	Assistance at Delivery	Grouped into two: health professional and traditional.

CHAPTER THREE

GENERAL BACKGROUND OF THE STUDY POPULATION

3.1 The Study Site

SNNPRS is one of the nine regional states of Ethiopia. It has common borders with Kenya in the South, Sudan in the Southwest, Gambella Region in the Northwest, and the Oromiya Region in the North and East (Figure 7). Based on the 1994 census, SNNPRS has an estimated total population of 14,901,990, consisting of 7,408,993 men and 7,492,997 women. With an estimated area of 112,343.19 square kilometers, the region has an estimated average density of 133 persons per square kilometer (CSA, 2005), which is the highest in the country.

The region covers ten per cent of the country's surface area and is home to 21 per cent of the population. Although SNNPRS has the highest population density in the country, it is one of the least urbanized regions of Ethiopia. About 91.4 percent of the population lives in rural areas, while only 8.6 percent are urban; making the SNNPRS Ethiopia's most rural region (CSA, 2005).

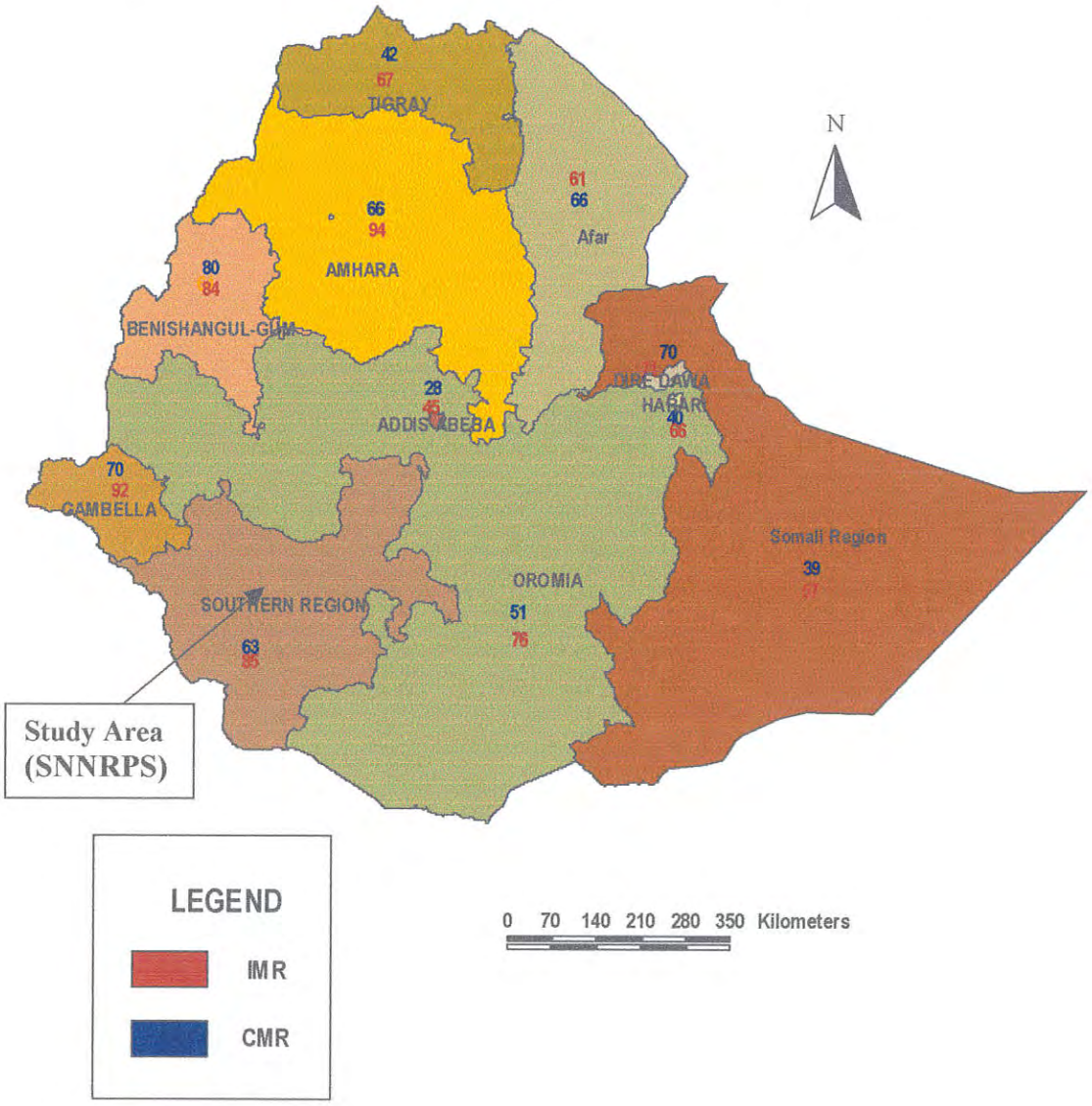
The SNNPRS is diverse in terms of ethnicity; it is inhabited by more than 80 ethnic groups, of which more than 45 are indigenous to the region (CSA, 1996). Different languages, cultures and socioeconomic organizations distinguish these groups. The SNNPRS is also diverse in terms of its religious composition and differs from other regions as a result of its experience with protestant missionary activity. Four major religions which represent the population of the region are Protestant (58 percent), Orthodox (23 percent), Muslim (14 percent) and traditional (6 percent).

Agriculture is the main occupation in SNNPRS and coffee is the most important cash crop. In the year 2004-2005, 100,338 tons of coffee was produced in SNNPRS, which represents 44.2% of the total production in Ethiopia. Other major crops of the region include maize, teff, enset, potato, wheat and spices(CSA, 2005) .

Only 38 per cent of the adult population are literate and as in other regions there is a gender disparity in literacy levels with 52 per cent for men and 25 per cent for women (CSA, 2004).

As pointed out earlier, the region is characterized by high level of infant and child mortality and high level of fertility with a total fertility rate of 5.6 children per woman of reproductive age. Some of the underlying causes for high level of fertility in the region are low level of contraceptive use (12 percent) and early age at marriage (17 years; CSA and ORC Macro, 2006).

Figure 7 Map of Ethiopia and the Study area (marked "Southern Region" in the map and indicated by an arrow;adopted from Wikipidia the free Encyclopedia)



3.2 Background Characteristics of the Respondents

This section shows the basic characteristics of women in the SNNPRS who were interviewed in the 2005 Ethiopian Demographic and Health Survey (EDHS) and who gave birth to children in the five years preceding the survey .

Table 3. Distribution of children by selected background characteristics of their mothers in SNNPRS, 2005

Variable	Frequency	Percent
Socioeconomic		
Type of place of residence		
Urban	127	7.3
Rural	1603	92.7
Level of Education		
No education	1291	74.6
Primary	364	21
Secondary and higher	75	4.3
Work status		
Working	354	20.5
Not working	1376	79.5
Environmental		
Source of Drinking water		
Protected	958	55.4
Unprotected	772	44.6
Type of Toilet facility		
Flush	68	3.9
Pit	946	54.7
Others	716	41.4
Maternal Health care factors		
Place of Delivery		
Home	1654	95.6
Health Facility	76	4.4
Assistance at delivery		
Traditional	1641	95
Health Professional	87	5

3.2.1 Place of Residence

Large proportions of children (92.7 percent) were born to mothers who reside in rural areas while smaller numbers of children (7.3 percent) were born to women who reside in urban areas.

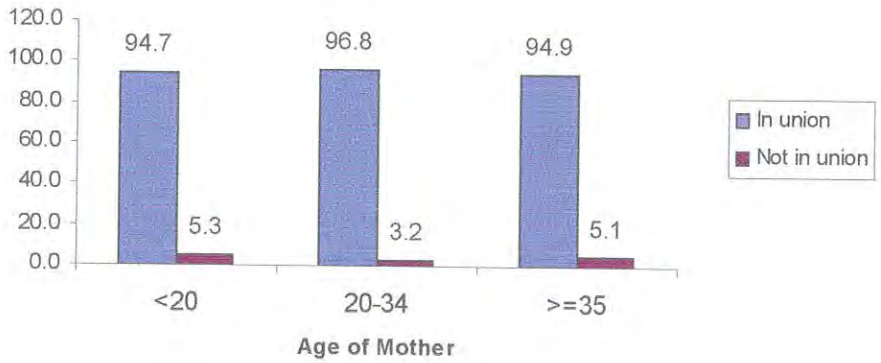
3.2.2 Education and Work Status

Educational level is defined here as the highest level of schooling attended by the mother and majority of the children (74.6 percent) were born to mothers who have no education, 21 percent to mothers who have primary education and the remaining 4.3 percent to mothers who have secondary and higher education. Large proportions of children (79.5 percent) were born to mothers who are not working while 20.5 percent of them were born to working mothers.

3.2.3 Age Distribution and Marital Status

The majority of children (73 percent) belong to mothers in the 20-34 age group and those children who belong to mothers aged ≥35 and <20 constitutes 15 percent and 12 percent, respectively. Referring to marital status most of the children (96 percent) were from mothers in union and the remaining 4 percent from mothers who were not in union at the time of the survey.

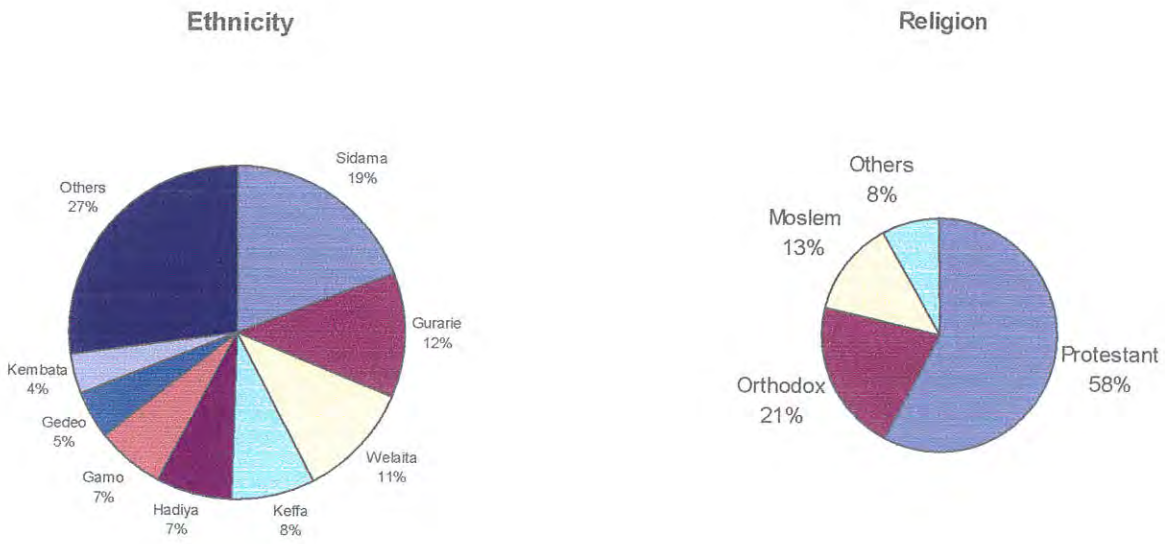
Figure 8. Distribution of children by Age and Marital status of mothers in SNNPRS, 2005



3.2.4 Religion and Ethnicity

The region is diverse in terms of its religious composition and ethnicity (Figure 9). Fifty eight percent were born from protestant mothers, 21 percent from orthodox mothers, those children who were from Moslem mothers constitute 13.4 percent and the remaining 7.9 percent of children come from mothers belonging to other religious groups including Catholics and traditional beliefs. Nineteen percent of children were born to Sidama, 12 percent to Guragie, 11 percent to Wolaita, 8 percent to Keffa, 7.1 percent to Hadiya, 6.9 percent to Gamo, 4.6 percent to Gedeo, 4 percent to Kembata and the remaining 27 percent to other ethnic groups.

Figure 9. Distribution of children by mother's ethnicity and religion in SNNPRS, 2005.



3.2.5 Type of Toilet Facility and Source of Drinking Water

Large proportion of children (55.4 percent) were born to households that use water from protected source (piped or protected well/spring) and the remaining 44.6 percent were from households that use unprotected well/spring, surface water and other sources. More than half (54.7 percent) of the children are from households that use pit latrine, 3.9 percent flush and the remaining 41.4 percent are from households with no such facility.

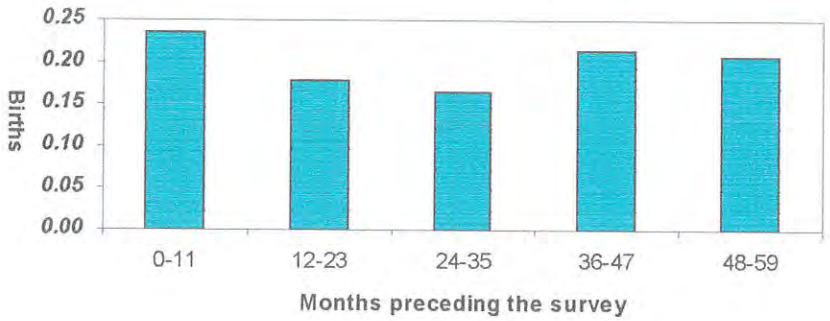
3.2.6 Place of Delivery and Assistance at Delivery

Similar to other regions in the country, most of the births (95.6 percent) take place at home and only 4.4 percent in health facility. On the other hand, only 5 percent of the mothers received assistance at delivery by a health professional, while the majority (95 percent) of children were born to mothers who were not assisted by health professionals.

3.3 Child Specific Characteristics

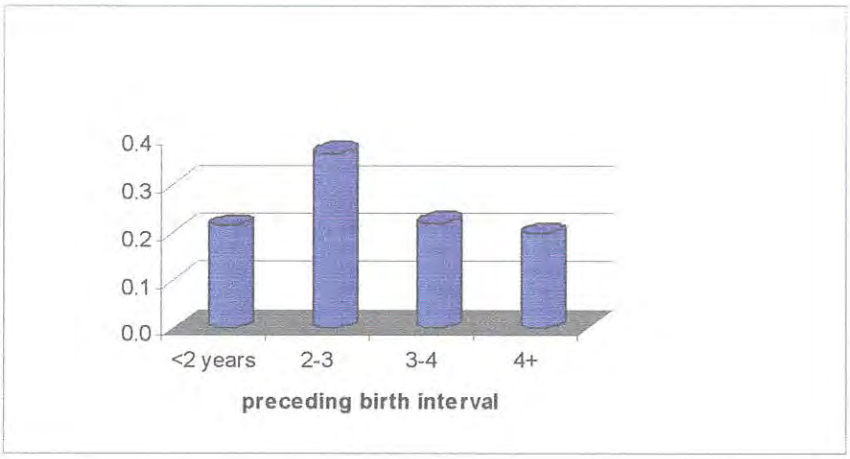
Since the unit of analysis are children under five years of age and the main variables of interest were collected for the recent five years, this study is limited to those children who were born five years preceding the survey. The working sample contains 1730 children aged 0-59 months. Nearly 25 percent of births occur one year preceding the survey (Figure 10).

Figure 10. Distribution of births by months preceding the survey in SNNPRS, 2005



The data shows that 51.4 percent of the children are females and the remaining 48.6 are males. Majority (98 percent) of births are singletons while smaller number (2 percent) of the births is twins or multiples. About one sixth of the children are of first birth order, 28.7 percent second or third, 23.3 percent fourth or fifth and the remaining 31.5 percent constitute births of higher order (sixth and greater order). Excluding first order births, the preceding birth interval of 36.7 percent of the children was 2-3 years, 22 percent was 3-4 years, 21.5 percent was less than 2 years and the remaining 19.8 percent was more than 4 years (Figure 11).

Figure 11. Distribution of births by length of preceding birth interval in SNNPRS, 2005



Regarding size of child at birth 38 percent of the children are reported to have large size. Thirty-seven have average and the remaining 25 percent have smaller size. Of the total 1730 births, there were 162 deaths out of which 128 (79 percent) were infants and the remaining 34 (21 percent) were child deaths. Some characteristics of children in the study population are presented in Table 4.

Table 4. Percent distribution of children born in the last five years by some characteristics in SNNPRS, 2005.

Variable	Frequency	Percentage
Sex of child		
Male	841	48.6
Female	889	51.4
Multiplicity of birth		
Single	1696	98
Multiple	34	2
Size of child at birth		
Large	659	38.1
Average	642	37.1
Small	429	24.8

CHAPTER FOUR

LEVELS, TRENDS AND DIFFERENTIALS IN INFANT AND CHILD MORTALITY

This chapter consists of two sections. In the first section levels and trends of infant and childhood mortality were estimated using the 2000 and 2005 EDHS data by applying indirect techniques. The second section focuses on the findings of the bivariate analysis to explore the relationship between the dependent and independent variables.

4.1 Levels and Trends

Levels of infant and child mortality for a given area or country can serve as an indicator of the health status of that community or country and trends of childhood mortality on the other hand, shows change overtime of the estimate of the level of childhood mortality (Trussel, 1984). In areas where there is no vital registration system, the only way of obtaining information apart from census is to conduct sample surveys. An estimate of basic demographic parameters from a sample survey is done most of the time using indirect techniques.

Under reporting of births and deaths as well as misplacement of dates of birth and death are common in countries like Ethiopia where the great majority of the population particularly women, are illiterate and births as well as deaths are not registered. Since estimation of infant and childhood mortality using direct methods is already presented in the final EDHS (2005) report, in this section an attempt is made to estimate levels of infant and child mortality in SNNPRS, using indirect techniques for the purpose of comparison.

In order to estimate these mortality indices, the Trussell variant of the Brass Indirect Technique (UN, 1983) was employed. The North family of the Coale and Demeny model life tables were selected as the standard pattern of mortality, since the North Model is considered to be more suitable for a society that breastfeeds more than a year as is the case in the study area (UN, 1983). Infant, child and under five mortality rates were computed using a program called Q FIVE (UN, 1990) and are presented in Table 5.

Table 5. Infant, child and under five mortality rates with their corresponding reference dates and probabilities of dying before reaching exact age x; q(x) estimated by Trussell Version North model using 2000 and 2005 EDHS data of the SNNPRS .

Age of women	Age X	2000					2005				
			Mortality rate					Mortality rate			
		q(x)	Infant (1q0)	Child (4q1)	Under five (5q0)	Reference date	q(x)	Infant (1q0)	Child (4q1)	Under five (5q0)	Reference date
15-19	1	0.186	0.186	0.155	0.312	1999.4	0.100	0.100	0.071	0.164	2004.2
20-24	2	0.159	0.124	0.097	0.208	1998.3	0.145	0.114	0.086	0.190	2003.3
25-29	3	0.184	0.126	0.099	0.213	1996.6	0.137	0.097	0.068	0.158	2002.0
30-34	5	0.196	0.117	0.090	0.196	1994.4	0.151	0.093	0.064	0.151	2000.3
35-39	10	0.242	0.124	0.097	0.209	1991.8	0.257	0.132	0.105	0.223	1998.5
40-44	15	0.260	0.125	0.098	0.210	1989.1	0.240	0.116	0.088	0.193	1996.3
45-49	20	0.288	0.129	0.102	0.218	1986.1	0.275	0.123	0.096	0.207	1993.5

Since the estimates based on reports of women aged 20-34 have been proven to be more accurate than the estimates of younger and older women (CSA, 1995), infant (1q0), child (4q1) and under five (5q0) mortality rates are calculated by taking the average values of the three rates implied by q(2), q(3) and q(5) from Table 5 above, and the results are presented in Table 6.

Table 6. Average infant, child and under five mortality rate estimated by by Trussell Version North model using 2000 and 2005 EDHS data of the SNNPRS .

Year	Rates per 1000		
	Infant Mortality Rate (1q0)	Child mortality Rate (4q1)	Under five mortality Rate (5q0)
2000	122	95	205
2005	101	72	166

According to the results in Table 6, infant mortality rate for the region is 101 per 1000 live births and the corresponding child and under five mortality rates are 72 and 166, respectively .The infant and under five mortality rates are lower compared to the regions mortality estimates based on the 1994 census and the 2000 EDHS estimate (both direct and indirect), and higher as compared to the

direct estimates of the EDHS 2005. However, the results are consistent with the estimates of the 1997 community and family survey conducted in the region.

Estimate of infant mortality is also computed using Brass Logit Life Table System using equation (2)

$$Y_x=\alpha+\beta Y_{s(x)} \qquad (2)$$

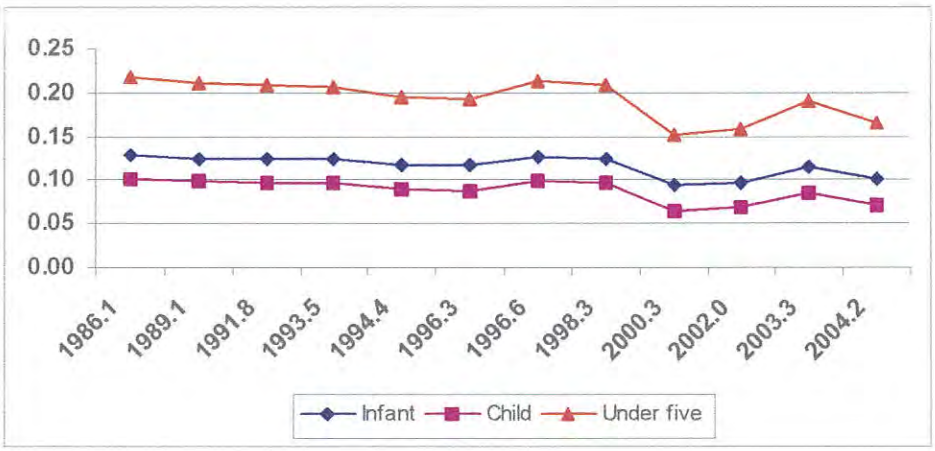
Where Y_x and $Y_{s(x)}$ are two different life tables

α and β are constants.

Details about this method are presented in Manual X (UN, 1983). Estimate of infant mortality for the region using this method is found to be 87 and it is consistent with the direct estimate made by CSA and ORC Macro (2006).

Results from Both EDHS (2000) and (2005) show an overall decline in infant, child and under five mortalities between 1986 and 2004. A major decline appears to have occurred in child mortality (44 percent), with some what smaller declines in infant mortality (29 percent). Mortality apparently fluctuated with no clear trend between 1998 and 2004 as indicated in Fig. 12 and this could be attributed to a major famine and drought episodes in 1993-1999 and 2002-2003 in the region(USAID,2005).

Figure 12. Trends in infant, child and under five mortality in SNNPRS between 1986 and 2004.



4.2 Differentials in Infant and Child Death

The bivariate relation between the dependent and explanatory variables is examined and presented here. Direct estimates of infant and child mortality were calculated across demographic, socioeconomic, environmental and maternal health care seeking factors for the five-year period preceding the survey.

4.2.1 Biodemographic Differentials

4.2.1.1 Mother's Age at Child Bearing

Maternal age at childbirth has been obtained by subtracting the respondent's date of birth from the child's date of birth where, both of which were recorded in century month code. As expected, infants born to mothers who are below age 20 had lower chances of surviving as compared to infants born to women in the age group 20-34. However, infant mortality is lower for infants born to mothers above age 35. Contrary to the expectation, child mortality for the different age groups is almost similar and in fact children of women in the age group 20-34 have slightly higher childhood mortality than those of younger (<20 years) and older (>35 years) age groups.

The reason for higher mortality risk of infants born to younger women is that younger mothers are more likely to be premature, have low birth weights, and they are not, in general, ready to take on parental responsibilities.

4.2.1.2 Birth Order

Usually the relationship between birth order and mortality at early ages takes a U shape. Mortality is high for first born children as well as births of very high orders, and is low for intermediate birth orders (Fig. 13). Table 7 indicates that the expected high infant mortality for first order births and higher order (5+) is evident and births of order 3-4 have the lowest infant death rate.

Figure 13. Proportion of infant and child deaths by birth order in SNNPRS, 2005.

The possible explanation for greater risk to first order and higher order births is that first order births are more likely to have a difficult birth process than later births, thus increasing the risk of neonatal mortality. Moreover, first-born children are likely to be raised by parents with limited skills and experience, possibly increasing the risk of infant and child mortality. Births of very high order may have mothers who are physically depleted at the time of conception and throughout pregnancy and the births may have low birth weight.

Similar result was obtained during early childhood period. During this period, children of first and higher (5+) order seem to have higher mortality risk compared to children of birth order 3-4. However, children of birth order 2 show highest death rate than all other birth orders, although the differences are not statistically significant. This is due to the fact that once children survive infancy, the risk of first and higher order births significantly declines as childhood mortality, during these stages, is more likely to depend on the care they receive than on biological factors.

4.2.1.3 Birth Interval

The length of birth interval between births has a significant influence on a child's chances of survival. Short birth intervals are associated with high rates of infant and child mortality. As can be seen from Table 7 the expected higher risk of infant and child mortality for births with short preceding birth interval is clearly observed. The difference is statistically significant (at $P< 0.001$) both during infancy and childhood periods.

The risk of dying during infancy for children born less than two years after a previous birth is more than double that of children born four or more years after a previous birth. Similarly mortality among children born less than two years after a previous birth is nearly ten times the level among children born four or more years after a previous birth.

4.2.1.4 Multiplicity of Birth

Twins or multiple births are at higher risk of mortality than single births. In this study, it has been shown that infant mortality among multiple births is almost 3 times that of singletons, and child mortality among multiple births is 71 percent higher than that of single births. However, these results should be interpreted with caution due to small number of such cases. The higher risk among multiple births might be due to biological factors such as low birth weight and complications at delivery.

4.2.1.5 Sex of Child

The proportion of infant deaths is higher for male children than for female children (87 versus 62 per 1000). The excess male to female infant death could be attributed to genetic reasons. During early childhood period, however, male children seem to have slight advantage over their female counterparts and childhood mortality among females is higher. But the difference is statistically significant only during infancy.

4.2.1.6 Size of Child at Birth

Since most births in Ethiopia occur at home where children are often not weighted at birth, data on birth weight is available for only a few children, those born at health facilities. However, mothers in Ethiopian DHS survey were asked whether their child was very large, larger than average, average or small at birth since this has been found to be a good proxy for the child's weight (EDHS, 2005). Table 7 shows that infant and child mortality among children of large and small size at birth are higher as compared to children of average size at birth but the differences are not statistically significant in both cases (infant and child). This might be due to the fact that reports from the mothers are hardly accurate as answers to the question are subjective.

Table 7. Demographic Differentials in infant and Child mortality in SNNPRS, 2005.

Demographic Variables	Births	Survivors at age 1	Deaths per 1000	
			Infant	Child
Age at Maternity			***	
Less than 20 years	208	147	144	20
20-34 Years	1268	883	65	29
Greater than 35	254	181	63	28
Birth Order			*	
1St	286	196	108	26
2nd	264	179	68	34
3-4	437	306	53	23
>=5	743	530	75	28
Preceding Birth Interval			***	***
Less than 24 Months	310	228	139	61
24-36 months	530	398	62	13
37-48 Months	318	213	41	42
48+	286	176	28	6
Multiplicity of Birth			**	
Single	1696	1190	71	28
Multiple	34	21	206	48
Sex of child			*	♣
Male	841	573	87	19
Female	889	638	62	36
Size of child at Birth				
Large	659	473	83	30
Average	642	450	59	20
Small	429	288	82	38
Duration of breastfeeding			***	*
Never breastfed	63	20	651	0
<6 Months	298	38	215	79
6-12 Months	251	41	72	73
>=12 Months	1106	1105	0	24

*** = P< 0.001, ** = P<0.01, * = P<0.05, ♣ = P<0.10 (***, **, *,♣ indicate level of significance at specified level).

4.2.1.8 Breast-feeding

Various studies have indicated that breastfed infants experience a lower mortality risk than artificially fed infants (e.g., Holland, 1987, Ebrstein et al., 1990). The effect of breast-feeding is more pronounced during infancy. According to the results in Table 7, those infants who were never breastfed and breastfed for less than 6 months had a higher risk of mortality as compared to those infants who were breastfed 6-12 months and the difference is statistically significant at ($P < 0.001$).

4.2.2 Socioeconomic Differentials

Differentials in childhood mortality by socioeconomic variables, namely, marital status, level of education, work status of mothers, wealth index, religion and ethnicity are presented in Table 8.

4.2.2.1 Marital Status

The result in Table 8 shows that mortality risk for infants born to mothers who were not in union are 71 percent higher than that of infants born to mothers in union. Similarly, children born to mothers who were not in union have 40 percent higher mortality risk than those children born to mothers who were in union. However, the differences are not statistically significant in both cases. This might be due to smaller number of cases in the second (not in union) category as a result of universal marriage in the region. In the region, 96 percent of women have been ever married (CSA and ORC Macro, 2006).

Table 8. Socioeconomic differentials in infant and child mortality in SNNPRS, 2005

Socioeconomic variables	Births	Survivors at age 1	Deaths per 1000	
			Infant	Child
Type of place of residence				
Urban	127	87	79	11
Rural	1603	1124	74	29
Marital Status				
In Union	1665	1162	72	28
Not in union	65	49	123	41
Level of education			*	
No education	1291	904	81	32
Some education	439	307	52	16
Work Status				
Not working	1376	951	72	30
Working	354	260	82	19
Wealth Index				
Lowest	504	354	85	25
Middle	455	305	79	36
Highest	771	552	64	25
Religion				
Protestant	997	702	69	28
Orthodox	364	248	80	36
Moslem	232	165	82	18
Other	137	96	80	21
Ethnicity			**	
Sidama	331	235	60	38
Guragie	208	147	63	14
Welaita	193	128	73	39
Keffa	138	91	145	33
Hadiya	123	97	8	21
Gamo	119	84	67	60
Gedeo	80	61	100	16
Kembata	69	45	87	22
Others	469	323	81	19

** = P < 0. 01, * = P < 0. 05

4.2.2.2 Maternal Education

Maternal education has been identified as one of the most important socioeconomic determinants of infant and child mortality. An examination of infant and childhood mortality rates presented in Table 8 reveales the expected pattern of inverse relationship between mother's education and child's risk of dying. Mortality rate of children whose mothers have no education is higher than those whose mothers have some education both during infancy and childhood periods. For instance, infant mortality risk among children born to mothers with no education is 56 percent higher as compared with children born to mothers with some education; and childhood mortality risk is twice higher among children born to mothers with no education than that of children born to mothers with some education. The difference is only statistically significant for infants.

4.2.2.3 Work Status and Wealth

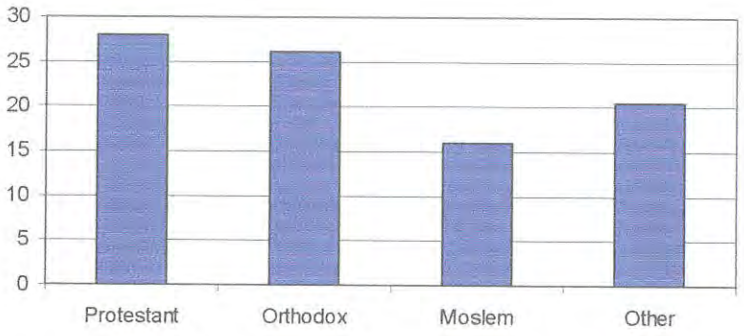
The result in Table 8 indicates relatively higher proportion of infant mortality for working mothers than non-working mothers. The possible explanation for such result could be shorter duration of breastfeeding and using other alternatives to compensate breast-feeding, such as bottle-feeding which is exposed to infections by working mothers. According to the data from EDHS (2005) working mothers who had never breastfeed their infants are 89 percent higher than that of non-working mothers in SNNPRS. Another reason might be lack of adequate childcare among working mothers due to lack of time. On the other hand, the current study reveals that childhood mortality is higher for non-working mothers as compared to working mothers and this could be explained by relatively better education and income generated by working mothers which could compensate the negative effect of lack of adequate care given by non-working mothers.

With respect to wealth and mortality, children born to mothers in the lowest wealth index are at higher risk of dying than children born to mothers in the middle and highest wealth index during infancy. However, the relationship is not consistent during childhood and in fact childhood mortality risk is the same for children born to mothers in the lowest and highest wealth index. This is due to the fact that being born to wealthy mother doesn't necessarily imply that all the child's requirements are fulfilled such as nutrition, sanitation and appropriate care.

4.2.2.4 Religion and Ethnicity

Regarding relation between religion and mortality, Table 8 reveals that children of Orthodox, Muslim and Other (Catholic and Traditional) mothers have higher risk of dying during infancy than those of Protestant mothers. As can be seen in Figure 14 the difference could be explained by the relatively higher number of mothers with some education among Protestant mothers. However, childhood mortality among children of Orthodox and Protestant mothers is higher as compared to children of Muslim mothers, although the difference is not statistically significant in both (infant and child) cases.

Figure 14. Percentage of mothers who have some education by religion, in the SNNPRS, 2005.



Differentials by ethnicity show considerable effect during infancy than childhood period. According to Table 8, infant mortality of children of mothers belonging to Keffa ethnic group is the highest, followed by those belonging to Gedeo, Kembata and "Others" ethnic groups and is lowest among the Hadiya ethnic group. According to the data from EDHS (2005), the highest mortality risk to children among Keffa and Gedeo ethnic groups during infancy may be due to higher number of illiterate mothers among these ethnic groups (85 and 83 percent, respectively) as compared to mothers belonging to other ethnic groups. Childhood mortality is highest among the Gamo ethnic groups followed by the Sidama and Wolaita and lowest among the Guragie ethnic group.

4.2.3 Environmental Differentials

4.2.3.1 Source of Drinking Water and Type of Toilet Facility

The positive effect of toilet, sanitation and use of pure water on child survival has been documented in various literatures (e.g., Da Vanzo et al., 1983; UN 1985). Households with flush or pit latrine have lower mortality risk during infancy as compared to households with no facility, bush or field. Infant mortality among children from households with no facility, bush or field is 75 percent higher than children from households with flush toilet, and infant death is also higher in households with pit latrine. The result in Table 9 reveals that there is no mortality risk for children born to households with flush toilet during childhood but there is high mortality risk for children born to households with pit latrine. But the result should be taken with caution due to small number of cases in the flush toilet category.

The results also indicate that there is no significant difference in both infant and childhood mortality by source of drinking water in the region (Table 9). Moreover, differentials by source of drinking water and type of toilet facility are not statistically significant both during infancy and childhood periods.

Table 9. Environmental differentials in infant and child mortality in SNNPRS, 2005

Environmental variables			Deaths per 1000	
			Infant	Child
Source of drinking water	Births	Survivors at age 1		
Protected	958	670	73	27
Unprotected	772	541	75	30
Type of toilet facility				
Flush	68	46	44	0
Pit	946	676	72	36
No facility/Bush/Field	716	489	80	20

4.2.4 Maternal Health Care Seeking Factors

4.2.4.1 Place of Delivery and Assistance at Delivery

Children delivered at a medical facility are likely to experience lower mortality risk than children delivered at home because such facilities usually provide a sanitary environment, proper birth assistance and vaccination. But in developing countries like Ethiopia most births takes place at home and the risk of mortality is higher. Table 10 presents infant and childhood mortality rates by place of delivery and assistance at delivery. However, the result is not as expected and both infant and child mortality is higher for institutional delivery than home delivery.

The same result is also obtained when referring to assistance at delivery. The result in Table 10 demonstrates that both infant and child mortality is higher among mothers who receive assistance from health professionals as compared to mothers who receive assistance from traditional birth attendant. The result might be due to small number of cases (births at health facility and assistance by health professional) in the region and those mothers who seek assistance or go to health facilities might be those who encounter complications during delivery that may lead to death, or go to health facilities as a last resort (unable to give birth at home after long hours of labour).

Table 10 Maternal health care differentials in infant and child mortality in SNNPRS, 2005

Maternal Health Care Variables	Births	Survivors at age 1	Deaths per 1000	
			Infant	Child
Place of Delivery				
Home	1654	1161	73	27
Health facility	76	50	92	60
Assistance at delivery				
Traditional	1641	1151	73	26
Health Professional	87	58	92	52

CHAPTER FIVE

DETERMINANTS OF INFANT AND CHILD SURVIVAL: A MULTIVARIATE ANALYSIS

In the previous chapter the bivariate relationship between some background characteristics of women and children on the one hand and infant and child mortality on the other has been assessed. In such type of analysis, there is always lack of estimating the net effect of a particular variable separately, and together as a group on the dependent variable; it is also difficult to know which factor is more important. The objectives of the study can only be achieved by applying multivariate analysis, and in this chapter the Cox Proportional Hazard Model is applied in order to examine the net effect of each independent variable on infant and childhood mortality by controlling the effects of other variables. The analysis is restricted to singleton births in the last five years preceding the survey. The restriction to singleton births is due to small number of cases in the multiple birth categories and higher risk of mortality associated with such births.

The variables that are included in the model are those which showed a significant association with the dependent variable in the bivariate analysis and those variables that are suspected to show some tendency of relationship even though they do not show statistically significant association with the dependent variable.

5.1. Check for Multicollinearity

Multicollinearity is the situation where the correlations among independent variables are strong. As a rule of thumb, the problem primarily occurs when x variables are more highly correlated with each other than they are with the dependent variable. There are several classical tests for diagnosing collinearity problems. This study applied the Variance Inflation Factor (VIF) and correlation matrix to assess the impact of multicollinearity. The VIF is calculated as 1 divided by the tolerance (one minus the multiple R for each independent variable) level for that independent variable. The common cut of criterion for the presence of multicollinearity is VIF≥5.

In this study it was found out that place of delivery and assistance at delivery have VIF>5. In addition, these variables have small number of cases in some of the categories that are of main

interest to this study. Therefore, place of delivery and assistance at delivery were dropped from the multivariate analysis. The results of the VIF test are presented in Annex I, and II.

5.2 Determinants of Infant Mortality

The analysis in infant mortality is conducted in two stages .In the first stage, 4 models are fitted in order to re-examine the gross effect of each independent variable and to assess the relative influence of demographic and socioeconomic factors on infant mortality. The single factor (gross effect) indicates the effect of one predictor variable when the effect of other factors is not taken into account. These estimates are produced by including only one variable at a time in the model and are presented in Model 1 of Table 11. In model 2, all the demographic variables are considered as a group, while in model 3 all socioeconomic variables are included. Model 4 considers all the variables (demographic and socioeconomic) simultaneously and is considered the full model.

In the second stage only maternal factors are considered to assess the relationship between maternal factors and infant mortality.

5.2.1 Bio-demographic factors and infant mortality

5.2.1.1 Age at Maternity

The single factor effect of maternal age at birth shows that infants born to mothers aged less than 20 years experience a higher mortality risk as compared to infants born to mothers aged 20-34 and ≥35 years. For instance, infant mortality for children of mothers under 20 years at the time of birth of their child is 2.23 times higher than that for infants whose mothers were 20-34 years at the time they gave birth and the effect is statistically significant at ($P < 0.001$ level). Mortality risk among infants born to older mothers is, however, almost the same as infants born to mothers aged 20-34 and the effect is not statistically significant.

When all demographic factors are controlled in Model 2, the effect of maternal age at birth had declined and lost its significance in affecting infant mortality. Although the effect is not

statistically significant and its magnitude is reduced, infants born to younger mothers (<20 years) still have a higher risk (43 percent) of mortality as compared to infants born to mothers aged 20-34 years. Results in the full model (Model 4) are almost the same as results in Model 2.

According to the EDHS (2005) data, 48 percent of births from younger mothers are first order births and the major difference between the gross and net effect of age at maternity on infant survivorship could be explained by the inclusion and exclusion of first order births in the gross and net effect models, respectively.

Table 11. Relative effects of predictor variables on infant mortality.

Variables	Model 1	Model 2	Model 3	Model 4	X^2_{LR}	df
Bio-Demographic						
Age at Maternity	***				0.43	2
<20 years	2.230***	1.434		1.413		
20-34	1.000	1.000		1.000		
35+	0.974	1.003		0.830		
Preceding Birth Interval	***	***		**	17.8	3
<2 years	4.959***	3.734***		3.649**		
2-3 years	2.226*	2.372*		2.272*		
3-4 years	1.461	1.301		1.228		
>4	1.000	1.000		1.000		
Birth Order	♣	♣		♣	7.9	2
1st	1.590					
2nd	1.000	1.000		1.000		
3-4 order	0.772	2.199♣		2.240♣		
5+ order	1.105	2.868*		2.900*		
Duration of Breastfeeding	***	***		***	45.8	2
Never Breastfed	9.075***	8.419***		8.248***		
<6 Months	2.995***	3.581***		3.497***		
>6 Months	1.000	1.000		1.000		
Sex of Child	♣				0.16	1
Male	1.403♣	1.081		1.104		
Female	1.000	1.000		1.000		
Survival Status of Preceding Child	**				1.00	1
Alive	1.000	1.000		1.000		
Dead	1.780**	1.371		1.328		

Socioeconomic	Model 1	Model 2	Model 3	Model 4	X^2_{LR}	df
Maternal Education	*				1.3	1
No education	1.552*		1.353	1.264		
Some education	1.000		1.000	1.000		
Marital Status					1.6	1
Currently in Union	1.000		1.000	1.000		
Not in union	1.708		1.582	1.965		
Wealth Index					0.52	2
Lowest	1.342		1.116	1.159		
Middle	1.245		1.174	0.971		
Highest	1.000		1.000	1.000		
Toilet Facility					7.2	2
Flush	1.000		1.000	1.000		
Pit	1.629		1.378	4.295		
No facility/Bush/Field	1.804		1.470	4.820		
Ethnicity	*		♣		2.1	8
Sidama	1.000		1.000	1.000		
Guragie	1.034		1.051	1.049		
Wolaita	1.201		1.211	1.375		
Keffa	2.399**		2.269**	1.148		
Hadiya	0.135*		0.144♣	0.418		
Gamo	1.113		1.131	0.931		
Gedeo	1.655		1.661	1.212		
Kembata	1.439		1.587	1.223		
Others	1.341		1.355	1.041		

*** = P < 0.001, ** = P < 0.01, * = P < 0.05, ♣ = P < 0.10 (Note: In this and the following tables, the symbols ***, **, *and ♣ indicate the level of significance at the specified level and they refer to the departure of the relative risk from unity or the value of the relative risk for the reference category).

5.2.1.2 Preceding Birth Interval

Table 11 shows that both unadjusted and adjusted effects of previous birth interval on infant mortality are large and highly significant (P < 0.001 level) in SNNPRS. The single factor effect (Model 1) indicates that mortality risk for infants born within 2 years after the previous birth is 4.96 times higher than that of the reference category (> 4 years). Births with preceding birth

interval of 2-3 years after the previous birth have also a higher risk (more than twice) of mortality compared to the reference category.

Results in Model 2 and Model 4 of Table 11 show that even though the adjusted effect of preceding birth interval is somewhat smaller than the single factor effect, the relationship is still very strong. For example, in the full model, births with preceding birth interval of less than 2 years after the previous birth have 3.65 times higher mortality risk than births in the reference category with preceding birth interval of four or more years.

In general being born within a very short birth interval (less than 2 years) is associated with a very high mortality risk.

5.2.1.3 Birth Order

When the effect of other factors is not taken into account, first and higher order births have relatively higher mortality risk as compared to other order births (order 2 and order 3-4); but the difference is not statistically significant. The inclusion of demographic and socio-economic variables increases the risk of dying of higher order births as compared to the reference category (order 2) and the difference is statistically significant. For instance, in the full model, the relative risk of dying for births of higher order (≥ 5) is 2.9 times higher than that of 2^{nd} order births. This might be due to the fact that high-order births are born into families that already have a number of young children who compete for resources and parental care, and most of higher order births have mothers who are physically depleted. Such children are more likely than others to suffer from high mortality risks such as low birth weight.

5.2.1.4 Duration of Breastfeeding

Breastfeeding showed a very large and significant effect both during the gross and net effect models. Even though its effect is reduced, duration of breastfeeding showed strong and significant effect on infant survival when other controls are added to the model. For instance, in the full model, infants who were never breastfed and who were breastfed less than 6 months have a higher mortality risk than infants who were breastfed for more than 6 months. After controlling the effect

of both demographic and socioeconomic variables, infants who were never breastfed had 8 times higher mortality risk than infants who were breastfed six or more months.

5.2.1.5 Sex of the Child

The result of the single factor effect on Model 1 shows that mortality risk among male children is 40 percent higher than their female counterparts. But when control is made for other variables, the mortality risk between male and female infants become almost the same and in all the models the difference is not statistically significant.

5.2.1.6 Survival Status of Previous Sibling

Survival status of preceding child at the birth of the index child has a significant effect on infant survival when the effects of all other variables are not taken into account. For instance, in Model 1 infant mortality is 78 percent higher for infants whose older sibling had died than those whose older sibling survived. The high risk is reduced and lost its significance, when control is made for the other variables.

The increased risk of mortality of an index child preceded by a sibling who died could be due to shared common biological, social and even behavioral problems affecting the mothers of such children (e.g., Winikoff, 1983; Eberstein & Parker, 1984; Hobcraft, 1987; Cramer, 1987; Das Gupta, 1990; Aaby, 1990; Guo, 1993; Sastry, 1997). On the other hand, several studies report lower mortality risks in the post-neonatal and/or childhood periods for a child whose older sibling died as an infant as a result of care given by parents who experience child loss and reduction in sibling competition as well as the risk of cross-infection between two siblings close in age (Koenig et al., 1990; Majumder, 1990; Curtis, Diamond & McDonald, 1993).

5.2.2 Socioeconomic Factors and Infant Mortality

5.2.2.1 Maternal Education

The single factor effect of maternal education shows that infants born to mothers with no education experienced 55 percent higher mortality risk as compared to mothers with some education (Table 11, Model 1) and its effect is statistically significant.

The inclusion of other socioeconomic and demographic variables in the Model reduced the effect of maternal education in explaining variability in infant survival status. The effect is not statistically significant in the net effect models.

5.2.2.2 Marital Status

The results both in the gross and net effects models demonstrate that infants whose mothers were in union at the time of the interview have higher chances of survival than those whose mothers were not in union during the survey. For instance, in the full model, infants from mothers who were not in union at the time of the survey have 96 percent higher risk of dying than infants from mothers who were in union. This can be explained by the fact that most women in Ethiopia are economically dependant on their husbands. Hence, the lack of conjoint may aggravate the socio-economic condition of the family. Moreover, married women are more likely to use maternal health services than their unmarried counterparts because the stigma associated with out-of-wedlock pregnancies could be severe in societies like Ethiopia, and it is reasonable to assume that most such pregnancies are unwanted or unintended. As a result, such women may be less motivated to seek maternal and child health care services.

5.2.2.3 Wealth

The single factor effect in Model 1 shows that infants from mothers who are in the lowest and middle wealth index face relatively higher mortality risk as compared to the reference category (highest wealth index). When control is made for other socioeconomic factors in Model 3 and both socioeconomic and demographic factors in Model 4 its effect is reduced. In all the models the result is not statistically significant.

5.2.2.4 Type of Toilet Facility

Access to a flush or pit toilet is potentially a very important determinant of infant and child mortality in developing countries. Children in households that lack such access could have higher exposure than other children to diseases such as tetanus and digestive disorders (e.g., Puffer and Serrano, 1978; UN, 1985).

As shown in Table 11, unadjusted infant mortality is higher for infants in households that do not have access to a flush toilet in the region. When control is made for socioeconomic variables in Model 3, the risk is reduced. When both demographic and socioeconomic factors are controlled in Model 4 the risk of dying becomes higher for infants in households that don't have access to flush toilet. But in all the models the difference is not statistically significant, which might be due to small number of cases in households that have access to flush toilet in the region.

Contrary to the expectation, in all the models, the risk of infant mortality associated with households with pit latrine is higher. This is due to the fact that pit latrine might not be a good measure of sanitation. Having pit latrine does not mean that it will be used hygienically or by all members of the household and caretakers may not have the habit of washing their hands using soap after using latrines. A study of child mortality in relation to water supply and nutritional status in Malawi noted that young children often did not use the pit latrines, and consequently there was much fecal contamination around homes. Even though pit latrines protect against some parasitic diseases, they appear not to protect against diarrhea, which is one of the major contributors to child mortality in most developing countries (Lindskog et al., 1988).

5.2.2.5 Ethnicity

Infants from Keffa ethnic group show a higher and significant mortality risk than other ethnic groups in the region. Inclusion of maternal education brought a slight change in Model 3 but it still shows a significant difference. When demographic variables are taken into account, the difference disappeared and lost its significance. One possible explanation for this difference is that relatively higher number (25 percent) of infants who were never breastfed belongs to Keffa ethnic group. In all the models, infants from Hadiya ethnic group show a higher chance of surviving as compared to other ethnic groups.

As one of the objectives of the study is to assess the relative influence of demographic and socioeconomic factors on infant and child survival, log likelihood ratio tests were used to determine the relative importance of variables. The size of the likelihood ratio chi-square relative to its degree of freedom indicates the relative importance of a variable. According to this criterion, duration of breastfeeding is the most important factor affecting infant mortality followed by birth

interval and birth order. From the socioeconomic variables, type of toilet facility appears to be important even though its effect is not statistically significant. The value of the likelihood ratio test and its degree of freedom are presented in the last two columns of Table 11.

In general in this study the demographic factors are found to be very important in determining infant mortality in SNNPRS.

5.2.3 Maternal Factors and Infant Mortality

As can be seen from the previous results and discussion, maternal factors like age at the birth of the child, birth interval, birth order and duration of breast-feeding showed a significant association with infant mortality. In this section, an attempt is made to distinguish the two-factor effect and the independent effect of each variable by considering only maternal factors.

Models 2-7 indicate the two-factor effect of maternal factors on infant mortality (Table 12). Model 2 reveals that when preceding birth interval is controlled, the effect of young maternal age on infant mortality is reduced and lost its significance. The effect of age at maternity on infant mortality is increased when control is made for birth order. This could be explained by higher mortality risk associated with first order births, since most first order births are from younger mothers.

Model 4 suggests that including duration of breastfeeding in the model somewhat reduces the effect of age at maternity, but the effect is still strong and statistically significant.

As can be seen from model 2, 5 and 6, only duration of breast-feeding due to its role in birth spacing bring about a slight decline on the effect of birth interval on infant survivorship. In all the models preceding birth interval showed a strong and significant effect on the survivorship of infants.

Controlling age at maternity results in an increase in the risk of dying for higher order births though the difference is not statistically significant. The high mortality among higher order births may be related to the age of the mother at the birth of the child, which is termed as high-risk births for very young and older mothers.

Model 5 showed that birth order and preceding birth interval affect the chance of infant survival independently of each other. In general as can be seen from the full model (Model 8) preceding birth interval and duration of breastfeeding seem to be strong and significant in affecting infant mortality.

Table 12. Relative effects of maternal factors on infant mortality.

Variables	Model 1	Model 2	Model 3	Model 4	Model_5	Model_6	Model_7	Model 8
Age at maternity								
< 20 years	2.230***	1.457	2.358**	1.850**				1.788
20-34	1.000	1.000	1.000	1.000				1.000
>=35	0.974	1.199	0.791	1.031				1.000
Preceding birth interval								
<2 years	4.959***	4.904***			4.932***	4.077***		3.997***
2-3 years	2.226*	2.215*			2.223*	2.421*		2.457*
3-4 years	1.461	1.471			1.459	1.444		1.461
>4 years	1.000	1.000			1.000	1.000		1.000
Birth order								
1	1.590		1.238				1.621	
2	1.000		1.000		1.000		1.000	1.000
3-4 order	0.772		0.956		0.830		1.037	1.384
5+order	1.105		1.527		1.162		1.372	1.823♣
Duration of breastfeeding								
Never breastfed	9.075***			8.162***		7.254***	8.624***	7.171***
< 6 months	2.995***			3.033***		3.229***	3.005***	3.356***
> 6 months	1.000			1.000		1.000	1.000	1.000

*** = P < 0.001, ** = P < 0.01, * = P < 0.05, ♣ = P < 0.10

5.3 Determinants of Childhood Mortality

Table 13 presents hazards of childhood mortality. Model 1 considers the gross effect of all the variables that are believed to have relationship with child mortality. Models 2 and 3 consider the effects of bio-demographic and socioeconomic variables, respectively, while Model 4 is the full model.

5.3.1 Biodemographic Factors and Child Mortality

Model 1 shows that the effect of preceding birth interval, which was strong in the case of infant mortality, has still a strong effect on child survival. But when other demographic variables are controlled (Model 2) and when control is made for all variables considered (Model 4), it lost its significance. Higher order births show a higher risk of mortality as compared to other birth orders even though the effect is not statistically significant.

Duration of breastfeeding appears to have strong and highly significant effect on child mortality in both the single factor and net effect models. The net factor effect of duration of breastfeeding is such that the risk of dying during childhood of a child who was breastfed less than a year is five times higher as compared to a child who was breastfed 2 or more years.

Female children seem to have a higher mortality risk as compared to their male counterparts during childhood period. But the difference is not statistically significant. This result is consistent with results found in other developing countries. For instance, a study based on data from the International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR, B) showed that, in the neonatal period, male mortality exceeds female mortality. During the post-neonatal period and childhood (1-4 years), the pattern is reversed, with female death rates exceeding those for males (Chen et al., 1981). A comparative study based on DHS data also confirms this result in some countries (Bangladesh, India and Nepal) (Mahy, 2003). Excess female mortality at post neonatal and childhood ages in India and other South Asian countries is believed to result from son preference, which leads to differential treatment of sons and daughters in terms of food allocation, prevention of diseases and accidents, and treatment of illness (UN, 1998). However, this is an area, which requires further research.

Children whose older sibling had died seem to have a higher mortality risk as compared to children whose older sibling had survived. For instance, in the net effect model, children whose older sibling had died show 70 percent higher mortality risk than children whose older sibling had survived. But the difference is not statistically significant in both the single factor and net effect models.

Table 13. Relative effects of predictor variables on child mortality.

Variables	Model 1	Model 2	Model 3	Model 4
Bio Demographic				
Preceding birth interval	**	*		*
<2 years	10.997*	7.680♣		7.591♣
2-3 years	2.216	1.578		1.615
3-4 years	7.530♣	5.056		4.862
>4	1.000	1.000		1.000
Birth Order				
1st	0.753			
2nd	1.000	1.000		1.000
3-4 order	0.676	1.781		1.722
5+ order	0.894	2.731		2.718
Duration of Breastfeeding	***	*		*
<12 months	6.862***	5.230**		5.093*
12-24	5.322***	3.936**		4.144**
>24 Months	1.000	1.000		1.000
Sex of child				
Male	0.531♣	0.539		0.539
Female	1.000	1.000		1.000
Survival Status of preceding child				
Alive	1.000	1.000		1.000
Dead	2.134♣	1.630		1.704

Socioeconomic				
Maternal Education				
No education	1.980		2.035	1.598
Some education	1.000		1.000	1.000
Marital status				
Currently in Union	1.000		1.000	1.000
Not in union	1.497		1.622	1.512
Wealth Quintile				
Lowest	0.997		0.775	0.837
Middle	1.417		1.209	1.085
Highest	1.000		1.000	1.000
Work status				
Working	1.000		1.000	1.000
Not Working	1.589		1.443	1.822
Ethnicity				
Sidama	1.000		1.000	1.000
Guragie	0.354		0.361	0.658
Welaita	1.020		1.101	1.899
Keffa	0.871		0.913	1.725
Hadiya	0.542		0.608	0.714
Gamo	1.598		1.707	1.368
Gedeo	0.429		0.436	0.715
Kembata	0.579		0.702	1.824
Others	0.485		0.536	0.885

*** = P < 0.001, ** = P < 0.01, * = P < 0.05, ♣ = P < 0.10

5.3.2 Socioeconomic Factors and Child Mortality

From the socioeconomic variables, maternal education, marital status and work status seem to have an effect on the chance of child survivorship. But none of them appear to have a significant effect in determining childhood mortality.

For instance, children from educated women experience higher chance of survivorship during childhood than children from mothers with no education in both the single effect and net effect

model, even though the magnitude of the effect is reduced in the full model. The reason that education does not show significant effect on childhood death could be due to the fact that the effect of education has already been explained by other variables.

Another possible explanation for this result could be the extent of education of women that are classified under the 'some education' category. Women with primary, secondary and higher education have been grouped all together as having some education because the number of cases under each group was too small for analysis if taken separately. However, over 80 percent of women in the "some education" category have only primary education.

According to the results of Table 13, children born to mothers in marital union have higher chances of survivorship as compared to children from mothers who were not in union. The explanation given for infant mortality holds here too.

The model results show that children from working mothers have a higher chance of surviving as compared to children from non-working mothers. Children from Wolaita, Keffa, Gamo and Kemabata ethnic groups seem to have a higher mortality risk than the remaining ethnic groups in the region.

In general, the results of the multivariate analysis confirm that demographic characteristics have consistent and substantial effect on infant and child mortality in the region. Birth interval and duration of breastfeeding are found to be the two most important variables that affect infant and child mortality. Moreover, mortality risk of children declines with increase in birth interval length and duration of breastfeeding. Infants born to younger mothers (less than 20 years) are more likely to die than infants born to mothers aged 20-34 years. Higher order births are also found out to be associated with high risk of infant and child mortality in the region.

From the socioeconomic variables maternal education shows a significant effect in determining infant mortality in the single factor model. But when control is made for other socioeconomic and demographic variables its effect is reduced and lost its significance. Other socioeconomic characteristics such as marital status and ethnicity also show some relationship with infant and child mortality even though their effect is not statistically significant.

CHAPTER SIX

CONCLUSION AND POLICY RECOMMENDATION

The purpose of this study was to identify the major determinants of infant and childhood mortality in the SNNPRS. The birth history data from the 2005 Ethiopian Demographic and Health Survey were used for this study and a total of 1730 children born five years preceding the survey were taken as unit of analysis.

Evaluation of data quality performed before conducting the actual analysis (using Meyer's blended index to measure degree of preference for digits of age data, sex ratio, average parity and proportion of dead children), revealed that the data are of reasonably good quality and can be used for further analysis

Levels of infant and childhood mortality were estimated using indirect techniques for the purpose of comparison and it was found out that infant and under-five mortality rates are lower compared to the region's mortality estimates based on the 1994 census, and that of both direct and indirect estimates of the EDHS (2000), while they are higher as compared to the direct estimates of the EDHS (2005). The results are consistent with the estimates of the 1997 community and family survey conducted in the region. The major difference between the direct and indirect estimates of the EDHS (2005) is due to the fact that the direct estimate was calculated for the 10 years period preceding the survey, and the Brass type (indirect) method itself is based on certain assumptions which may not usually be satisfied in practice.

Results

The result from the bivariate and multivariate analysis showed that children born to younger mothers (less than 20 years) have lower chance of survivorship. The effect of maternal age was more pronounced at infancy than later childhood periods. These results are consistent with findings of previous works that have found a lower chance of survival for infants born to teenage mothers (e.g., Assefa and Mekonnen, 1997; Sear et al., 2002; Sastry, 1994). The higher mortality risk of infants of younger women may be partly due to physical immaturity or lack of experience or knowledge in caring and treating children. The absence of any effect of maternal age on child

mortality suggests that the underlying causes of death during infancy are more of endogenous (prematurity, low birth weight, complication of delivery etc.) nature (Hamed, 1987).

Both the bivaraite and multivariate analysis results show that children born to older mothers (35 years or older) have almost the same mortality risk as compared to the reference category (20-34 years). The possible reason might be the fact that women who are older are more experienced in childcare.

An analysis of maternal factors on infant mortality confirms that controlling the effect of the preceding birth interval reduced the effect of young age at maternity. When control is made for birth order, the effect of young age at maternity is increased due to the higher risk associated with first order births, since most first order births (48 percent) are born to younger mothers (under 20 years) in the region.

Significant differences by length of preceding birth interval were also observed. The results confirm the negative effects of short birth interval on infant and child survival. The bivariate and Cox proportional Hazard model regression analysis demonstrate that children born after short intervals (less than 2 years) have lesser chances of survival than children born after relatively long birth intervals. Although the effect is statistically significant both at infancy and later childhood periods, length of previous birth interval has a more pronounced effect on infant survival.

This result is supported by findings from previous studies. For instance, evidence from developing countries over the last two decades shows that birth interval length remains the most important predictor of infant and child mortality risks, even when the confounding effects of socioeconomic, demographic and environmental factors are controlled (e.g., Cleland & Sather, 1984; Hobcraft, McDonald & Rutstein, 1984; Palloni & Millman, 1986; Pebley & Millman, 1986). One hypothesis of the pathway through which short preceding birth intervals affect child survival is that of maternal depletion. Under this hypothesis, a mother who has a child after a very short birth interval does not have time to recover from the previous birth so that her subsequent child is born weak and of low birth weight.

A result of separate analysis of maternal factors indicates that controlling for duration of breastfeeding appears to reduce the impact of short birth interval on infant mortality, due to its role

in regulating human fertility by lengthening the birth interval, especially in societies, like those in the SNNPRS, where the practice of modern contraceptive is low.

The result of the gross and net effect models confirmed that first and higher birth order children are more likely to have lower chance of survival than intermediate births. The findings on the relationship between birth order and survival are consistent with expectation, and the effect is more important during infancy. The high mortality risk for higher order births may be related to the age of the mother. Higher order children may face competition over resources such as food and medical care. The effect of first order and higher order births on childhood survival is not significant in both the bivariate and multivariate analysis.

This study also found out differences in infant and child survival by sex. Although the result in both the gross and the net effect model is not significant, the gross effect shows higher mortality risk for male children than female children at infancy. Excess male mortality has been documented by many researchers and has been attributed to the biological weakness of male children at birth. It has been noted that boys are more vulnerable to prematurity, malformation, and birth injury(Benjamin and Pollard, 1993). However, during childhood period, male children seem to have a higher survival chance as compared to female children.

In this study, duration of breastfeeding is found to be the most important variable explaining the variation in both infant and childhood survivorship. In all the models, children who were never breastfed and who were breastfed less than 6 months, face a higher risk of mortality as compared to children who were breastfed for relatively longer period. This can be explained by the effect of breastfeeding on child survival by its role in nutrient intake, birth spacing and anti-infective properties.

There is some support in this study for the correlation of mortality risks between siblings, since those whose previous sibling had died have higher risks of dying in infancy. Mortality between children of the same family may be correlated because of genetic reasons, child care practices, or access to similar quality and quantity of resources such as food and health care. The death of the previous sibling can have also an effect on the survival chances of the index child by reducing the

length of the birth interval, either because of biological factors (a quick return to fecundity due to curtailed breastfeeding), or by parental choice (replacement of the dead child).

The result of the gross effect model revealed that those infants who were born from mothers with some education have a better chance of survival as compared to those infants who were born to mothers with no education and its effect is significant at $p<0.05$ levels. But maternal education lost its significance when control is made for other variables.

Among the socioeconomic variables, maternal education, marital status and type of toilet facility are found to be important variables in explaining the variation in infant and childhood mortality even though their effect is not statistically significant.

In this study, households with access to a flush toilet are found to have a lower mortality risk than households with pit latrine or no facility. But contrary to the expectation, the variable for pit latrine did not turn out to be significant and it is in fact related to higher mortality risks. This could be explained by the fact that owning a toilet facility does not mean that it will be used hygienically or used by all members of the household

Contrary to the expectation, the bivariate analysis in this study confirms that children born to mothers who had received assistance at delivery and those who delivered in a health facility have higher mortality risk as compared to children born to mothers who were not assisted by a health professional or delivered at home. This result might be attributed to smaller number of cases (births at health facility and assisted by health professional) in the region. Another reason for such result may possibly be that mothers who seek assistance or go to health facilities might be those who encounter pregnancy complications that are associated with higher risk of child death, or go to health facilities as a last resort after long labours at home.

Results from both the bivariate and multivariate analysis revealed that ethnicity shows considerable effect during infancy than during childhood period. It was found out that infants from Keffa ethnic group are more likely to die than infants from other ethnic groups. This could be explained by relatively higher number of illiterate mothers (85 percent) among this ethnic group. Though the effect is not statistically significant children from Welaita, Keffa, Gamo and Kembata ethnic groups seems to have higher mortality risk than the remaining ethnic groups in the region.

The difference in childhood mortality among these ethnic groups may possibly be attributed to the cumulative effects of major famine and drought episodes in 1984-85,1993-1999 and 2002-2003 in Sidama,Wolayita and Gamo Gofa zones which depleted household coping mechanisms and leads to livelihood crises (USAID, 2005).

In general, analyses of infant and child mortality in this study have shown that bio-demographic factors are relatively important for determining both infant and childhood mortality in the SNNPRS. From the maternal factors, duration of breastfeeding and preceding birth interval are found to be the most important variables that determine infant and childhood mortality in the region.

Of the working hypotheses adopted at the beginning of the study, two of them (those concerning birth order and previous birth interval) have been proven right in case of infant mortality. Age of the mother at the time of childbirth is partially proven for the case of young age at maternity. The other hypothesis dealing with maternal education is proved to be right only in the case of the bivariate relation. When control is made for other socioeconomic and demographic variables maternal education lost its significance, even though the magnitude of the relationship is in the expected direction. This is due to the fact that its effect has been already explained by other variables.

Recommendations

The following recommendations are proposed based on the findings of this study:

- Encourage women in the region to breastfeed their babies for longer period of time, as the results of this study indicated that lengthening birth interval could reduce both infant and childhood mortality. Availing contraceptive supplies and ensuring access to them will also help to lengthen the pace of child bearing and hence lower mortality risk of children in the region.

- Promotion of breastfeeding will have a great effect especially in areas where there is inadequate access to clean water supply and waste disposal facilities, as breastfeeding is found to be one of the most important variable that determine infant and childhood mortality.
- Efforts have to be made to improve family planning programs that may play a significant role in both fertility and mortality reduction, as higher order births are found to have a strong association with infant mortality and the presence of higher order birth is an indicator of high parity.
- Effective education that discourage teenage child bearing and early marriage should be given to women, in order to curb the high mortality of children born to very young mothers in the region.
- Community based homecare should be given as a strategy for improving maternal and child care, as the results of this study indicated that the use of maternal and child health care services in the region is very limited.
- Further studies are needed on mechanisms related to excessive risk of infant and child death in mothers with a history of prior child loss. Both biological and behavioral mechanisms may be operating, but these are not yet well understood.
- Further studies on socio-cultural practices, seasonal food insecurity and other related factors that contribute to the differences in childhood mortality among various ethnic groups (children from Wolaita, Keffa, Gamo and Kembata ethnic groups have relatively higher mortality risk than other ethnic groups) is suggested.

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ANNEX

Annex I: Multicollinearity Diagnosis for Infants

Independent variables	Collinearity Statistics			
	All independent Variables		Excluding place of delivery and assistance at delivery	
	Tolerance	VIF	Tolerance	VIF
Age at maternity	0.611	1.636	0.615	1.626
Birth order	0.586	1.706	0.588	1.700
Preceding Birth interval	0.895	1.118	0.902	1.108
survival status of preceding child	0.945	1.058	0.945	1.058
Duration of breastfeeding	0.532	1.797	0.557	1.794
Multiplicity of birth	0.911	1.098	0.925	1.081
Current marital status	0.967	1.034	0.968	1.033
Work status	0.908	1.101	0.913	1.096
Wealth Index	0.738	1.355	0.755	1.325
Maternal Education	0.826	1.211	0.849	1.178
Religion	0.929	1.077	0.930	1.075
Ethnicity	0.953	1.050	0.956	1.045
Type of toilet facility	0.799	1.251	0.800	1.249
Place of delivery	0.098	10.251		
Assistance at delivery	0.096	10.396		

Annex II: Multicollinearity Diagnosis for child

	Collinearity Statistics	
Independent variables	All independent Variables	
	Tolerance	VIF
Age at maternity	0.922	1.084
Birth order	0.919	1.088
Preceding Birth interval	0.951	1.052
survival status of preceding child	0.971	1.029
Duration of breastfeeding	0.959	1.043
Multiplicity of birth	0.965	1.037
Current marital status	0.985	1.015
Work status	0.970	1.031
Wealth Index	0.761	1.315
Maternal Education	0.892	1.121
Religion	0.974	1.026
Ethnicity	0.965	1.037
Type of toilet facility	0.809	1.236
Place of delivery	0.294	3.406
Assistance at delivery	0.293	3.416

DECLARATION

The thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for the thesis have been duly acknowledged.

Name SELAMAWIT MUSSIE

Signature _____

Date 09-08-2007

This thesis has been submitted for examination with my approval as university advisor.

Asseja Hailemariam — Asseja Hailem — Aug. 9, 2007

Advisor — Signature — Date