CHILDHOOD MORTALITY IN AMARA REGION: A CASE STUDY OF MISRAK GOJJAM AND WAG HEMRA ZONES

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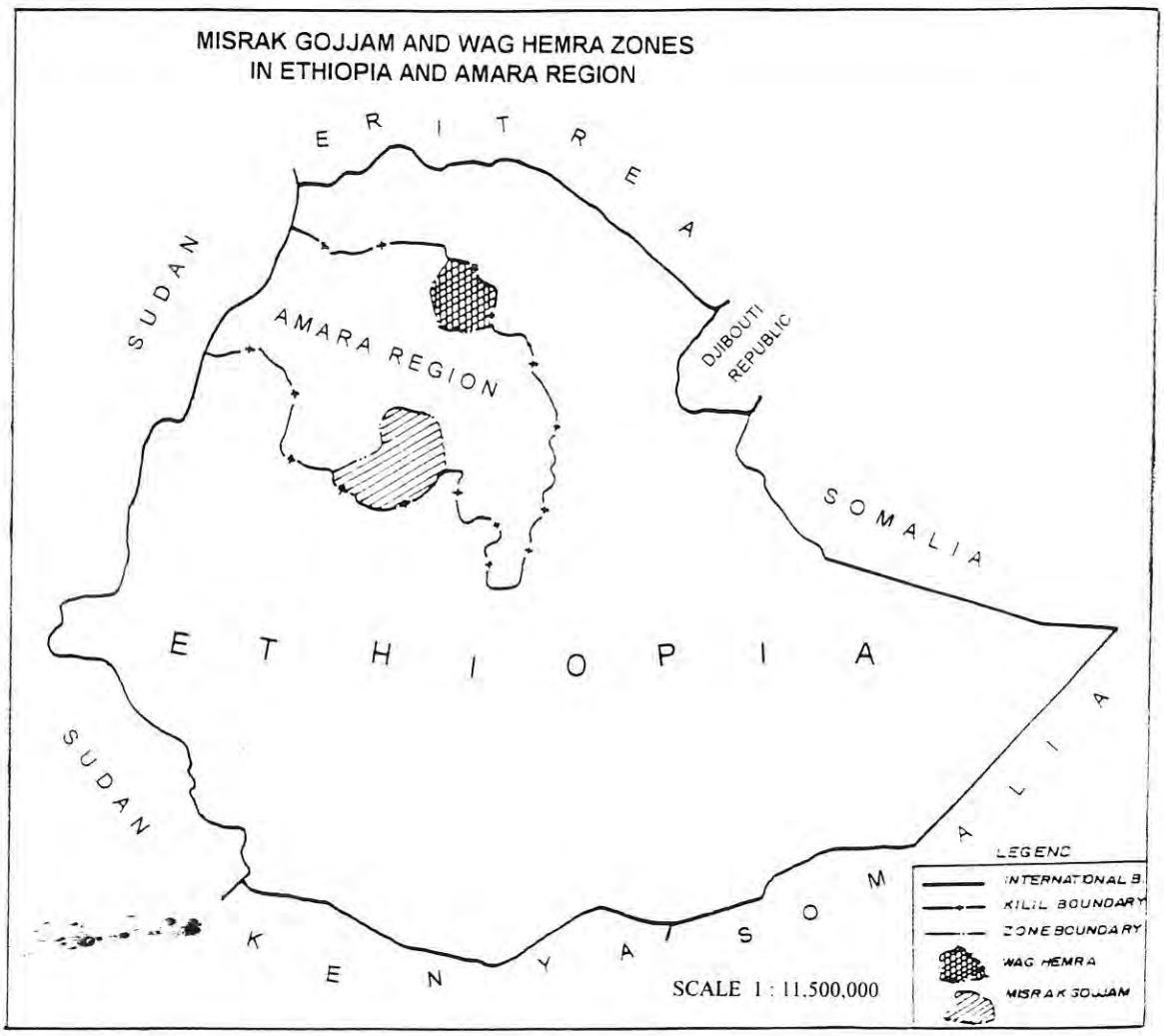
MISRAK GOJJAM AND WAG HEMRA ZONES
IN ETHIOPIA AND AMARA REGION
E R I T R E A
SUDAN
AMARA REGION
DJIBOUTI REPUBLIC
SOMALIA
E T H I O P I A
SUDAN
K E N Y A
S O M A L I A
LEGEND
INTERNATIONAL B.
KILIL BOUNDARY
ZONE BOUNDARY
WAG HEMRA
MISRAK GOJJAM
SCALE 1 : 11,500,000

Source: CSA

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ABSTRACT

This study examines variations in childhood mortality between Misrak Gojjam and Wag Hemra Zones of the Amhara Regional State. Misrak Gojjam is relatively more accessible than Wag Hemra and by indicators such as food security, the former is much better than the latter. The thrust of the study is to compare the two zones in terms of the correlates of childhood mortality using the data generated by the Census of Population and Housing of Ethiopia of 1994.

Childhood mortality is found to be relatively higher for Misrak Gojjam Zone than Wag Hemra Zone. If we exclude information from the first and the last two age groups of women in the reproductive age, childhood mortality had shown a declining trend in the recent past for each zone. In spite of the fact that Misrak Gojjam is relatively more accessible, relatively free from the problem of food insecurity and less affected by the last civil war than Wag Hemra, child mortality is higher in the former than in the latter.

Using Trussell and Preston (1981) dependent variable (the ratio of observed to expected deaths) that can be used for statistically sound childhood mortality studies, and controlling for twelve explanatory variable in the model, the proportion of children dead among children ever born was 11.0 per cent higher in Wag Hemra Zone compared to Misrak Gojjam Zone. In addition, the study revealed zonal variations in signs and strengths of the interrelationships between childhood mortality with its covariates . The general level of the socio-economic factors, and ecological settings may be the possible reasons for such an observed variations in childhood mortality between the two zones.

It can be concluded from this study that relatively drought prone (food insecure) and remote areas need priority attention, indeed without ignoring other areas in the Amara region. Finally, further studies concerning childhood mortality are highly recommended.

CHAPTER I

INTRODUCTION

1.1. Background

High mortality is mostly observed in developing countries. Specially the share of the infant and early childhood mortality out of the total deaths in a year is much higher when compared with the other sections of population. Out of the total deaths in a year for Africa, for instance, 35 to 54 per cent was the share of infant and early childhood deaths (ECA, 1979). This is also true in the Ethiopian case. In the year 1997, for instance, the overall mortality rate (crude death rate) was 18 deaths per 1000 persons, while the infant mortality rate was 120 deaths per 1000 live births (PRP, 1997).

According to the 1984 Population and Housing Census of Ethiopia, out of 1000 live births 160 children will die before reaching the age of five years (P.H.C.C, 1991). The census that had been conducted after a period of a decade (the 1994 census) also indicated that out of 1000 live births 164 children will die before reaching their fifth birth date (P.H.C.C, 1991). This implies that there was no decline in childhood mortality between these two periods.

High childhood mortality is not only observed at the national level, but it is also observed in most parts of the country. If we take the northern portion of the country, for instance, the 1984 population and housing census indicated that under-five mortality was 155, 153 and 131 children per 1000 live births for the former Gojjam, Wello and Gondar administrative regions (P.H.C.C, 1991). The current Amara region is mostly a union of the former Gojjam, Wello and Gondar administrative regions, and according to the 1994

census report, out of 1000 live births 170 children will die before reaching the age of five years in the Amara region. This implies that childhood mortality is still high in the northern portion of the country.

In general, high childhood mortality had been observed for the overall country and for several administrative regions at different time periods. A decline in childhood mortality is also not observed when comparison is made for two census periods for the country as a whole and for the northern portion of the country in particular.

1.2. Statement Of The Problem

The 1994 population and housing census of Ethiopia had revealed that the total population of the country was about 53.5 million of which 25.9 per cent were residing in the Amara region, the second highest, with respect to population size, among the eleven regions in the country. From the total population of the Amara region, women of all age groups comprise 49.8 per cent of which 58.5 per cent were found in the reproductive age groups (PHCC, 1998). Under five year mortality rate ranged in the region from 120 deaths per 1000 live births in Bahir Dar Special Zone to 211 deaths per 1000 live births in Misrak Gojjam Zone. The region has 12 zones, and all areas in the region are not equally accessible due to transportation problems that prevail in some parts of the region. In addition to this, some zones have been found in drought prone areas, and some areas in the north and north-western part of the region were identified as war front areas relative to the other areas in the region during the Derg Regime.

Wag Hemra Zone is relatively inaccessible when compared with the other zones that are found in Amara region. It is situated in the northern part of the region, about 530

Kilometer away from the regional capital, Bahir Dar, and about 700 Kilometer away from the primate capital city of Ethiopia, Addis Ababa. It is also one of the drought prone areas, and it was considered as a war front area during the Derg Regime when compared with the other zones in the region.

In contrast to this, the more accessible zone to the capital of the region (Bahir Dar), next to Debub Gondar and Mirab Gojjam, and to the capital of Ethiopia (Addis Ababa), next to Semen Shewa, is Misrak Gojjam Zone. It is situated in the southern portion of the region about 300 Kilometers away from Addis Ababa and about 250 Kilometers from Bahir Dar. It was a relatively secure area when compared with Wag Hemra Zone with respect to drought, and peace and stability for decades before the year 1991.

In most cases, planners give priority attentions to remote and inaccessible areas assuming that such areas suffer from scarcity of modern social services like information, education, health, and the like. A health planner, for example, of the Amara region might consider Wag Hemra Zone as a priority area in the region for implementing infrastructures that can improve the health status of the people. Such type of decision may be misleading unless it is supported by relatively reliable information that can indicate the status of each zone with respect to the levels, patterns and determinants of mortality.

As can be seen from the 1994 census result, under five years mortality rates were 211 and 167 deaths per 1000 live births in Misrak Gojjam and Wag Hemra Zones, respectively (P.H.C.C, 1995; P.H.C.C, 1998). It is mostly expected that areas that suffer from intermittent drought and civil war will have higher childhood mortality than areas that are relatively secure. But in the case of Misrak Gojjam and Wag Hemra Zones, the rates are found to be out of one's expectation

Generally speaking, according to the 1994 census statistical reports, high under five year mortality was observed for the Amara region and there was also some indications of cross zonal differences concerning childhood mortality. Specifically, unexpected direction of variation in childhood mortality between Misrak Gojjam and Wag Hemra Zones was observed. It is therefore proposed that critical study on childhood mortality is vital to draw plausible policy implications for the two areas in the region.

1.3 Objectives of The Study:

The general objective of the study is to study childhood mortality for Misrak Gojjam and Wag Hemra Zones, in order to have an overview about variations in childhood mortality between these zones.

The specific objectives of the study are:-

1. To elucidate some background characteristics of women at the reproductive age in order to have an overview about the status of these women in the two areas in the region.
2. To estimate childhood mortality rates and trends, and to study childhood mortality differentials for the two zones.
3. To find out some possible socio-economic and demographic factors that may lead to childhood mortality differentials in the two areas in the region
4. To forward plausible policy recommendations based on the study results for the two areas in the region

1.4. Related Literature Review

Several studies have been conducted around the world concerning childhood mortality, and different arguments about the factors favoring high or low mortality have been suggested. One of the factors is place of residence where attempts are made to show that there are urban/rural differences in the level of mortality. Several scholars argue that childhood mortality rates are lower in urban than in rural areas because of the relative availability of modern health services. Studies conducted in India (1979), Ghana (1979) and Zimbabwe (1979) showed that infant and child mortality rates in urban areas are considerably lower than in rural areas. A study in Senegal by Martin Brockerhoff also revealed that the risks of child mortality among rural natives remain 6 times that of urban natives. But a study by Ewbank et al (1986) in Kenya found that mortality levels in urban areas are high on account of the fact that most cities and towns include low income population groups, recent migrants who have abandoned some of the traditional child-feeding practices such as extended breast-feeding, and who have not yet learned to take advantage of modern medical facilities. A study in Ethiopia suggests that infant mortality was lower in the urban population (94 per 1000) than the rural population (105 per 1000), (CSA, 1993).

One of the covariates of childhood mortality is educational level of Mothers. Because of her responsibility for her own care during pregnancy and the care of her child through the most vulnerable stages of its life, woman's educational level can affect child survival by influencing her choices and increasing her skills in health care practices (Mosley and Chen, 1984). Caldwell (1979) also explained the importance of education as follows:

" .....maternal education is the single most significant determinant of these marked differences in child mortality."

"..... maternal education cannot be employed as a proxy for general social and economic change but must be examined as an important force in its own right."

Educated mothers may change a range of feeding and child care practices without imposing significant extra costs on the household, may be capable of manipulating the modern world and/ or may greatly change the traditional balance of familial relationships with profound efforts on child care, and hence will have a lower proportion dead of their children when compared with that of non-educated mothers (Caldwell, 1979).

Various studies in developing countries have also supported the above general argument. Studies in Ghana by Tawiah (1979) and Caldwell, (1979) have revealed the existence of strong negative relationship between education and childhood mortality. Zimbabwe Demographic and Health Survey (ZDHS) and a study in Kenya by Ewbank et al (1986) revealed the same result as observed elsewhere in developing countries. According to the ZDHS report: *"[O]ver all, under-five mortality for children of women with at least a secondary level of education was less than half that of children whose mothers had no formal education."* Ewbank et al argued that *"[I]n all of the studies of the social determinants of child mortality, education appears as a central variable."* and *"..... the more educated woman in every age group reported a lower proportion deceased among their children."* In the Ethiopian context also, the same inverse relationship between education and childhood mortality was observed in several researches (CSA, 1993; Mekonnen, 1993, Yohannes, 1990; and Meaza, 1997).

Differential in childhood mortlity by migration status of women is empirically documented. A study in Senegal by Martin Brockerhoff (1990) revealed that the risk of

dying remains much higher, among urban migrant children than among children of urban natives (non-migrants), particularly after infancy, even after the mother has lived in a city for several years. The risk relative to that of urban natives is more than 9 times greater for rural natives, 5 times greater for recent migrants, and almost 4 times greater for longer-time migrants.

Some studies show that marital status of mothers has an influence on the risk of dying of their children. A study in Senegal by Martin Brockerhoff (1990) has revealed that the risk of child death is reduced by half when the mother is currently married, suggesting a critical role for fathers in providing financial assistance and emotional support for the mother and in assisting in child-raising duties. In Ethiopian case lower mortality of children born to mothers who are currently married is observed in a study by Yohannes (1990) in Addis Ababa town and Assefa (1991) in Shewa Region.

It is argued that children of young mothers experience mortality risks well above average (UN, 1983). In general, young age reflects maternal immaturity, while old age is associated with high probability of birth defects (Davanzo, 1984). Thus, childhood mortality may be higher for those young and older women and relatively lower for those women in between these two groups. In fact, some research results have indicated that children of older women have lower risks of infant deaths and this may be due to the higher infant death rate suffered by children born to mothers under age 20 (Ewbank et al, 1986).

A large household size means too many competitions among household members for food, clothing, shelter, etc. (Davanzo, 1984). Assuming that other conditions are being constant, a household with a larger size will have a lower status of its members with respect to nutrition and health when compared with a household with a smaller family size.

So, women from a household with a larger number of members are expected to have a higher proportion of children dead than women from a household with a smaller number of members.

On the other hand, family members such as grandfathers and other relatives can substitute for parents in child care, and hence parents and other family member can easily engage in a gainful economic activity to generate income for the family (Davanzo, 1984). With regard to this argument, household size may have a negative association with childhood mortality. The interrelationships between parity of the mother's and the survival chance of their children is also well studied and documented. The general argument forwarded by scholars is that childhood mortality is an increasing function of parity of the mothers (UN, 1983)

Through expanded mass media it is possible to improve the health conditions of the society by diffusing improved knowledge with regard to personal hygiene, nutrition, environmental dangers, and so on. They may also breakdown traditional beliefs and customs and thus undermine cultural practices, such as feeding habits, attitude towards modern treatment and disease prevention, and others (Easterline, 1978; Mosely and Chen, 1984). In line with this argument, availability of information media in the household may have an impact on the survival chance of children born and bring up in that particular family.

The household economic status can be considered as a measure of the flow of economic resource to the family (Tekce and Shorter, 1984). Thus a household with a better economic status may have basic minimum supply of food, clean water, clothing/ bedding, housing, etc., so that its members will not be easily subjected to infectious diseases. Thus, women from wealthy households are expected to have lower proportion of children dead

when compared with women from relatively poor households. Indeed, Tekce and Shorter (1984) in their study in Jordan had shown that there was no difference in child mortality between women from households with above and below medium economic status. In Ethiopian case, a study by Yohnnes (1990) in Addis Ababa, using rent level of a housing unit as a proxy indicator of household economic status, have shown a negative association between childhood mortality and household income and wealth.

The availability of sanitation facilities in a household may have a strong association with the survival chance of children in that particular family. Secure way of west disposal, clean kitchen materials and rooms for food preparation in the household may minimize the probability of a child getting ill. Specially, both the quality and quantity of water supply, and the availability and the quality of toilet and kitchen are important correlates of exposure to disease, and hence the availability of tap water, and clean toilet and kitchen facilities for a family may be the major indicators of sanitation status of a household. Both toilet, kitchen and clean water facilities affect childhood mortality through affecting the rate of illness of a healthy child in the family (Mosely and Chen, 1984).

The above arguments have been supported by various studies around the world. In India(1979) the infant mortality rate was relatively lower for a household who had had tap water supply than well and pond/Tank/ River water supply. A study in Senegal by Martin Brockerhoff (1990) had also revealed that the availability of piped drinking water and flush toilets in the household reduce the mortality risk by 23 per cent and 26 per cent, respectively, during infancy and by 56 per cent and 35 per cent, respectively, at later ages. In Ethiopian case, a study at Sebeta town by Mekonnen (1993) revealed that the mortality rate of children born to households without latrine was higher than children born to

households with latrine. A study in Addis Ababa by Yohannes (1990) had also revealed that mothers using tap inside the house or compound experience 32 per cent lower child mortality than those who use tap outside their compound. In the same way, in the 1990 National Family Fertility Survey (NFFS) of Ethiopia, infant mortality was slightly lower for children who live in a household which had access to safe drinking water (104 per 1000) and flush latrine (73 pert 100), compared to those who live in a household without access to safe drinking water (109 per 1000) and flush latrine (109 per 1000).

Concentration in densely populated areas may increase exposure to disease and tends, other things being equal, to increase mortality (Easterline, 1978). Thus, mortality can be related to population density directly through increased spread of disease. It may also have an indirect impact through the availability of social services such as schools and other advantages that sometimes appear in heavily populated areas before they are extended to sparsely populated places (Ewbank et al, 1986). In relation to the above arguments, because of the reason that communicable diseases can easily be transmitted from one locality to another, the risk of dying may be much higher in densely populated areas than relatively sparsely populated areas, in fact, if all other conditions are equal. In addition to this, there may be a strong competition for resources among residents and scarcity of the necessary resources such as land may affect the economic status, and then the nutritional status of the community and ultimately it may affect the health status of the people. In the other direction also, mostly governments give priority attention to densely populated areas than sparsely populated areas with respect to the supply of social services. Generally, population density may have a positive or a negative impact, depending on the context, on childhood mortality.

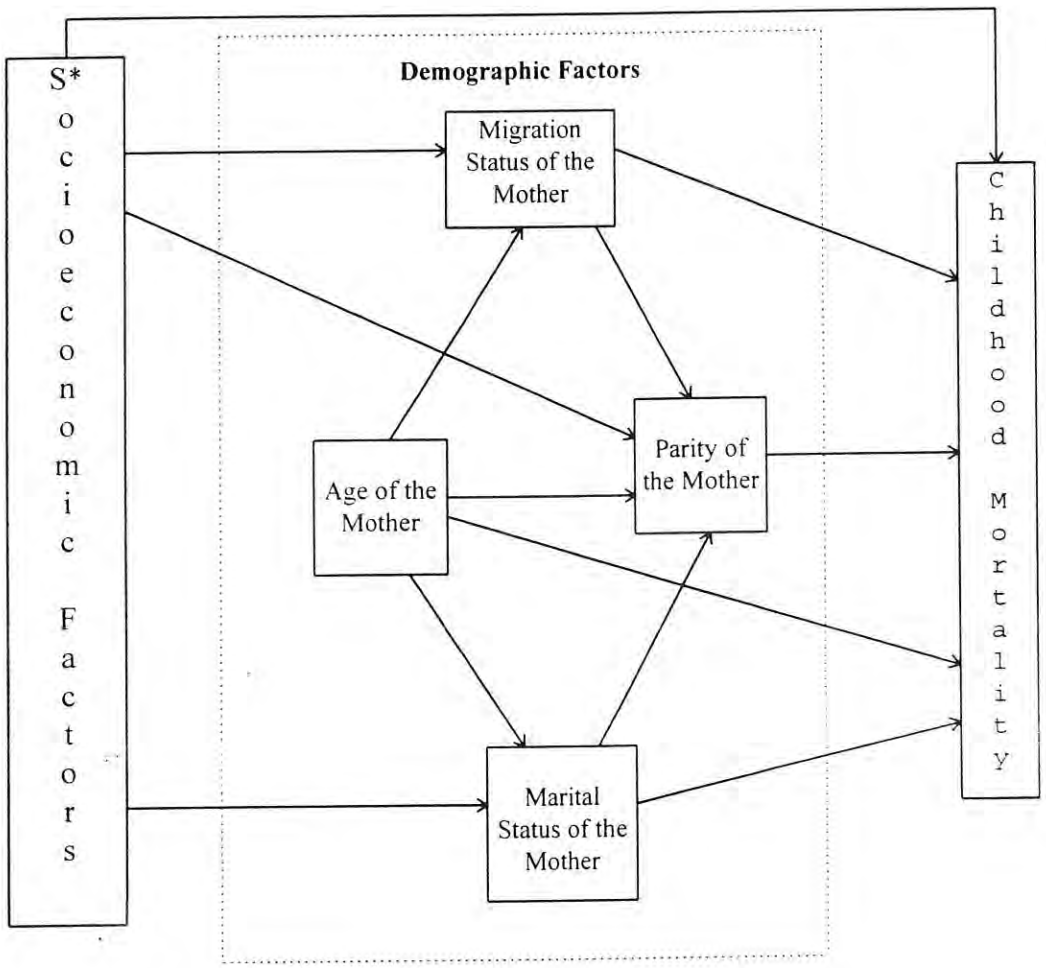
Modernization has been considered as a major factor for the decline of mortality as can be understood from the demographic transition theory of Europe. The wide spread of modernization in Europe led to an improvement of water supply, housing and sanitation conditions. These improvements in turn led to a decline in mortality level during the 17th, 18th and 19th centuries. Advancement in medication also contributed to a decline in infectious disease such as smallpox. When conditions for improving one's chances of living become available, they are easily accepted by the people. Generally, the advancement of the community may have a strong impact on the survival chance of children in that society (Thomson, 1929 as cited in Kammeyer and Ginn, 1986). The development status of the society can be identified by various indicators, such as percentage adult (15+) literate (ECA, 1979). A community with a higher percentage of literate may be in a better position with respect to its socio-economic development relative to a community with a lower percentage of literate out of its total population. Therefore, women from a community with a relatively higher percentage of literate population may have a lower proportion of children dead. This is because of the reason that in most cases socioeconomic developments may have a negative association with mortality (Thomson, 1929 as cited in Kammeyer and Ginn, 1986).

A study by ECA Population Division (1979) in Africa showed a strong association (zero order correlation coefficients) between infant mortality, and percentage of adult (15 years and over) literate population. In addition an ordinary least square regression had also shown that the partial coefficients for percent adult literate population was significant at 0.01 significant level.

1.5. Conceptual Framework

Two groups of factors have been considered for the study. The first group consists of some of the socio-economic factors, while the second group incorporates some demographic factors. To facilitate discussion, a grouping of variables is portrayed in figure 1.1, which does not presume to be an operational dynamic model, rather it is a schema for factors affecting childhood mortality.

Figure 1.1: Conceptual Framework of the Study



Note: * Under the 'Socio-economic Factors' the following variables are included:

a) Mother background characteristics
   -Zonal residence - Current urban-rural residence - Level of Education

b) Household's Background characteristics
   - Household size - Possession of radio
   - Proxy indicators of economic status - Proxy indicators of sanitation status

c) Background characteristics of the Wereda
   - Population density - Percent adult (15+) literate

As portrayed in the given diagram, socioeconomic factors are assumed to be the ultimate determinants of child survival, and they are expected to have a direct and indirect influence on childhood mortality. Their indirect influence is expected to reach at the ultimate dependent variable (childhood mortality) through affecting some of the demographic factors that have been introduced into the given causal model. The demographic factors in turn are also expected to have a direct and an indirect influence on the survival chance of children. The indirect effect of a demographic factor is expected to reach at the ultimate dependent variable through affecting the factors that are posterior to it. Even if most of the explanatory variables under study are expected to have a direct and an indirect effect, the direct influence of each explanatory variable will be considered to measure the relative importance of a variable in explaining the dependent variable.

1.5.1. Variables Under Study

*1) **The Dependent Variable.*** The dependent variable for the study is childhood mortality that is operationally defined as mortality under the age of five and is indexed by the ratio of observed deaths to expected deaths that can be computed for each woman or groups of women using the Trussell and Preston (1981) procedures. One has to understand here that the proportion of children ever born who have died are indicators of child mortality and can yield robust estimate of childhood mortality (UN, 1983)

2) Socio-economic Variables. Under this category of the explanatory variables, three groups of variables are considered:

a) Mother's Background Characteristics

Current place of residence (rural-urban and zonal residence status) and educational levels of mothers are considered under these groups of socio-economic factors. Urban center is generally defined as a locality with 2000 or more inhabitants. However, in

addition to this, in the census urban centers includes all administrative capitals regardless of population size, and all localities having a population of 1000 or more persons who are primarily engaged in non-agricultural activities (P.H.C.C, 1998).

Current residential status is expected to indicate the influence of environment on individual person's attitude and behavior in child care activities, while educational level of mothers indicates its impact on the survival chance of children through improving the skills of mother's in child care activities such as prevention and treatment of diseases and by affecting other intermediate factors (Ewbank et al, 1986; and Caldwell, 1979).

b) Households Background Characteristics

Household size, availability of a working radio, proxy indicators of economic and sanitation statuses are included in this group. A larger household size means too many competitions among household members for food, clothing, shelter and the like and hence may have an impact on the survival chance of children (Davanzo, 1984). Availability of a working radio in a household may increase the knowledge of household members in relation to personal hygiene, food care, environmental dangers and so on. It is also possible to breakdown bad traditional beliefs and customs in relation to child care activities by diffusing knowledge of modern practices through media (Easterline, 1978; Mosely and Chen, 1984).

Economic and sanitation conditions of a household will have a major impact on the survival chance of children. The household economic status can be considered as a measure of the flow of economic resources to the family, while sanitation status indicates the quality of life with respect to sanitation conditions in the household which have the major role in transmission of diseases (Mosely and Chen, 1984; and Tekce and Shorter,

1984). Both economic and sanitation statuses of the household are introduced into the analysis using proxy indicators (see Appendix I for detail descriptions of these indicators).

c) Background Characteristics of the Wereda

Population density and percentage adult (15 years and over) literate population of the wereda are included in this group. Concentration in densely populated areas may increase exposure to infectious diseases and may also aggravate scarcity of resources in a population. Thus, mortality can be related to population density directly through increased spread of disease. It may also have an indirect impact through the availability of social services that sometimes appear in heavily populated areas before they are extended to sparsely populated places (Easterline, 1978; and Ewbank et al, 1986).

Percent adult literate population of a wereda is expected to be an indicator of modernization. As we know from various literature, modernization has a strong impact on the survival chance of individuals (Thomson, 1929 as cited in Kammeyer and Ginn, 1986). A society with higher percentage literate population may be in a better position with respect to its socio-economic development and hence women from such areas may have lower proportion of children dead. Modernization may not always have a negative impact on childhood mortality, but it may also reduce the survival chance of children at its early stage.

3) Demographic Variables. Age, migration status, parity and marital status of the mother are included in this category. Age of the mother is considered in completed years and it may have an impact on the survival chance of children in the sense that the child raising activities may vary by the age of mothers. It may also affect the ultimate dependent variable through affecting other demographic factors as can be seen from the causal model.

Migration status of the mother may affect the survival chance of children through selectivity, disruption and adaptation processes of migration. Migrants are mostly selective in their characteristics in the sense that they have better status, in any respect, than the none migrants in their place of origin. They may disrupt their life style due to migration and may adapt new way of life in their distention place (Brockerhoff, 1990). Thus, the proportion of children dead among children ever born may vary by migration status of mothers.

An operational definition of migration was made during the 1994 census. In rural areas, a woman was said to be a migrant if she was born in rural areas of another wereda or any town but currently found in the wereda of enumeration (life time migrant). In addition to this, a woman was also considered as a migrant if she was born in rural areas of the wereda of enumeration but at one time or another resided in a rural part of a different wereda or any town and has returned to the rural part of the wereda of enumeration (return migrant). A woman was said to be a non-migrant one if she was born in the rural part of the wereda and resided there continuously until the enumeration date (P.H.C.C, 1995b).

In urban areas, a woman was said to be a migrant if she was born in another town or any rural part of Ethiopia, but currently found in the enumerated urban area. or if she was born in the same town but at one time or another resided in any other place. But, a woman who was born in a given town and continuously residing there, was considered as a non-migrant woman (P.H.C.C, 1995b).

During the census, each woman was asked about the number of live births she had had up to the date of the survey and recorded, and this number is called the parity of the women.. The number of live births for a woman may affect the survival chance of her

children through affecting the intensity of child care activities that are mostly given to the child at the early stages of life.

Marital status may have an impact on childhood mortality and the possible explanation for this is that the role of fathers in child-raising activities, such as providing financial and emotional support for the mother.

1.6. Hypotheses to be Tested:

An attempt has been made to test the following hypotheses:

- The survival chance of children in Misrak Gojjam Zone (a relatively food secure zone) is expected to be higher than the survival chance of children in Wag Hemra Zone (a relatively food insecure zone).
- Children of women in urban areas will have a higher survival chance than their rural counterparts.
- A rise in the age of the mother increases the risk of the death of her children.
- Educational level of the mother is likely to have a negative impact on childhood mortality
- Children of migrant women will have higher mortality than children of non-migrant women.
- Children of currently married women will have lower childhood mortality as compared with those children born to divorced and widowed women.
- Parity of women is expected to have a positive relationship with childhood mortality.
- Household size will have a positive association with childhood mortality.

- Availability of a working radio in a household may increase the survival chance of children of the family.

- Household economic and sanitation statuses are expected to have a negative association with childhood mortality.

- Percent literate, out of the total population aged 15 and older, and population density of a wereda are expected to have a negative relationship with childhood mortality

1.7. Data Source

During the 1994 population and Housing Census of Ethiopia a 20 percent sample of households was chosen and each member in the selected households was asked about his background characteristics and the response was recorded using a long questionnaire that was administered during the census in conjunction with the short questionnaire. Among other questions asked during the census, questions of the Brass type were the ones that have been considered as the appropriate method of data collection for fertility and mortality studies in developing countries. Therefore this data will be used for the study.

The total number of women, in the reproductive age groups (15 - 49 years) interviewed using the long questionnaire were 78,387 and 14,020 for Misrak Gojjam and Wag Hemra zone, respectively, of which 53,850 and 10,027 were found in the age group 20 - 44 years in the former and the latter zones, respectively. Among the number of women in the age group 15 – 49 years only 55,510 and 9,448 had at least one live birth for Misrak Gojjam and Wag Hemra zones, respectively. In the same way, out of the total number of women in the age group 20 – 44 years only 46,188 and 8,109 had at least one live birth. Those women who had had at least one live birth are eligible for the major sections of the study.

1.8. Methods of Analysis

To estimate levels and trends of childhood mortality, *indirect methods for demographic estimations* have been used. The reason is that data from the less developed countries mostly suffer from errors and hence this method will give reliable estimates of childhood mortality rates.

To study differentials and covariates of childhood mortality, appropriate descriptive and analytical statistical methods have been used. Concerning the descriptive methods, univariate and bivariate analysis have been used. With respect to analytical statistical methods, multivariate analysis is used.

The dependent variable is childhood mortality that is indexed by the ratio of observed deaths, O_i, to expected deaths, E_i, that was suggested by Trussell and Preston (1981). The ratio of observed to expected death can be a continuous variable that is computed for each women and hence multiple linear (OLS) regression is used for the multivariate analysis, and the descriptions of the model is presented in the due section.

1.9. Organization of the Study

The study is organized into six chapters. The first chapter is an introductory chapter which incorporates the background of the study, statement of the problem, objective of the study, review of some literature, conceptual framework, hypothesis, data source, methods of analysis and this section. In the second chapter an attempt is made to assess the quality of the data. The background characteristics of the respondents are also described in the second chapter. In the third chapter estimated levels and trends of

childhood mortality have been discussed using various demographic techniques that have been suggested by scholars.

The fourth and fifth chapters deal with factors affecting childhood mortality in the study areas. Methods of obtaining Trussell and Preston dependent variables for childhood mortality studies are discussed under these chapters. Univariate and bivariate results are presented in chapter four, while in chapter five, multivariate results and their implications are discussed. Finally, summary of the major findings and their policy implications are discussed in chapter six.

CHAPTER II

DATA QUALITY CHECK, AND CHARACTERISTICS OF THE STUDY POPULATIONS

2.1. Introduction

Among the errors that are affecting the data quality are age-heaping (digit preference) by mothers, omission of children that have died and inclusion of still births among the children ever born to the mothers. These errors may have a strong negative impact on the reliability of childhood mortality estimates (Brass, 1975). Hence, assessment of data quality before the actual estimation process is vital.

2.1.1. Quality Of Age Data

Various methods have been suggested by scholars to check the quality of age reporting. Among others, Myers' blended method is the one that can be used in this case This method is appropriate because it can provide the degree of preference for each digit, and it can also give the overall summery index for all terminal digits. The index of preference for each terminal digit is calculated as deviation from 10 per cent of the total population reporting on the given digit. A summary index of preference for all terminal digits is computed as one-half of the sum of the deviations from 10 per cent, each taken irrespective of sign. The summary index indicates the minimum proportion of persons in the population for whom an age with an incorrect final digit is reported. The theoretical values of the summary indices are 0 and 90. The value 0 indicates that there is no age heaping at all, while a summary index very close to the value 90 implies that the age reporting is very rough (Shryock and Siegal, 1976).

Considering women in the age groups 20 to 49 the Myers' index is calculated and presented in Table 2.1. According to the results obtained, in Misrak Gojjam zone, the most avoided ages, in descending order, were those ages ending in digit 9, 1, 4, 3, 7, 6 and 2; while the most preferred digits, in descending order, were those ages ending in digit 0, 5 and 8. With regard to Wag Hemra zone, the most avoided ages, in descending order, were those ages ending in digits 1,9, 4, 3, 7, 6 and 2 while the most preferred digits, in descending order, were those ages ending in digit 0, 5 and 8. In general, the same digits were preferred (0, 5 and 8) and avoided (1, 2, 3, 4, 6, 7, and 9) by women for each zone.

Table 2.1. Myers Digit preference Indices by Zone: 1994

Terminal Digits	Misrak Gojjam Zone	Wag Hemra Zone
0	15.9	21.9
1	-7.0	-7.9
2	-1.2	-2.6
3	-5.2	-6.1
4	-5.8	-7.0
5	14.9	16.1
6	-3.5	-4.3
7	-4.2	-5.1
8	3.6	2.7
9	-7.4	-7.7
Total	68.7	81.4
Summary Index	34.4	40.7

Source: Calculated by the author from 1994 census data tape.

With respect the summery indices, Misrak Gojjam had relatively lower index (34.4) when compared with Wag Hemra zone (40.7). It can be concluded from this that the data for the two zones is fairly accurate and hence age heaping might have a slight effect in childhood mortality estimation procedures. In fact, since the estimation of childhood mortality is mostly computed for five years age groups, such fairly inaccurate age data

may not have a strong impact on the estimated results. In any way, one has to take into account such problem in interpretation of the final results, which is mostly observed in developing countries like Ethiopia.

2.1.2. Sex Ratio of Children ever Born, Mean Parity and Proportion of Children Dead

Before proceeding with the estimation of childhood mortality, it is also possible to check the consistency of the data by computing and examining the sex ratio of children ever born, the average parities and the proportion of children dead out of the total children ever born. The respective computed values are presented in Table 2.2 and one can understand the consistency of the data by observing the results.

As can be understood from literature reviews, the expected value of the sex ratio at birth is 1.05 (UN, 1983). Any value very far from this figure might be an indication of omission or inclusion of either of the sexes. In other words, a lower sex ratio may be an indication of omission of male children. In contrast to this, a higher sex ratio might be a result of omission of female children. As can be seen from Table 2.2 the sex ratio of children ever born in Misrak Gojjam zone was not far from the expected value. Even if the sex ratios fluctuate somewhat by mother's age, they lie within the acceptable range (1.02 to 1.07) without showing any systematic trend. The overall sex ratio, 1.06, is also acceptable as its value is very close to the expected one.

Table 2.2 Average parity, Proportion Dead, and Sex Ratio of Children Ever Born (CEB) by Zone: 1994

Age Group of Women	Misrak Gojjam Zone				Wag Hemra Zone			
	Number of Women	Average Parity	Proportion Dead	Sex Ratio of CEB	Number of Women	Average Parity	Proportion Dead	Sex Ratio of CEB
15-19	18831	0.311	0.149	1.06	2813	0.252	0.110	1.11
20-24	14194	1.469	0.163	1.02	2432	1.213	0.125	1.14
25-29	12814	3.064	0.193	1.07	2299	2.383	0.155	1.05
30-34	9957	4.739	0.222	1.07	2011	3.711	0.189	1.10
35-39	8877	5.883	0.241	1.06	1599	4.485	0.223	1.08
40-44	7177	6.583	0.276	1.07	1358	4.633	0.232	1.13
45-49	5151	6.914	0.284	1.05	900	4.718	0.268	1.15
Total	77001	3.224	0.234	1.06	13412	2.558	0.201	1.10

Source: Calculated by the Author from 1994 census data tape

The sex ratio of children ever born in Wag Hemra zone indicated somewhat higher than the expected value. Even if there is no an observed systematic trend, there is an indication of omission of female children. Except in the age group 25-29, in all age groups of mothers, the sex ratios are higher than the expected value, and the overall sex ratio, 1.10, is also higher than the acceptable range. Thus, with respect to sex ratio, it can be said that there might be an omission of female children. But, such an argument has to be supported by other methods of consistency checks to arrive at the final conclusion.

Another way of checking the quality of data on children ever born is by examining the trends of average parities by age groups of mothers. According to various arguments forwarded by scholars, 'unless Fertiltiy rose at some time in the past, average parities should increase with age up to age group 45-49'(UN, 1983). According to this test, the average parities of both Misrak Gojjam and Wag Hemra zones indicated that the reporting of children ever born by mothers was consistent. This is because the average parities have

shown an increasing trend by advancing age of mothers up to the age group 45-49 years. Even if the trends of the average parities are generally acceptable, the very small increase in the average parities can be considered as an indication of some problems. But such trend has been generally observed in several surveys (UN, 1983).

Proportion of dead children by mother's age can also be used as a data quality check. As can be seen from Table 2.2, the proportion of dead children increases with the age of mothers, and this can be considered as an indication of the absence of increasing omission of dead children by mother's age (UN, 1983).

To sum up this section, except the sex ratio observed in Wag Hemra zone, all methods of data quality checks on children ever born have shown acceptable results and hence childhood mortality estimation based on such data may give robust estimate. Indeed, some observed inconsistencies such as the sex ratio of Wag Hemra zone and the very small increase in average parities for the last age groups of mothers have to be taken into account during interpretation of the final results.

2.2. The Study Areas and Populations

Amara region is found in the north-western part of Ethiopia. Specifically the study areas, Misrak Gojjam and Wag Hemra Zones, are located in the southern and northern portion of the Amara region, respectively. Misrak Gojjam Zone is situated between 9^0 15′ and 11^0 14′ north latitude and 37^0 17′ and 38^0 29′ east longitude, while Wag Hemra Zone lies between $12^0$16′ and $13^0$18′ north latitude and 38^0 20′ and $39^0$18′ east longitude.

The terrain of Misrak Gojjam Zone is relatively plane except in the western part, where a few elevations and in the eastern part where a few depressions can be observed, while the terrain of Wag Hemra Zone is mostly up and down. Hot climate areas are found in the north-east, east and south-east part of Misrak Gojjam, where the Blue Nile river is adjacent to it, while the climate of Wag Hemra, on the whole, is hot relative to Misrak Gojjam, and the degree of hotness is stronger for areas that are closer to Tekeze river, a river that is found in the northern part of Wag Hemra Zone.

As can be seen from Table 2.3, Misrak Gojjam Zone has a surface area of 14.103.6 square kilometers that accounts for 8.9 per cent of the Amara region, while Wag Hemra has a surface area of 8,329.7 square kilometers, which accounts for 5.2 per cent of the Amara region. The former is divided into fourteen administrative weredas, while the latter is divided into three administrative weredas.

Misrak Gojjam was a residence place of 1,700,331 persons, which accounts for 12.3 per cent of the total population of the Amara region, while Wag Hemra Zone was a residence place of 275,615 persons which accounts for only 2 per cent of the Amara region. Among the total population of Misrak Gojjam Zone 46.3 per cent, 50.5 per cent and 3.3 per cent were found in the age groups 0 - 14, 15 - 64, and 65 and older years, respectively. With respect to Wag Hemra Zone, 39.8 percent, 56.9 percent and 3.4 per cent of the total population were found in the age groups 0 - 14, 15 - 64, and 65 and older years, respectively. The adjusted total fertility rate of Misrak Gojjam Zone was 7.9 live births, while it was 6.0 for Wag Hemra Zone. The average household sizes of Misrak Gojjam and Wag Hemra Zones are 4.4 and 3.9 persons, respectively (Table 2.3).

Table 2.3. Back Ground Characteristics of the Study Areas and Total Populations

Background Characteristics	Misrak Gojjam Zone	Wag Hemra Zone
1	2	3
Population Size[1]	1,700,331	275,615
Per cent out of the total population of the region[2]	12.3	2.00
Area in Square Kilometer[3]	14,103.62	8,329.70
Per cent out of the total area of the region[4]	8.86	5.23
Population in broad age groups[2]		
0-14	46.26	39.76
15-64	50.46	56.9
65+	3.28	3.35
Dependency Ratio[4]:		
Demographic Dependency (%)		
Young	91.7	69.9
Old	6.5	5.9
Young and Old	98.2	75.8
Economic Dependency (%)*	82.4	61.3
Average Household Size[1]	4.4	3.9
Adjusted TFR[4]	7.9	6.0
Percent Literate[4]	20.1	5.2
Percent Male in Non-Agricultural Industry[4]	5.9	1.6
Percent Urban[4]	8.5	4.2
Population Density[4]	120.6	33.2
Boundary Length with Blue Nile/Tekeze River[4]	490	228.8

Source: [1] P.H.C.C (1995). [2] P.H.C.C (1998). [3] CSA (1998). [4] Calculated by the author.

* : Calculated as: persons under age 10 plus inactive plus unemployed persons in the age groups 10 years and older divided by Employed persons in the age groups 10 years and older times 100.

The young, the old and the overall demographic dependency ratio of Misrak Gojjam Zone were 91.7 per cent, 6.5 per cent and 98.2 percent, respectively, while the economic dependency ratio was 82.4 per cent. Concerning Wag Hemra Zone, the young, the old and the overall demographic dependency ratio were 69.9 per cent, 5.9 per cent and

75.8 percent, respectively, while the economic dependency ratio was 61.3 per cent. From these, we can understand that in Misrak Gojjam Zone 100 persons, in addition to themselves, were supporting about 98 persons with respect to the overall demographic dependency, and 82 persons with respect to the economic dependency. In Wag Hemra Zone, 100 persons, in addition to themselves, were supporting 75 persons with respect to the overall demographic dependency and 61 persons with respect to the economic dependency.

In Misrak Gojjam Zone, out of the total population in the age groups five years and older, 20.1 per cent were literate, while in Wag Hemra, in the same age groups, only 5.2 per cent were literate. In the former zone, out of the total economically active male population in the age groups ten years and older that had been employed or with some work experience, only 5.9 per cent were engaged in non-agricultural occupations, while in the latter zone, only 1.6 per cent were engaged in non agricultural occupations. Out of the total population of Misrak Gojjam Zone 8.5 percent were residing in urban areas, while in Wag Hemra Zone only 4.2 per cent of the total population were residing in urban areas. The crude population density of Misrak Gojjam and Wag Hemra zones were 120.6 and 33.2 persons per square kilometers, respectively (CSA, 1998). The length of Blue Nile river adjacent to Misrak Gojjam Zone is about 490 kilometers, while Tekeze river, taking into account both sides of the river in places where it passes through, extends about 228.8 kilometers adjacent with Wag Hemra Zone. This may aggravate the distribution of malaria in the surrounding areas.

In both zones, it can be said that there is no adequate health facilities. The 1996 report from the Health Bureau of The Amara National Regional State reveals that only one hospital has been found in Misrak Gojjam Zone, while there was no Hospital in Wag

Hemra Zone. One health center had been serving 594,568 and 288,652 persons in the former and the latter zones, respectively. In the same way, one clinic had been serving 27,026 and 13,745 persons in Misrak Gojjam and Wag Hemra Zones, respectively; while one health post had been serving 71,348 persons in the former zone but there was no any in the latter zone (see Appendix IV).

With respect to health professionals, for the year 1998, for instance, any one health related professional in Government Organizations had been serving about 4,352 and 2,852 persons in Misrak Gojjam and Wag Hemra Zones, respectively. When we consider a specific profession in the same year, one physician (medical doctor) had been serving about 103,965 and 75,581 persons in Misrak Gojjam and Wag Hemra Zones, respectively. In the same way, one Nurse had been serving 17,994 and 15,911 persons, while one Health Assistant had been serving 7,170 and 5,304 persons in Misrak Gojjam and Wag Hemra Zones, respectively (see Appendix IV).

According to the 1996 report of the Health Bureau of the Amara National Regional State, among the communicable diseases reported, Malaria was the most prevalent and killer in the two areas. About 10,322 and 522 Malaria cases were reported in Misrak Gojjam and Wag Hemra Zones, respectively. Among the Malaria cases reported, about 0.8 per cent and 1.2 per cent died in Misrak Gojjam and Wag Hemra Zones, respectively. This indicates that Malaria had a relatively stronger impact on mortality in Wag Hemra Zone when compared with Misrak Gojjam Zone (see Appendix IV).

2.3. Background Characteristics of Women at Reproductive Age

To study levels, trends, defferentials and covariates of childhood mortality, it is advisable, in the first place, to discuss the status of mothers with respect to the variables under study. In line with this argument, the percentage distribution of women at reproductive age by the variables under study has been presented in Table 2.4. Therefore, based on the given table, the individual and household background characteristics of this women have been discussed and hence the result may throw light for the interpretation of the final results of the study.

Current Residence of Mothers: As can be seen from Table 2.4, out of the total sampled women, 11.7 per cent and 4.5 per cent of women were currently living in urban areas of Misrak Gojjam and Wag Hemra Zones, respectively. The proportion of women in urban areas of Misrak Gojjam was 160 per cent higher than that of Wag Hemra Zone. Such differentials in current residential status of women between the two zones may have an impact on variation of the survival chance of children, and hence it might lead to differentials in childhood mortality between the two study areas.

Table 2.4. Percentage Distribution of Sampled Women at Reproductive Age (15 - 49 years) for Different Background Variables by Zone: 1994

Background Variables	Misrak Gojjam Zone		Wag Hemra Zone		Percentage Difference
	Number	Per cent	Number	Per cent	
1	2	3	4	5	6=(3-5)/5x100
Total*	78387	100.0	14020	100.0	0.0
Current Residence					
Rural	69245	88.3	13386	95.5	-7.5
Urban	9142	11.7	634	4.5	160.0
Educational Level					
Illiterate	67058	86.5	13522	98.1	-11.8
Literate:	10478	13.5	261	1.9	610.5
Non-Regular	3478	4.5	51	0.4	1025.0
Grades 1-6	3276	4.2	149	1.1	281.8
Grades 7+	3724	4.8	61	0.4	1100.0
Migration Status:					
Non-Migrant:	62376	80.4	11547	83.8	-4.1
Rural Non-Migrant	58135	75.0	11167	81.1	-7.5
Urban Non-Migrant	4241	5.5	380	2.8	96.4
Migrant	15158	19.5	2228	16.2	20.4
Length of Continuos Residence:					
Since Birth	62376	80.4	11547	83.8	-4.1
0-9 years	7840	10.1	1359	9.9	2.0
10+ years	7318	9.4	869	6.3	49.2
Streams of Migration:					
Rural-Rural Migrant	9759	12.6	1535	11.1	13.5
Urban-Rural Migrant	636	0.8	452	3.3	-75.8
Rural-Urban Migrant	3018	3.9	140	1.0	290.0
Urban-Urban Migrant	1743	2.2	101	0.7	214.3
Marital Status					
Never Married	6237	8.0	2329	16.7	-52.1
Currently Married	53111	68.0	9698	69.6	-2.3
Divorced	16327	20.9	1474	10.6	97.2
Widowed	2486	3.2	431	3.1	3.2
Parity of Woman					
0 Births	21491	27.9	3964	29.6	-5.7
1-4 Births	30988	40.2	6484	48.3	-8.1
5-9 Births	21148	27.5	2780	20.7	6.8
10+ Births	3374	4.4	184	1.4	214.3
Household Size					
1-4 Persons	32967	42.1	7321	52.2	-10.1
5-9 persons	42137	53.8	6310	45.0	8.8
10+ persons	3190	4.1	389	2.8	46.4

Table 2.4: (Continued)

Back Ground Variables	Misrak Gojjam Zone		Wag Hemra Zone		Percentage Difference
	Number	Per cent	Number	Per cent	
Possession of Radio by Household					
No radio	70458	90.2	13140	95.1	-5.2
Has radio	7640	9.8	675	4.9	113.0
Household Economic Status[1]					
High	28362	36.9	649	4.9	653.1
Medium	22551	29.3	1335	10.0	193.0
Low	26010	33.8	11338	85.1	-60.3
Household Sanitation Status[1]					
High	9428	12.1	578	4.2	188.1
Medium	15000	19.3	2857	20.6	-6.3
Low	53452	68.6	10415	75.2	-8.8

Source: Computed by the Author from 1994 census data tape. [1] See Appendix 1.

* : The total number of women under each background variable may not be add up to the total because of missing cases.

Educational Level of Women: In Misrak Gojjam Zone, among women at reproductive age only 13.5 per cent were literate of which 4.5 per cent, 4.2 per cent and 4.8 per cent were completed non-regular (literacy program/informal), eliminatory (grades 1 to 6), and junior secondary and above (grades 7 and above) educational levels. With regard to Wag Hemra Zone, only 1.9 per cent of women at reproductive age were literate of which 0.4 per cent, 1.1 per cent and 0.4 per cent were completed non-regular, primary, and junior secondary and above educational levels. The proportion of literate women was 610.5 per cent higher for Misrak Gojjam than that of Wag Hemra Zone. The difference was much higher for the educational level of junior secondary and above (1100.0 %). This strong differential in educational background characteristics of women at reproductive age might lead to a strong childhood mortality differential between the two zones which will be realized in the due chapter.

Migration status of Women: Among women at reproductive age of Misrak Gojjam 19.5 per cent were migrants of which 10.1 per cent and 9.4 per cent were continuously residing (starting from the day of arrival to the date of enumeration) in the area of

enumeration for about 0 to 9 years, and 10 years and over, respectively. Concerning Wag Hemra Zone, 16.2 per cent of women were migrants of which 9.9 per cent and 6.3 per cent were continuously residing for about 0 to 9 years, and 10 and over years, respectively.

When we assess the status of women by migration stream, rural-rural migrants account for the highest percentage for the two zones, 12.6 per cent and 11.1 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. The lowest percentages were observed for urban-rural (0.8%) and urban-urban migration (0.7%) streams in Misrak Gojjam and Wag Hemra Zones, respectively.

The proportion of migrant women in Misrak Gojjam Zone was 20.4 per cent higher than Wag Hemra Zone, and rural-urban and urban-urban migrant women had also a higher proportion in the former than in the latter zone. But, urban- rural migrant women had a higher proportion in Wag Hemra Zone than Misrak Gojjam zone.

Marital status of Women: Among women of the reproductive age interviewed during the census using the long questionnaire, 68.0 per cent and 69.6 per cent were currently married in Misrak Gojjam and Wag Hemra Zones, respectively. The proportion of women who had dissolved their marriage due to divorce was much higher in Misrak Gojjam Zone when compared with Wag Hemra Zone. In contrast to this, the proportion of women who were in the never married category was 52.1 per cent higher in Wag Hemra Zone than Misrak Gojjam Zone. Such differential by marital status of women between the two zones may have some implications in the variations of the survival chance of children between the two areas which will be realized in the following chapter.

Parity of Women: As can be understood from Table 2.3, the adjusted total fertility rates were 7.9 and 6.0 live births per woman for Misrak Gojjam and Wag Hemra Zones, respectively. When we observe the distribution of women by their parity it was also true

that the actual fertility performance of women in Misrak Gojjam Zone was higher than women from Wag Hemra Zone. This is because high parity women were observed in Misrak Gojjam Zone than that of Wag Hemra Zone. The proportion of women with 10 live births and above was 214.3 per cent higher for Misrak Gojjam Zone when compared with Wag Hemra Zone. In both zones, women of parity 1 to 4 live births constitute the highest percentage, 40.4 per cent and 48.3 per cent in Misrak Gojjam and Wag Hemra Zones, respectively.

Distribution of Women by Household Characteristics: High percentages of women were residing in a household with size 5 to 9 persons and 1 to 4 persons in Misrak Gojjam and Wag Hemra Zones, respectively, that accounts for 53.8 per cent and 45.0 per cent in Misrak Gojjam and Wag Hemra Zones, in the same order. The lowest percentage of women was observed in a household with size 10 or more persons, but the proportion of women in this category was 46.4 per cent higher in Misrak Gojjam Zone than Wag Hemra Zone.

Women who were residing in a household with a working radio accounted for only 9.8 per cent and 4.9 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. Even if the availability of radio in a household was very small in both areas, the proportion of women who were residing in a household with a radio was 113.0 per cent higher for Misrak Gojjam than Wag Hemra Zone.

Among women at the reproductive age, 36.9 per cent and 4.9 per cent were members of a household with high economic status in Misrak Gojjam and Wag Hemra Zones, respectively. The proportion of women from a household with high and medium economic status was much higher for Misrak Gojjam Zone when compared with that of Wag Hemra Zone. With respect to sanitation status, only 12.1 per cent and 4.2 per cent of

women were a member of a household with a high sanitation status for Misrak Gojjam and Wag Hemra Zones, respectively. The proportion of women in a household with medium or low sanitation status was lower in Misrak Gojjam Zone than Wag Hemra Zone.

To summarize this section, women in Misrak Gojjam Zone had a better status with respect to current residence, educational level, household information status, and household economic and sanitation status. Concerning women in Wag Hemra Zone, they were in a better position with respect to, marital status (considering low percentage of divorced an advantage) and parity (considering low parity an advantage).

CHAPTER III

LEVELS AND TRENDS OF CHILDHOOD MORTALITY

3.1. The Methods Used

The levels of childhood mortality indicate the health status of the population, while trends give an indication of changes over time. Thus, estimation of childhood mortally in statistically poor countries can have a greater value in formulation of health policies.

It has been argued that the proportion of children ever born who have died can be used as an indicator of child mortality, and hence can be used for estimation of childhood mortality (UN, 1983). Brass suggested a technique for estimating childhood mortality from information on children ever born and children surviving that are commonly collected in censuses and surveys. According to Brass' argument, the proportion dead among children ever borne, D(i), (where the i's stand for successive five-year age groups, i.e., i = 1 for age group 15 - 19, i = 2 for age group 20 - 24, etc.) can be converted into the probability of dying between birth and age x, q(x), by the following equation:

$$q(x) = k(i)\, D(i)$$

where k(i) is the adjustment factor that can be computed by

$$k(i) = a(i) + b(i)\, p(1)/\, p(2) + c(i)\, p(2)/\, p(3)$$

where a(i), b(i) and c(i) are more recent Trussell multipliers obtained from tables in UN Manual X, and p(1), p(2), and p(3) are average parities of women in the age groups i = 15 - 19, i = 20 - 24 and i = 25 - 29, respectively.

The underlying assumptions made in the development of the Brass method are that fertility and childhood mortality have remained constant, and the risk of dying of a child is

a function of the age of the child, but not depend on other factors such as mothers age or the child's birth order (UN, 1983).

In the contemporary world, mortality is actually declining in various countries and hence the assumption of constant childhood mortality may not hold true. Thus, Feeney, and latter Coale and Trassel had made an effort to estimate the number of years before the survey to which the mortality estimate applies, and suggested the following estimation equation:

$$t(x) = a(i) + b(i)\, p(1)/\, p(2) + c(i)\, p(2)/\, p(3)$$

where t(x) is the estimated number of years before the survey to which the mortality estimate for women in age groups i applies. The a(i), b(i) and c(i) are regression coefficients, different for each age group i of women, which can be obtained from UN Manual X (UN, 1983).

3.2. Estimated Levels of Childhood Mortality

Estimated levels of childhood mortality for the two zones is computed using the West and North families of the Coale-Demeny Model Life Tables. These families are selected because they are the best fits to depict the mortality pattern of the country when compared with the other families (PHCC, 1998). In addition, the number of women in the not stated category was very small, and has no observed linear relationship (Appendix V), and hence they are not considered in the calculation of the average parities that has been used in the computations of the multipliers (UN, 1983).

Table 3.1: Estimated Childhood Mortality Rates by Zone and Percentage Difference Between Zones: 1994

Age Groups of Mothers	Age of Child, x	Coale-Demeny Model (Trussell Equations)					
		West Model			North Model		
		Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference	Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference
1	2	3	4	5 = (3-4)/4 x 100	6	7	8= (6-7)/7 x 100
15 - 19	1	0.140	0.107	30.8	0.134	0.103	30.1
20 - 24	2	0.166	0.126	31.7	0.157	0.119	31.9
25 - 29	3	0.192	0.152	26.3	0.183	0.145	26.2
30 - 34	5	0.225	0.189	19.0	0.221	0.185	19.5
35 - 39	10	0.250	0.228	9.6	0.256	0.233	9.9
40 - 44	15	0.283	0.235	20.4	0.290	0.240	20.8
45 - 49	20	0.289	0.269	7.4	0.292	0.272	7.4

Source: Computed by the Author from 1994 census data tape.

As can be understood from the estimated results (Table 3.1), in both zones, the childhood mortality rate increases with the age of children and mothers for the two families (West and North) of the Coale-Demeny Mortality Models. In all zones, the childhood mortlity implied by the West family was higher than the North family. In all age groups, childhood mortality was higher in Misrak Gojjam Zone as compared with Wag Hemra Zone. Even if a strong difference was observed in the first three age groups of mothers, variations in childhood mortality between the two zones decrease with the age of children except at the age of 15 years. The highest difference was observed in the age group 20 - 24 in which mortality was more than 31 per cent higher for Misrak Gojjam Zone compared to Wag Hemra Zone.

3.3. Estimated Trends of Childhood Mortality

Trends of mortality have a paramount importance for policy implications, for instance in evaluation of an intervention program. But, in countries that lack consistent time series data on mortality, like the study areas, it will not be easy to depict the actual trends of mortality except using the estimated trends. Thus an attempt is made to estimate the trends of childhood mortality in this section.

The common index of childhood mortality, $q^c(5)$, is computed and presented in Table 3.2. Under five mortality as a common measure, $q^c(5)$, is appropriate for trend analysis because most childhood deaths occur at the early ages of life, particularly before the age of five years (ECA, 1979). As can be seen from the estimated results, for Misrak Gojjam Zone, under five mortality was an increasing function of the age of the mothers except in the first and the last reproductive age groups. In the same way, childhood mortality was an increasing function with the age of mothers for Wag Hemra Zone except in the first and the last two age groups of mothers. Like that of the actual childhood mortality observed for each age group of mothers in Table 3.1, childhood mortality measured by the common index was higher in Misrak Gojjam Zone when compared with Wag Hemra Zone in all age groups of mothers.

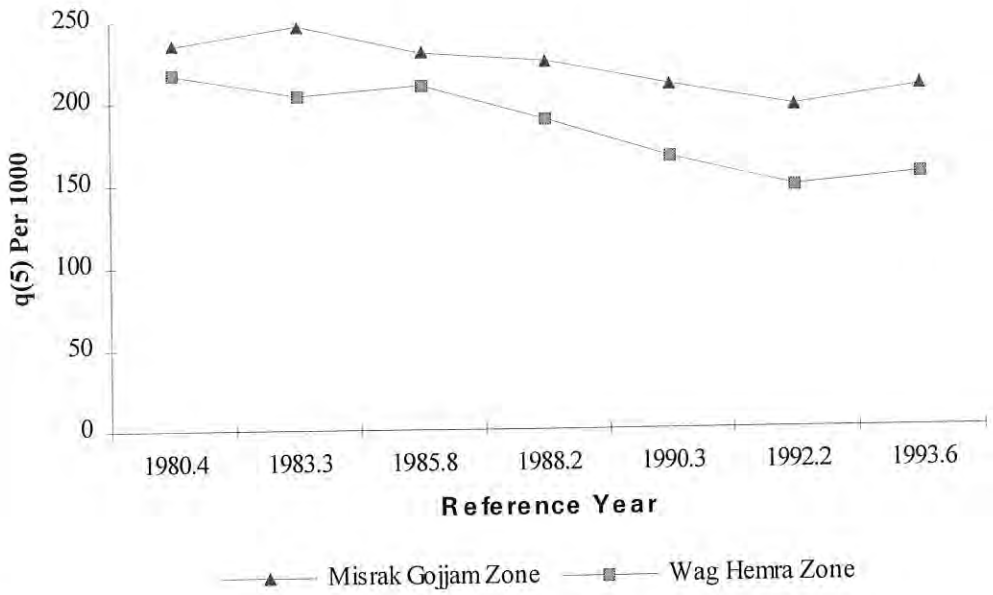
Table 3.2: Estimated Trends of Childhood Mortality Measured by the common Index of Under five Mortality, $q^c(5)$, using the Coale- Demeny West Model (Trussel Equations): 1994

Age Groups of Mothers	Misrak Gojjam Zone		Wag Hemra Zone		Percentage Difference of $q^c(5)$	Average Reference Date for the Two Zones
	$q^c(5)$	Reference Date	$q^c(5)$	Reference Date		
1	2	3	4	5	6 = (2-4)/4 x 100	7=(3+5)/2
15 - 19	0.208	1993.5	0.155	1993.6	34.2	1993.6
20 - 24	0.197	1992.2	0.148	1992.2	33.1	1992.2
25 - 29	0.210	1990.4	0.166	1990.2	26.5	1990.3
30 - 34	0.225	1988.3	0.189	1988.0	19.0	1988.2
35 - 39	0.230	1986.1	0.210	1985.5	9.5	1985.8
40 - 44	0.247	1983.6	0.204	1982.9	21.1	1983.3
45 - 49	0.235	1980.7	0.217	1980.0	8.3	1980.4

Source: Computed by the Author from 1994 census data tape.

When we observe mortality by time, in all zones, childhood mortality measured by the common index (under five mortality) had shown a declining trend, specially in years between 1986 to 1992 (Figure 3.1). That is, if we exclude information from the first and the last two age groups of mothers, childhood mortality had shown a declining trend in the recent past. The decline in mortality in the recent past was much higher for Wag Hemra Zone as compared with Misrak Gojjam Zone. That is, under five mortality declined approximately by about 10.0 to 12.2 per cent every two years between the years 1986 and 1992 for Wag Hemra Zone, but in the same years only about 3 - 7 per cent decline was observed in the case of Misrak Gojjam Zone.

Figure 3.1: Estimated Trends of Childhood Mortality Considering Under Five Mortality, q(5), as a Common Index, and Using the West Family of the Coale-Demeny Model (Trussell Equations)



Generally speaking, in all age groups of mothers, and in all years for which the estimated childhood mortality refers, childhood mortality levels were higher for Misrak Gojjam than Wag Hemra Zone. At this point one can raise a question like, being a remote and drought prone (food insecure) area, why mortality was lower in Wag Hemra Zone? In other wards, having been relatively secure area (with respect to food, and peace and stability during the Derg regime), why childhood mortality was higher in Misrak Gojjam Zone as compared to Wag Hemra Zone? That is, is the observed direction of difference in childhood mortality between the two zones actually true or something faulty due to some other confounding factors? The possible answers will follow in the coming chapters.

CHAPTER IV

DIFFERENTIALS OF CHILDHOOD MORTALITY

4.1. The Method Used

It is assumed that the risk of a child will be a function of the length of exposure to the risk of dying which in turn depends on the age of the mother (UN, 1983). It is also known that the proportion of children dead and the age of children are both expected to increase with the age of the mother. It means that there will be interactions between duration of exposure and other covariates of child mortality. To measure the independent effect of each covariate, such an interaction term has to be removed or minimized. To do so, it is advisable to have had first an appropriate mortality index before fitting a model (Trussell and Preston, 1981).

Trussell and Preston (1981) were the first to develop an index that can be used for statistically sound childhood mortality studies. According to their argument, the index of childhood mortality, m, for women in the i^{th} category can be computed as a ratio of the observed deaths, O_i, to the expected deaths, E_i, i.e., $m = O_i/E_i$. The expected number of deaths in turn can be computed as

$$E_i = \sum_j CEB_i(j)\ PD^s(j)$$

where $CEB_i(j)$ is the number of children ever born to women in the i^{th} cell (factor level or category) with age group j (j = 1 for age group 15 - 19, j = 2 for age group 20 - 24, ... j = 7 for age groups 45 - 49) and $PD^s(j)$ is the standard expected proportion dead to women in the age group j.

To estimate the expected proportion dead, $PD^s(j)$, it is simply a matter of inverting the original Brass equation, i.e. inverting the equation $q^s(a) = PD^s(j)\ K^s(j)$. Thus by inverting this formula we will arrive at

$$PD^s(j) = q^s(a)/\ K^s(j)$$

where $q^s(a)$ is the probability of dying by exact age 'a' that is taken from the selected standard of Coale-Demeny Model Life Tables and $K^s(j)$ is a multiplying factor that depends on the average parities of women in the first three five-year reproductive age groups.

To compute the values of the multiplying factors, $K^s(j)$'s, category- specific parity ratios which accounts explicitly the fertility histories of women in a particular category or cell, or population- wide parity ratios that are computed from the whole population of women in the sample can be used. Indeed, population-wide parity ratios are more appropriate because of the reason that some parity values may be zero for some cells and hence it will be difficult to compute the multipliers using cell specific parity ratios (Trussell and Preston, 1981).

4.2 Estimated Differentials of Childhood Mortality

The indices of childhood mortality are calculated and presented in Tables 4.1 and 4.2 using the Coale-Demeny West Model Life Table as a standard and considering population wide parity ratios for estimating the multipliers. In Table 4.1 the univariate results are presented that are computed for each zone factor by factor, while in Table 4.2 the bivariate results are presented that are computed for each zone controlling for urban

and rural current residence of mothers. Percentage differences of the indices of mortality between the two zones are also calculated and presented in both tables.

The indices are computed for age group 20 - 44 years in addition to the conventional reproductive age group, 15 - 49 years. The reason for these is that, in most practical applications information from the first and the last conventional five years reproductive age groups of women suffer from errors and hence may affect the final results. Thus our discussion will focus mostly on the results that are computed based on information from women in the age groups 20 - 44 years and hence one can feel free from the possible errors that might be introduced due to the inclusion of women in the two extreme age groups (15 - 19 and 45 - 49 years).

In addition to this, one has to understand that the higher the index the higher the childhood mortally in that particular group of women when compared with the other groups with lower indices of childhood mortality.

4.2.1) Current Residence of Mothers and Childhood Mortality:

The index of childhood mortality showed differentials by zonal and rural-urban residence of mothers. As can be seen from Table 4.1, the over all childhood mortality was 6.4 per cent and 5.2 per cent lower in the age groups 15 - 49 and 20 - 44 years, respectively, for Misrak Gojjam Zone as compared with Wag Hemra Zone. In the case of urban-rural current residence of mothers, childhood mortality was higher in urban areas when compared with rural settings for each zone, except in the age group 15 - 49 for Misrak Gojjam Zone (Table 4.1). Such an expected direction of association between current urban-rural residence and childhood mortality might have several possible reasons. Even if urban areas contain the largest share of the countries' well- educated population

and the best medical facilities, they do not always have the lowest mortality rates (Ewbank et al. 1986). There may not be major differences in the characteristics of cities and urban localities when compared with rural localities in the study areas in terms of cultural and technological advancement. But the small cities that are mostly found in the two areas may contain persons who have abandoned some of the traditional child-feeding practices such as extended breast-feeding, and not yet learned to take advantage of modern medical facilities which in turn may aggravate child mortality. Unemployment has also been a problem of urban areas in the Amara region and may affect the economic status of the people and hence childhood mortality rate (CSA, 1995a).

For both categories of current residence, and for both age groups, 15 - 49 and 20 - 44, the survival chance of children was better for Misrak Gojjam Zone when compared with Wag Hemra Zone. If we consider the age group 15 - 49 years, for instance, childhood mortality was 6.4 per cent and 7.0 per cent lower for Misrak Gojjam Zone when compared with Wag Hemra zone for rural and urban areas, respectively. When we consider the age group 20 - 44 years, the difference between rural areas of the two zones decreased to 5.0 per cent, while the difference between urban areas rose to 10.6 per cent. The possible reason for such differentials in childhood mortality between the two zones by rural and urban residence might be due to differentials in socio-economic and/ or ecological factors between the two settings.

Table 4.1. Indices of Childhood Mortality (Ratio of Observed to Expected Deaths) for Each Zone, and Percentage Differences of the Indices Between the Two Zones by Different Background Variables for the Two Age Groups of Mothers: Urban and Rural, 1994

Background Variables	Age Groups of Mothers					
	15 - 49			20 - 44		
	Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference	Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference
1	2	3	4= (2-3)/3x100	5	6	7= (5-6)/6x100
Total	1.0771	1.1508	-6.4042	1.0728	1.1316	-5.1962
Current Residence						
Rural	1.0768	1.1503	-6.3896	1.0737	1.1298	-4.9655
Urban	1.0812	1.1621	-6.9615	1.0577	1.1826	-10.5615
Education Level						
Illiterate	1.0932	1.1533	-5.21	1.0901	1.1335	-3.83
Literate:	0.8568	0.8033	6.65	0.8585	0.8413	2.04
Informal	0.9441	1.0069	-6.23	0.9460	1.2197	-22.44
Grade 1-6	0.7815	0.7713	1.32	0.7916	0.7379	7.28
Grade 7+	0.4230	0.4151	1.90	0.4128	0.4243	-2.69
Migration Status						
Migrant	1.1197	1.3947	-19.72	1.1118	1.3764	-19.22
Non-Migrant	1.0671	1.1003	-3.02	1.0636	1.0799	-1.51
Length of Continuos Residence:						
Since Birth	1.0671	1.1003	-3.02	1.0636	1.0799	-1.51
0 - 9 Years	1.1611	1.4757	-21.32	1.1358	1.4473	-21.52
10+ Years	1.1040	1.2938	-14.67	1.1025	1.2908	-14.59
Streams of Migration:						
Rural-Rural	1.1229	1.4047	-20.06	1.1188	1.3997	-20.07
Urban-Rural	1.0568	1.3497	-21.70	1.0065	1.2928	-22.14
Rural-Urban	1.2893	1.4849	-13.18	1.2693	1.4048	-9.64
Urban-Urban	0.7401	1.3101	-43.51	0.7455	1.3789	-45.93
Rural Non-Migrant	1.0679	1.1037	-3.24	1.0653	1.0815	-1.50
Urban Non-Migrant	1.0398	0.9768	6.49	1.0086	1.0160	-0.73
Marital Status						
Never Married	0.9153	1.5493	-40.92	0.8699	1.4468	-39.88
Currently Married	1.0388	1.0777	-3.62	1.0353	1.0698	-3.22
Divorced	1.3430	1.5860	-15.32	1.3458	1.5535	-13.37
Widowed	1.1998	1.5145	-20.78	1.2315	1.4987	-17.82
Parity of Woman						
1-4 Births	0.7533	0.7302	3.17	0.7407	0.7168	3.33
5 - 9 Births	1.1093	1.3713	-19.11	1.1264	1.3807	-18.42
10+ Births	1.4777	2.0332	-27.32	1.5564	2.1438	-27.40
Household Size						
1-4 Persons	1.4640	1.5825	-7.49	1.4952	1.5892	-5.92
5-9 Persons	0.9684	0.9482	2.13	0.9651	0.9355	3.17
10+ Persons	0.6200	0.6896	-10.08	0.6122	0.6852	-10.65

Table 4.1: (Continued.)

Background Variables	Age Groups of Mothers					
	15 - 49			20 - 44		
	Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference	Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference
1	2	3	4= (2-3)/3x100	5	6	7= (5-6)/6x100
Possession of Radio						
No radio	1.0905	1.1583	-5.85	1.0871	1.1395	-4.61
Has radio	0.9140	0.9664	-5.42	0.9014	0.9598	-6.09
Household Economic Status						
High	1.0141	1.0613	-4.45	1.0130	1.1016	-8.05
Medium	1.0565	1.1115	-4.95	1.0508	1.1309	-7.08
Low	1.1790	1.1523	2.32	1.1722	1.1258	4.11
Household Sanitation Status						
High	0.9990	0.9080	10.02	0.9899	0.9462	4.62
Medium	0.9976	1.1311	-11.80	0.9957	1.1078	-10.12
Low	1.1106	1.1683	-4.94	1.1063	1.1489	-3.71

Source: Computed by the Author from 1994 census data tape.

4.2.2) Educational Level of Mothers and Childhood Mortality

As explained in the literature review section, there is a general consensus among scholars that educational level of parents is negatively related to childhood mortality (Caldwell, 1979; and ECA, 1979). In our univariate and bivariate analysis, we also arrived at the same conclusion. That is, in general, for both age groups and zones, educational level had shown an inverse relationship with childhood mortality.

Based on information from women in the age group 20 - 44 years in Table 4.1, for instance, the index of childhood mortality declined by educational levels, except in factor level 'Informal' for Wag Hemra Zone. If we move from factor level 'Illiterate' to 'Grades 7 and above', childhood mortality declined by about 62.1 per cent and 62.6 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. In the same way, a change in educational level from 'informal' to 'grades 1-6' reduced childhood mortality by 16.3 per cent and 39.5 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. A change in educational level from 'Grades 1-6' to 'grades 7 and above', in turn, reduced childhood

mortality by 47.9 per cent and 42.5 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. While we move from 'Illiterate' category to 'Informal', childhood mortality declined by 13.2 per cent in the case of Misrak Gojjam Zone, but increased by 7.6 per cent in the case of Wag Hemra Zone. The discrepancy observed between 'Informal' and 'Illiterate' groups, might be due to the type of education that have been given to the 'Informal' groups which does not bring major changes in one's life style when compared with the illiterate groups. The same inverse relationship between education and childhood mortality was observed in several studies in Ethiopia (CSA, 1993; Mekonnen, 1990; Meaza, 1997; and Yohannes, 1997).

When we observe results by zone for the age group 20 - 44 in Table 4.1, in all factor levels except in Grades 1-6, childhood mortality was relatively higher for Wag Hemra Zone than Misrak Gojjam Zone. The difference was much higher in factor level 'Informal' for which childhood mortality was 22 per cent lower for Misrak Gojjam Zone when compared with Wag Hemra Zone. If current rural-urban residence is controlled (Table 4.2), among children of illiterate women in rural areas, mortality was 4.3 per cent lower for Misrak Gojjam Zone than Wag Hemra Zone. In the case of urban areas, among children of illiterate women, mortality was higher for Misrak Gojjam Zone. Such differentials in childhood mortality by zone may arise due to difference in the background characteristics of the study areas, and women at the reproductive age (Tables 2.3 and 2.4).

Table 4.2. Cross Tabulation of Indices of Childhood Mortality (Ratio of Observed to Expected Deaths) for Each Zone, and Percentage Differences by Different Background Variables Controlling for Current Urban -Rural Residence of Mothers in the Age Group 20 - 44 Years: 1994

Back Ground Variables	Current Residence of Mothers					
	Rural			Urban		
	Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference	Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference
1	2	3	4=(2-3)/3x100	5	6	7=(5-6)/6x100
Education Level						
Illiterate	1.0822	1.1310	-4.32	1.2900	1.2119	6.44
Literate:	0.9279	0.7543	23.01	0.6937	0.8737	-20.61
Migration Status						
Migrant	1.1138	1.3746	-18.98	1.1022	1.3946	-20.97
Non-Migrant	1.0653	1.0815	-1.50	1.0086	1.0160	-0.73
Length of Continuos Residence						
Since Birth	1.0653	1.0815	-1.50	1.0086	1.0160	-0.73
0 - 9 Years	1.1038	1.4667	-24.74	1.2398	1.2935	-4.15
10+ Years	1.1179	1.2691	-11.91	1.0096	1.6058	-37.13
Marital Status						
Never Married	0.7912	1.2739	-37.89	1.0249	1.8166	-43.58
Currently Married	1.0405	1.0720	-2.93	0.9212	0.9797	-5.97
Divorced	1.3298	1.5741	-15.52	1.4317	1.4167	1.06
Widowed	1.2578	1.4986	-16.07	0.9949	1.4991	-33.63
Parity of Woman						
1-4 Births	0.7302	0.7071	3.27	0.8701	0.9520	-8.60
5 - 9 Births	1.1265	1.3832	-18.56	1.1249	1.3030	-13.67
10+ Births	1.5591	2.1437	-27.27	1.4899	2.1465	-30.59
Household Size						
1-4 Persons	1.4898	1.5877	-6.16	1.5565	1.6165	-3.71
5-9 Persons	0.9697	0.9385	3.29	0.8735	0.8280	5.50
10+ Persons	0.6197	0.6978	-11.19	0.5693	0.2518	126.08
Possession of Radio						
No radio	1.0789	1.1354	-4.97	1.2863	1.2730	1.05
Has radio	0.9924	0.9807	1.20	0.6698	0.8361	-19.89
Household Economic Status						
High	1.0196	1.1131	-8.40	0.7871	0.9476	-16.93
Medium	1.0533	1.1521	-8.57	1.0260	0.8669	18.36
Low	1.1640	1.1203	3.90	1.3140	1.3625	-3.56
Household Sanitation Status						
High	1.0769	1.1051	-2.55	0.9256	0.5992	54.47
Medium	0.9804	1.1096	-11.64	1.5621	1.0166	53.66
Low	1.1024	1.1367	-3.02	1.4428	1.6039	-10.04

Source: Calculated by the Author from the 1994 census data tape

4.2.3) Migration Status of Women and Childhood Mortality

Even if it is difficult, if not impossible, to show the relative effects of migration due to selectivity, disruption and adaptation processes, it is generally argued that

childhood mortality varies by migration status of mothers (Brockerhooff, 1990). As presented in Table 4.1 for both zones, children of non-migrant women had enjoyed a better chance of survival when compared with their counterparts, and the same was true when current residence is controlled (Table 4.2). Among the non-migrant category, children of urban non-migrants enjoyed a better chance of survival when compared with children of rural non-migrant women (Table 4.1).

When we observe the result by migration streams (Table 4.1), in both age groups and zones, children of rural-urban migrants suffered from a strong mortality than the other categories. In contrast to this, children of urban-urban migrants enjoyed the lowest mortality for Misrak Gojjam zone for both age groups. In Wag Hemra zone, children of urban-urban and urban-rural migrants enjoyed a better chance of survival for the age groups 15 - 49 and 20 - 44 years, respectively. The highest mortality that was observed among the rural-urban migrants might be due to the impact of the rural areas in which the women resided before migration to their current urban residence and/ or the impact of urban areas during the early arrival of migrants (Brockerhooff, 1990).

Observation of the data by length of continuos residence of mothers revealed that children of the recent migrants, migrants who continuously resided only for 0 - 9 years, had the highest mortality as compared to the other groups, while children of women who resided since birth (non- migrants) enjoyed the lowest mortality among these categories. This is true for both the univariate (Table 4.1) and bivariate (when current rural-urban residence is controlled, Table 4.2) results, and for both age groups and zones, except in urban areas of Wag Hemra Zone in which children of women who reside 10 years and older suffer from higher mortality when compared with the other groups.

When comparison is made by zone, in almost all categories of migration, childhood mortality was lower for Misrak Gojjam Zone than Wag Hemra Zone. The difference was much higher for the urban-urban category of migration stream in which childhood mortality was more than 43 per cent lower for Misrak Gojjam Zone than Wag Hemra Zone (Table 4.1). The impact of migration was much higher for Wag Hemra Zone as compared with Misrak Gojjam Zone. In other wards, being a migrant increased childhood mortality rate by about 27 per cent for Wag Hemra Zone, while for Misrak Gojjam Zone it increased the rate by about 5 per cent only (Table 4.1).

4.2.4) Marital Status of Mothers and Childhood Mortality

Studies indicated that childhood mortality varies by marital status of mothers. The possible reason for such variation, according to various arguments forwarded by scholars, may be the role of fathers in child-raising activities (Brockerhoff, 1990) . The result obtained from this study also supported the existence of differentials of childhood mortality by marital status

As presented in Table 4.1, for Misrak Gojjam Zone, based on information from women in the age groups 15 - 49 and 20 - 44 years , children of never married women had a relatively lower mortality as compared with the other groups. In the same zone children of divorced women suffered from strong mortality than the other groups. With regard to Wag Hemra Zone, childhood mortality was lower among the currently married groups of women, while children of the divorced group suffered from a higher mortality in both age groups.

In most cases children of currently married women are expected to have a lower mortality as compared with the other groups of women and this argument has been

supported by various studies. But, the lower mortality observed among the never married women for Misrak Gojjam Zone is out of one's expectation. There is no other strong reason for such unexpected result obtained in Misrak Gojjam Zone except saying that it might be due to under reporting of births and/ or dead children out of wedlock due to cultural problems that prevailed in the study areas. In northern part of Ethiopia as a whole, births out side marriage are considered as an abnormal norm or value and hence single mothers mostly try to cover their fertility performance. When current residence is controlled, i.e., in the case of bivariate analysis presented in Table 4.2, the expected trend was observed for both rural and urban areas in the age group 20 - 44 years. That is, in both zones, children of currently married women enjoyed a better survival chance as compared to all other groups in both rural and urban settings.

Comparison of the indices among categories of marital status by zone revealed that childhood mortality was higher for Wag Hemra Zone as compared with Misrak Gojjam Zone in all factor levels, except in urban areas of the two zones for factor level 'Divorced' in which childhood mortality was 1.1 per cent higher for Misrak Gojjam Zone as compared to Wag Hemra Zone . If we consider the age groups 20 - 44 in Table 4.1, for instance, and if one moves from currently married groups to divorced groups of women, childhood mortality will increase by about 30 per cent and 45.2 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. This implies that marital status might have a strong impact for Wag Hemra Zone as compared to Misrak Gojjam Zone.

4.2.5) Parity of Women and Childhood Mortality

The index of childhood mortality is calculated by parity of women and presented in Tables 4.1 and 4.2. As can be understood from these tables, even after removing the non-

additive effect of the exposure term, parities of women have shown a positive association with childhood mortality. For both zones and age groups, and for the univariate (Table 4.1) and bivariate (Table 4.2) analysis, high parity women had higher childhood mortality as compared with relatively lower parity women. This might be because high parity women will have less intensity of child care activities that may be given to their children in the early ages of life which in turn may affect the survival chance of their children.

Except in rural areas for factor level '1-4 Births', in all factor levels of parity of the women, childhood mortality was higher for Wag Hemra Zone as compared with Misrak Gojjam Zone (Table 4.2). If we consider age group 20 - 44 years, for instance, children born to women with parity 1 - 4 births had 52.4 per cent and 66.6 per cent lower mortality as compared with children born to women with 10 and above births for Misrak Gojjam and Wag Hemra Zones, respectively (Table 4.1).

4.2.6) Household Size and Childhood Mortality

A large Household size may lead , in one side, to sever competitions among household members for consumption goods and services. In the other direction, specially in a predominantly agricultural economy like the study areas, a large household size may enable the household to have labour intensive agricultural activities and hence better agricultural productions. In general, household size may have a positive or a negative impact on several background characteristics of a household and hence on the household members, and finally on childhood mortality.

According to our analysis presented in Tables 4.1 and 4.2, household size has shown a negative association with childhood mortality, i.e., a woman from a household with relatively larger size had reported a lower proportion dead of her children ever born.

Even if the direction of association between childhood mortality and household size was the same for both Misrak Gojjam and Wag Hemra Zones, childhood mortality was relatively higher for Wag Hemra Zone for factor levels '1-4 persons' and '10 and above persons' as compared to Misrak Gojjam Zone, but the reverse was true for factor level '5-9 persons'. The difference between the two zones was relatively stronger in factor level '10 and above persons'.

If we consider Table 4.1 and age group 20 - 44 years, and if a household increased its size from 1 - 4 persons to 10 and above, childhood mortality may decrease by 59.1 per cent and 56.9 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. It can be said from this that household size may have a strong negative impact on childhood mortality within each zone.

4.2.7) Possession of Radio by a Household and Childhood Mortality

Through radio, household members can easily obtain information about the out side world and hence can easily interact with the modern world (Mosely and Chen, 1984). In line with this argument, a woman from a household with a working radio may report a lower proportion dead of children ever born compared to a woman from a household possessing no radio.

Both the univariate and bivariate analysis presented in Tables 4.1 and 4.2. respectively, supported the above argument. That is, women from a household with a radio had lower childhood mortality as compared with women from households without radio. If we consider Table 4.1 and age group 20 - 44 years, for instance, and if one moves from a household without a radio to a household with a radio, childhood mortality may decline by

about 17.1 per cent and 15.8 per cent for Misrak Gojjam and Wag Hemra Zones, respectively.

4.2.8) Household Economic Status and Childhood Mortality

Since data on household income was not collected, a proxy indicator of household economic status has been constructed based on information for housing units (see Appendix 1.1). Such type of economic indicator can be considered as reasonable because 'housing is typically the family's single most important capital asset, ...' (Tekce and Shorter, 1984). Based on this indicator, the index of childhood mortality is calculated and presented in Table 4.1 and 4.2.

For Misrak Gojjam Zone, household economic status had shown a negative association with childhood mortality for both univariate and bivariate analysises (Tables 4.1 and 4.2, respectively). In the case of Wag Hemra Zone, except in the age group 15 - 49 (Table 4.1), in all cases, a clear direction of association was not observed. For age group 20 - 44 years in the case of univariate analysis (Table 4.1), for instance, children of women in the lower category enjoyed a lower mortality as compared with medium status. With regard to bivariate analysis (Table 4.2), medium status had also a higher childhood mortality when compared with the low status for rural areas, and medium status on the other hand had a lower mortality than the high status group for urban areas of the same zone. Such discrepancy out of the expected trend might be a result of national and international aids that prevailed in Wag Hemra Zone due to the intermittent draught that attacks the area and/ or the less explanatory power of the proxy indicators introduced into the analysis.

Comparisons of the indices by zone had revealed that in most cases childhood mortality was relatively higher for Wag Hemra Zone as compared with Misrak Gojjam Zone except for some factor levels. The exceptional factor levels are the 'Low' status category in Table 4.1 for which childhood mortality was higher for Misrak Gojjam Zone when compared with Wag Hemra Zone, and the 'Medium' and 'Low' status categories in Table 4.2 in which a higher childhood mortality was observed for urban and rural areas, respectively, of Misrak Gojjam Zone as compared with Wag Hemra Zone.

4.2.9) Household Sanitation Status and Childhood mortality

Proxy indicator of sanitation status of a household is constructed using information on the availability of toilet, tap water and kitchen for the household (see Appendix 1.2). The combined indices of the above three characteristics of the household have been taken into account because a smaller number of cases were observed in households with toilet, tap water and kitchen facilities. Quality water supply, separate and clean room for cooking and appropriate mechanisms of west disposal have a strong impact on the quality of life in a household and hence on childhood mortality (Mosley and Chen, 1984). To have an overview about the impact of such factors, the index of childhood mortality by proxy indicator of sanitation status of a household is calculated and presented in Tables 4.1 and 4.2.

If we consider the univariate case (Table 4.1), in all zones, childhood mortality showed a negative association with household sanitation status except for Misrak Gojjam Zone for age group 15 - 49 that showed a slight discrepancy. The results obtained for age group 20 - 44 years were consistent with the general agreement among scholars. If one moves from a lower to a higher sanitation status, childhood mortality may decline by 10.3

per cent and 17.6 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. Childhood mortality was generally higher for Wag Hemra Zone as compared with Misrak Gojjam Zone in 'Medium' and 'Low' categories, but the reverse was true in the 'High' category in which childhood mortality was 10.0 per cent and 4.6 per cent higher for Misrak Gojjam Zone than Wag Hemra Zone in the age groups 15 - 49 and 20 - 44 year, respectively.

Some discrepancies were observed when current residence of mothers is controlled (Table 4.2). The same trend was observed in rural and urban areas of Wag Hemra Zone like the total trend observed in the univariate analysis (Table 4.1). But in the case of Misrak Gojjam Zone, 'Medium' status has shown a lower index in the case of rural areas and a higher index in the case of urban areas when compared with the other groups. In addition to this, in urban areas, childhood mortality was higher for Misrak Gojjam Zone as compared to Wag Hemra Zone in 'Medium' category that was not the case in the univariate analysis. Further observation of the bivariat results also revealed that childhood mortality was much higher in urban areas of Misrak Gojjam Zone as compared to Wag Hemra Zone (a difference of upto 54.5 per cent).

As a summary of this section, in most factors, childhood mortality was higher for Wag Hemra Zone when compared with Misrak Gojjam Zone, even when current residence is also controlled. The observed trends in this section are not consistent with the values that are obtained in the previous section that deals about levels of childhood mortality. Such discrepancy may arise from the removal of the exposure term using the methods that were suggested by Trussell and Preston (1981). To support the general arguments forwarded in this section, multivariate analysis will follow, and this approach will enable

us to arrive at a clear conclusion about the relative magnitude and direction of association between childhood mortality and various factors that are under study.

4.3 One Way Analysis of Variance

Based on grouping used in Table 4.1, one way analysis of variance has been used just to have a statistically tested prior knowledge about differentials in childhood mortality among groups of a particular background variable. The analysis is conducted for both zones together, and for the two zones independently and presented in Table 4.3. It is found out from the analysis that there were statistically significant (at a significant level of F prob = 0.05) variations among groups with respect to childhood mortality, except among the factor levels of urban-rural current residence, and household economic and sanitation statuses for Wag Hemra Zone. These variations among factor levels may disappear if each variable in the model is controlled which will be assessed in the multivariate analysis in the coming chapter.

Table 4.3: Mean Sum of Squares Between Groups (MSSB) and Significant Levels (F prob.) for Different Background Variables from One Way Analysis of Variance: 1994

Background Variables	Both Zones		Misrak Gojjam Zone		Wag Hemra Zone	
	MSSB	F prob	MSSB	F prob	MSSB	F prob
Zone	8.168	.022	-	-	-	-
Current Urban-Rural Residence	16.139	.001	11.575	.005	4.276	.151*
Age Groups	169.192	.000	131.770	.000	42.996	.000
Education Level	99.998	.000	101.132	.000	6.286	.028
Migration Status						
Length of Continuos Residence	36.591	.000	18.631	.000	31.281	.000
Streams of Migration	31.151	.000	26.156	.000	12.366	.000
Marital Status	180.986	.000	142.631	.000	44.502	.000
Parity of Woman	1898.261	.000	1441.705	.000	544.564	.000
Household Size	521.915	.000	438.108	.000	95.992	.000
Possession of Radio	70.915	.000	65.422	.000	8.055	.048
Household Economic Status	14.401	.000	31.622	.000	2.764	.261*
Household Sanitation Status	18.566	.000	19.493	.000	3.431	.191*

Source: Computed by the Author from 1994 census data tape. *: Not significant at 0.05 significant level

CHAPTER V

COVARIATES OF CHILDHOOD MORTALITY: A MULTIVARIATE APPROACH

5.1. The Model Used

To estimate the covariates of childhood mortality an initial grouping of women into categories, as explained in section 4.1, is not necessary. The ratios of observed death, O_i, to expected deaths, E_i, can be computed for each woman with a birth. That is, the Trussell and Preston (1981) dependent variable (the proportional factor, m_i) for mortality studies can be computed for each woman as

$$m_i = O_i/E_i$$

where E_i = CEB (i) PD^S (j), and CEB (i) is children ever born of the i^{th} women and PD^S(j) is the expected proportion dead to women in the age group j obtained from a standard mortality schedule using population-wide parity ratios. In this case each women can be considered as the unit of observation and each observation is weighted by the woman's number of live births. As a result of which a continuous childhood mortality indicator can be at hand and hence an appropriate regression model can be used to asses the relative importance of variables under study (Trussell and Preston, 1981).

Therefore, the population regression equation can be written as

$$m_i = B_0 + B_1X_{1i} + B_2X_{2i} + ... + B_kX_{ki} + E_i$$

where m_i is the ratio of observed deaths to expected deaths for women i (i = 1, 2, . . ., N) obtained in the above procedures, X_{ri} is the value of the variable X_r (r = 1, 2, . . ., K) for women i, B_r's (r = 0, 1, 2, . . ., K) are regression coefficients and E_i is the error term for

the i^{th} women. K is the number of independent variables in the model and N is the total population of women at reproductive age.

The population regression equation can be estimated by the sample regression model, and hence the proportionate effect of each independent variable can easily be estimated by the partial regression coefficients. To do so, the following assumptions have to hold true (Berry and Feldman, 1985):

1. For each set of values for the k independent variables (X_{1i}, X_{2i}, . . ., X_{ki}) the mean values of the error term is 0, i.e., $E(e_i) = 0$.

2. The variance of the error term is constant, i.e, VAR $(e_i) = \sigma^2$

3. The error terms are uncorrelated, i.e., COV $(e_i, e_j) = 0$, and hence there is no autocorrelation.

4. Each independent variable is uncorrelated with the error term, i.e., COV $(X_i, e_j) = 0$.

5. There is no perfect collinearity, i.e., there is no perfect correlation among independent variables in the model.

6. The error term, e_i is normally distributed.

5.2. Estimated Covariates of Childhood Mortality

To estimate the covariates of childhood mortality it is advisable to select appropriate mortality levels from the standard model life tables. In fact, the method that was suggested by Trussell and Preston (1981) may not be sensitive to the type of mortality model chosen. In other wards, ". . . *the magnitude, signs and significance of covariates is unaffected by the choice of any of the four Coale-Demeny standards, though of course the*

estimated mortality schedule would differ according to which standard was selected" (Trussell and Preston, 1981).

The Coale-Demeny West Model Mortality Table is considered here as the best standard model life table that can depict the average mortality pattern of the country (P.H.C.C, 1998). Within this model, the best levels that can represent mortality of the study areas are chosen using *Mortpak* demographic software outputs. As can be seen from Appendix III, with respect to Misrak Gojjam Zone, levels 12.0 and 14.3 have been chosen for rural and urban areas, respectively, while for Wag Hemra Zone, levels 14.0 and 14.4 have been selected, in the same order. From the selected mortality levels, the standard mortality rates, $q^s(x)$, are computed using linear interpolation. The standard values of the multipliers, $k^s(i)$, are also computed using the population-wide parity ratios (P_i, i= 1, 2 and 3) and the coefficients from the west model of Coale-Demeny. The expected proportion dead among the children ever born is, in turn, computed by dividing $q^s(x)$ by $k^s(i)$ for each age groups of women (see Appendix III), so that, the expected number of children dead for each women can easily be computed by multiplying children ever born of a women by the expected proportion dead for women in the same age group. Ultimately, the dependent variable (proportional factor, m) is computed as the ratio of observed deaths to expected deaths.

The closer the mean values of the dependent variable (proportional factor) to unity are the better the chosen standard life tables to explain the average mortality levels in the study areas, i.e., if the standard mortality models that are chosen have depicted the actual mortality, then the mean values (grand means) of the proportional factor will be one (Tekce and Shorter, 1984). In our case the mean values of the dependent variable (the ratio

of observed to expected deaths) are 0.895 and 0.860 for Misrak Gojjam and Wag Hemra Zones, respectively, and hence, it can be said that the standards are satisfactorily chosen.

Unlike the univariate and bivariate analyses, in the case of multivariate analysis the proportionate effect of each covariate is determined while all other factors are controlled at some fixed value. To do so, some continuous and several categorical variables have been used as independent variables. For those categorical covariates, dummy variables are created and introduced into the model.

To be clear, zonal residence, current rural-urban residence, migration status (length of continuous residence), marital status, possession of a radio, and household economic and sanitation statuses are included in the model as categorical variables, while age of the mother, educational level of the mother, parity of the mother, household size, population density and percentage adult literate population of the wereda are introduced in the multivariate analysis as an interval scale variables. Thus one has to take into account these facts in interpretation of results.

Table 5.1. Proportionate Effects and Significance Levels of the Different Background Variables on Childhood Mortality (Based on Information from Women in the Age Groups 20 - 44 Years): Misrak Gojjam and Wag Hemra Zones (Total), 1994

Background Variables	Coefficient, B	Standard Error of B	Beta	VIF	Sig T
1	2		3	4	5
Zone					
Misrak Gojjam (= 0)[R]					
Wag Hemra	.1104	.0198	.0313	1.961	.0000
Current Residence					
Urban (= 0)[R]					
Rural	-.1860	.0271	-.0410	2.218	.0000
Age of Mothers	-.0238	.0010	-.1272	1.700	.0000
Education Level	-.0371	.0040	-.0435	1.345	.0000
Migration Status (Length of Continuous Residence)					
Reside Since Birth (= 0)[R]					
Reside only 0 - 9 Years	.2000	.0183	.0459	1.101	.0000
Reside 10+ Years	.0210	.0164	.0053	1.068	.1992*
Marital Status					
Currently Married (= 0)[R]					
Never Married	.5111	.0767	.0269	1.015	.0000
Divorced	.4422	.0154	.1225	1.128	.0000
Widowed	.0877	.0275	.0131	1.052	.0014
Parity of Woman	.2071	.0026	.4411	1.963	.0000
Household Size	-.1139	.0022	-.2346	1.238	.0000
Possession of Radio					
No radio (= 0)[R]					
Has radio	-.0707	.0205	-.0150	1.179	.0006
Household Economic Status					
Low (= 0)[R]					
High	-.0379	.0132	-.0141	1.503	.0040
Medium	-.0092	.0132	-.0032	1.333	.4843*
Household Sanitation Status					
Low (= 0)[R]					
High	-.0135	.0243	-.0031	1.895	.5783*
Medium	-.0525	.0134	-.0167	1.143	.0001
Population Density	-.0001	.00003	-.0286	3.426	.0001
Percent Adult (15+) Literate Population in the Wereda	.0038	.0010	.0307	4.285	.0002
Constant	1.3699	.0422	-	-	.0000
Adjusted R^2 = .1338 , Signif F = .000, Standard Error = 1.1641					
Maximum variance inflation factor, VIF, Observed (Collinearity Diagnosis) = 4.285 NB: Acceptable values are values not exceeding 5 or 10					
Mean of the Error terms = .0000 **Mean of the Predicted Values** = .8914 **Number of Cases** = 53,994					

Source: Computed by the Author from the 1994 census data tape.

[R] Reference category for the factor

* Not significant at .05 significant level, but all others are significant at .01 significant level.

5.2.1) Residual Analysis, and Explanatory Power of the Model

To forward reliable policy recommendations based on the OLS regression outputs, it is advisable to check the violations of the assumptions of the model. To do so, assessments have been made, and some of the important test results are presented in Tables 5.1 and 5.2 together with other outputs. In all regressions, for the two zones together, for Misrak Gojjam and Wag Hemra Zones, the mean values of the error terms are found to be zero. Since all values of the variance inflation factor (VIF) are below the value 5 it can be said that there is no problem of collinearity (Montgomery and Peck, 1992).

The assumption of normality is also assessed using the Normal P-P Plot, and it is revealed that the distribution of the error terms does not coincide with our assumption but not very far from normality. In addition, since our sample is very large, we can rely on the so-called central limit theory to ensure that even if the error terms are not normally distributed, the sampling distribution of a partial slope coefficient estimator will be normally distributed (Berry and Feldman, 1985). In general, even if all the OLS regression assumptions do not perfectly met our expectations, it can be said that they are adequate for practical applications. Therefore, one can proceed to interpret the results and forward reasonable policy recommendations.

Table 5.2: Proportionate Effects and Significance Levels of the Different Background Variables on Childhood Mortality by Zone Based on Information from Women in the Age Group 20 - 44 Years: 1994

Background Variables	Coefficient, B		Beta		Sig T	
	Misrak Gojjam Zone	Wag Hemra Zone	Misrak Gojjam Zone	Wag Hemra Zone	Misrak Gojjam Zone	Wag Hemra Zone
1	2	3	4	5	6	7
Current Residence						
Urban (= 0) [R]						
Rural	-.2158 (.029)	.0098 (.081)	-.0508	.0013	.0000	.9036*
Age of Mothers	-.0244 (.001)	-.0191 (.002)	-.1350	-.0875	.0000	.0000
Education Level	-.0392 (.004)	-.0365 (.026)	-.0505	-.0148	.0000	.1571*
Migration Status (Length of continuous Residence)						
Reside Since Birth (= 0) [R]						
Reside only 0 - 9 Years	.1824 (.020)	.2536 (.048)	.0427	.0534	.0000	.0000
Reside 10+ Years	.0150 (.017)	.1462 (.055)	.0040	.0263	.3760	.0074
Marital Status						
Currently Married (= 0) [R]						
Never Married	.4700 (.089)	.5481 (.152)	.0233	.0350	.0000	.0003
Divorced	.4437 (.016)	.1372 (.047)	.1280	.0306	.0000	.0032
Widowed	.0826 (.029)	-.1445 (.081)	.0128	-.0179	.0042	.0730*
Parity of Woman	.1931 (.003)	.3914 (.008)	.4305	.6129	.0000	.0000
Household Size	-.0989 (.002)	-.3667 (.009)	-.2171	-.4822	.0000	.0000
Possession of Radio						
No radio (= 0) [R]						
Has radio	-.0674 (.021)	-.0981 (.067)	-.0152	-.0144	.0014	.1428*
Household Economic Status						
Low (= 0) [R]						
High	-.0450 (.013)	.0704 (.071)	-.0178	.0096	.0007	.3242*
Medium	-.0249 (.014)	.1115 (.048)	-.0093	.0226	.0656	.0215

Table 5.2: (Continued)

Background Variables	Coefficient, B		Beta		Sig T	
	Misrak Gojjam Zone	Wag Hemra Zone	Misrak Gojjam Zone	Wag Hemra Zone	Misrak Gojjam Zone	Wag Hemra Zone
1	2	3	4	5	6	7
Household Sanitation Status						
Low (= 0) [R]						
High	-.0236 (.025)	.0250 (.076)	-.0058	.0034	.3528	.7431*
Medium	-.0664 (.014)	.0555 (.035)	-.0217	.0157	.0000	.1155*
Population Density	-.0002 (.00003)	.0032 (.001)	-.0427	.0264	.0000	.0082
Percent Adult (15+) Literate Population in the Wereda	.0049 (.001)	-.0533 (.009)	.0378	-.0634	.0000	.0000
Constant	1.3991 (.044)	1.8533 (.124)	-	-	.0000	.0000
Adjusted R^2 Misrak Gojjam Zone = .1269, Signif F = .0000 Standard Error = 1.136 Wag Hemra Zone = .2572, Signif F = .0000 Standard Error = 1.239						
Maximum variance inflation factor, VIF, Observed (Collinearity Diagnosis) Misrak Gojjam Zone = 3.410 Wag Hemra Zone = 1.884 NB: Acceptable values are values not exceeding 5 or 10						

	Mean of the Error Terms	Mean of the Predicted values	No. of Cases
Misrak Gojjam Zone =	.0000 (1.135)	.8966(.434)	46,008
Wag Hemra Zone =	.0000 (1.238)	.8609 (.731)	7,986

Source: Computed by the Author from the 1994 census data tape. * Not significant at .05 significant level, but all others are significant at .05 significant levels. NB: Values in brackets are standard errors. [R] Reference category for the factor

The adjusted values of the coefficients of determinations (Adjusted R^2) for the two zones together, and for Misrak Gojjam and Wag Hemra zones were 13.4 per cent, 12.7 per cent and 25.7 per cents, respectively. That means, all the variables in the analysis, explain only 13.4 per cent, 12.7 per cent and 25.7 per cent of the variation in childhood mortality for the two zones together, for Misrak Gojjam and Wag Hemra Zones, and both values are also statistically significant (Tables 5.1 and 5.2). Such low value of an adjusted R^2s may arise as a result of the absence of some important variables such as nutrition status of the child, breast feeding practices, cause of death and the like. Even if the model is not

adequate for prediction purpose because of its weak explanatory power, it can be used to measure the proportionate effect of each explanatory variable in the model that is in fact one of the objectives of the study.

5.2.2) Zonal Variation in Childhood Mortality

A dummy variable of zonal current residence is introduced in to the model as a proxy indicator of many other variables that are not included in the current model, but they are expected to bring variations in childhood mortality between the two zones. As can be seen from the Table 5.1, even after controlling all variables in the model, childhood mortality was 11.0 per cent higher for Wag Hemra Zone as compared with Misrak Gojjam Zone. The observed difference was also statistically significant (with significant level, t, = .0000). This finding also supports the result obtained in the univariate analysis (Table 4.1) and our expectation that was forwarded at the early stage of the study. Even if it is difficult to identify exactly the factors that lead to childhood mortality differential between the two zones, the general level of welfare of the two populations with respect to food security, weather conditions and ecological setting, and other community variables may be responsible for zonal differentials in childhood mortality. Indeed, some of the variables are included in the model and their effects are controlled.

5.2.3) Current Rural-Urban Residence and Childhood Mortality

A dichotomous dummy variable is introduced into the analysis to assess the impact of urban-rural residence in the study areas. In most research outcome, urban areas appear to have a negative impact on childhood mortality. In this study also it has been hypothesized that women in urban areas may report a lower child mortality than their rural

counterparts. But the study result for the two zones together revealed that childhood mortality is lighter in rural areas than urban areas (Table 5.1). The same result was observed in a study by Ewbank et al (1986) in Kenya. The possible reason might be that most towns may include a low income population who have abandoned some of the traditional child-rearing, and who have not yet learned to take advantage of modern life styles (Ewbank et al, 1986). In contrast to this a study by Assefa (1991) in Shewa Region had found a negative association between urban areas, and infant and early childhood mortality.

When observation is made for each zone, urban areas aggravate childhood mortality in Misrak Gojjam zone while they had a lowering effect in Wag Hemra zone. In other wards, children of women in rural areas of Misrak Gojjam zone had 21.1 per cent lower mortality than their urban counterparts, and such urban-rural difference was statistically significant. With regard to Wag Hemra Zone, rural areas had 1.0 per cent higher mortality than their urban counterparts, but the difference was not statistically significant (Table 5.2). Generally it can be said that there was a significant difference in childhood mortality between urban and rural areas of Misrak Gojjam, but there was no strong difference in Wag Hemra Zone.

5.2.4) Age of Mothers and Childhood Mortality

The age of the mother is introduced into the model as an interval scale variable. Then, after removing the exposure term by the method that was suggested by Trusell and Preston (1981), and then controlling all other factors in the model, age of the mother appears to have a significant negative impact on childhood mortality (Tables 5.1 and 5.2). Its impact was slightly higher for Misrak Gojjam Zone when compared with Wag Hemra

zone. That is, for every one additional year of the age of the mothers, childhood mortality decreased by about 2.4 per cent and 1.9 per cent in Misrak Gojjam and Wag Hemra Zones, respectively. Such research result was also observed in a study by Ewbank et al (1986) in Kenya. The possible reason for such trend may be due to the higher infant death rate suffered by children born to mothers at the early reproductive age groups (Ewbank et al, 1986). It might also be due to the reason that child-raising practices improve with age. In contrast to this, a study by Yohannes (1990) in Addis Ababa town had found a significant positive association between the age of the mother and child mortality.

5.2.5) Maternal Education and Childhood Mortality

Educational attainment is considered as an interval scale variable in the sense that the illiterate women and those women who attended informal education are given the value zero, while those women who completed any formal education are given the number of grades they actually completed. The negative impact of educational level of mothers on childhood mortality is well studied and documented by various scholars around the world (Caldwell, 1979; ECA, 1989; Tawiah, 1979; Ewbank et al, 1986; CSA, 1993; and Meaza, 1997). Our hypothesis has also been in the direction of the general argument and the data presented in Tables 5.1 and 5.2 have also revealed that educational level of the mother has a negative impact on childhood mortality.

For the two zones together, for instance, one additional increase in educational level of the mothers decreases childhood mortality by about 3.7 per cent, and such an impact was also statistically significant. The possible reason for such a negative impact of education on childhood mortality is that educated mothers may have a better skill in child health care practices. Educated mothers may also be able to manage the feeding and child

care practices better than non-educated mothers, given a fixed amount of income for a household. In general education has a strong power in changing the status of the mothers to interact with the modern world and to have a range of choices for them and for their children.

When comparison is made by zone, education had a significant lowering effect of mortality for Misrak Gojjam Zone, while for Wag Hemra Zone, its effect was not statistically significant (Table 5.2). Such discrepancy between these zones might be due to the difference in the proportion of women in the literate category. That is, it might be due to the reason that the proportion of women who were literate was 610.5 per cent higher in Misrak Gojjam Zone as compared to Wag Hemra Zone. (Table 2.4).

5.2.6) Migration Status of Women and Childhood Mortality

Those children born to migrant women suffered from higher mortality as compared with children born to non-migrant mothers (mothers who resided continuously starting from birth), (Table 5.1 and 5.2). Recent migrants, those who were residing about 0 - 9 years, reported 20.0 per cent, while those who were residing 10 years and over only reported 2.1 per cent higher childhood mortality when compared with non-migrants for the two zones together (Table 5.1). But the observed difference between the non-migrants and the long term migrants is not statistically significant. Such significant difference between recent migrants and non-migrants is in agreement with our hypothesis, and with the study that was conducted by Brockerhooff (1990) in Senegal. The possible reason for this phenomenon may be due to the fact that recent migrants are mostly subjected to several adverse conditions at the early arrival of their place of distention. Their life style may also

be disturbed and not stabilized within a short period of time and hence children of such mothers may be subjected to a higher mortality.

As can be seen from table 5.2, the impact of migration was much higher for Wag Hemra Zone as compared to Misrak Gojjam Zone. Childhood mortality among the recent migrants, for instance, was 25.4 per cent and 18.2 per cent higher when compared with the non-migrants for Wag Hemra and Misrak Gojjam Zones, respectively. The relative importance of migration in explaining variations in childhood mortality was also higher for Wag Hemra Zone as compared with Misrak Gojjam Zone (using beta values as a measure). But the observed difference, between permanent migrants (women who reside more than 10 years) and non-migrants, was not statistically significant in the case of Misrak Gojjam Zone.

5.2.7) Marital Status and Childhood Mortality

Observation of the proportionate effects by categories of marital status for the two zones together, revealed that children born to never married, divorced and widowed women had a higher mortality as compared to children born to currently married women (Table 5.1), and the results obtained were statistically significant. Such finding is in agreement with studies else where in Ethiopia and other countries (Brockerhooff, 1990; Yohannes, 1990; and Assefa, 1991). The possible reason for the observed lower childhood mortality among the currently married women may be the role of husbands in child raising activities such as income generating and psychological treatment for the family.

If we observe the proportionate effects for each zone, the same trend was observed, except the insignificant lower childhood mortality observed among the widowed mother for Wag Hemra Zone (Table 5.2). In addition, the lower childhood mortality that has been

observed among the never married women relative to the other groups in the case of univariate analysis for Misrak Gojjam Zone (Table 4.1) has disappeared at this stage of the analysis.

5.2.8) Parity of Mothers and Childhood Mortality

As observed in the previous chapters, the same strong positive relationship was observed between parity of the mothers and childhood mortality. That is, even after removing the exposure term by the method that was suggested by Trussell and Preston (1981), and controlling all other variables in the model, fertility performances of the mothers appear to have a strong positive relationship with childhood mortality (Tables 5.1 and 5.2). If we take, for instance, the regression coefficients as a measure of the proportionate effect of each factor, for every one additional live birth, childhood mortality increased by 20.7 per cent, 19.3 per cent and 39.1 for the two zones together, for Misrak Gojjam and Wag Hemra Zones, respectively. The relative importance of parity, with respect to factors in the model, in explaining the changes in childhood mortality was higher for Wag Hemra Zone as compared to Misrak Gojjam Zone (beta values of 0.4305 Vs 0.6129). The possible reason for the observed strong positive association between parity and childhood mortality is that, if all other conditions are assumed to be equal, high parity women may have less birth intervals and hence less time interval for each child to be given an adequate care during his/her early stages of life. Children born to high parity women are also more likely to be born with birth defects and hence their chance of survival could be lower as compared with children born to low parity women.

5.2.9) Household Characteristics and Childhood Mortality

Household Size and Childhood Mortality. It is expected that household size will have a positive association with childhood mortality. But the results obtained in Tables 5.1 and 5.2 do not meet our prior expectation. That is, the study revealed that there was a strong negative relationship between household size and childhood mortality in both study areas. The possible reason might be the major agricultural economy that prevails in the study areas. That means, in backward agricultural economy labour intensive activities have a paramount importance for a relatively adequate food production. A larger household size enables the household to have various divisions of labour and hence a better income. In line with this argument childhood mortality might be lower for those mothers from a household with large number of members. Observations of the regression coefficients by zone revealed that for every one additional member of a household, childhood mortality may decline by about 9.9 per cent and 36.7 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. On the other hand, household size can explain childhood mortality for Wag Hemra Zone better than Misrak Gojjam Zone (beta values of -0.2171 Vs -0.4822).

Possession of Radio and Childhood Mortality. As can be observed from Tables 5.1 and 5.2, availability of a working radio in a household had shown a negative impact on childhood mortality for both zones together, for Misrak Gojjam and Wag Hemra Zones, but the magnitude was not statistically significant for Wag Hemra Zone. Household members may interact with the outside modern world through radio. They may get information about the ways of life to attain better sanitation, treatments and prevention of communicable diseases and hence they may give care for themselves and their members. Such facts may be the possible reasons for the observed association between childhood mortality and availability of a working radio in the household.

Household Economic Status and Childhood Mortality. In the case of univariate and bivariate analysis, household economic status appeared to have a negative association with childhood mortality, except for some discrepancies observed in Wag Hemra Zone. The same is also true at this stage of the analysis, except for the unexpected positive association observed for Wag Hemra Zone. Statistically significant difference were observed between the low status (the reference) and the high status factor levels for both zones together and for Misrak Gojjam Zone. With regard to Wag Hemra Zone, a statistically significant difference was observed only between the reference category (Low status) and the medium status categories. Such a statistically strong negative association observed for some factor levels may be due to the fact that better economic status means a better supply of the basic necessities such as food, clothing and housing for the household members. A continuous supply of such necessities in turn may reduce child mortality in a household.

Household Sanitation Status and Childhood Mortality. In the case of univariate and bivariate analysis, sanitation conditions of a household had shown a negative association with childhood mortality, except for Misrak Gojjam Zone (Tables 4.1 and 4.2). With regard to multivariate analysis, a negative association was observed for both zones together and for Misrak Gojjam Zone, indeed statistically significant difference was observed for the medium and high factor levels for the former and the latter levels of analysis, respectively. But, in the case of Wag Hemra Zone, unexpected but statistically insignificant positive association was observed. Such unexpected direction of association might be attributed to improper utilization of sanitation facilities or poor indicators of household sanitation status.

5.2.10) Population Density and Childhood Mortality

The observed association of population density varies by zone. That is, for the two zones together and for Misrak Gojjam Zone, the study revealed a statistically significant negative association between population density and childhood mortality. But in the case of Wag Hemra Zone, the study revealed a statistically significant positive association. In fact, both directions have been possible as explained in the literature review. In one direction, concentration of people may increase exposure to disease and tends to increase mortality (Easterline, 1978); in the other direction, densely populated areas may be priority areas for governments to provide socio-economic service centers such as education and health facilities, and hence tend to decrease mortality (Ewbank et al, 1986). Thus, the observed trends in the study areas may not be far from these facts.

5.2.11) Modernization and Childhood Mortality

As can be understood from demographic transition theory, modernization was considered as a major factor for the transition of mortality from the high and inconsistent level to a very low and consistent level in the case of Western European countries (Thomson, 1929 as cited in Kammeyer and Ginn, 1986). To assess the impact of modernization on childhood mortality in the study areas, percent literate was included in the multivariate analysis as a proxy indicator of modernization.

According to the data presented in Tables 5.1 and 5.2, the study revealed a statistically significant positive association between childhood mortality and percent adult (15 years and older) literate population for the two zones together and Misrak Gojjam Zone, while a statistically significant negative association was observed for Wag Hemra Zone. The observed association for Misrak Gojjam Zone is out of our expectation and

several reasons may be responsible for this. Even if there is no concrete empirical evidence to support my argument , early stages of modernization might increase childhood mortality at community level. In Misrak Gojjam Zone, for instance, among the literate persons about 40 per cent were below grade 9 (P.H.C.C, 1998). Such an early level of education in turn may affect the attitude of persons to abandon some of the traditional child-feeding practices such as extended breast-feeding, but not yet learned to take advantage of modern child care facilities. As a result of which childhood mortality might tend to increase in such communities.

As a summary of the section, in almost all factors the findings of the univariate and the bivariate analysis have been supported by the multivariate analysis, except for some household level variables. In addition, almost all findings are in the expected directions, except for some household and community level variables. Thus one can forward reasonable recommendations based on these findings about childhood mortality.

CHAPTER VI

SUMMARY, RECOMMENDATIONS AND CONCLUSION

6.1. Summary

Mortality levels and differentials have shown variations not only among countries but also among administrative regions within a country (Ewbank, 1986). This is also true in the case of Ethiopia. Thus an attempt is made to study levels, trends, differentials and covariates of childhood mortality for Misrak Gojjam and Wag Hemra Zones that are found in Amara region. The former zone is relatively accessible, and free from drought and civil war in the past decades compared to the latter zone. Thus, by studying childhood mortality for these areas one can have an overview about childhood mortality differentials between remote and accessible areas, and relatively food insecure (drought prone) and secure areas in the region, so that it will be easy to understand priority areas for policy formulation and implementation.

Childhood mortality estimates are mostly sensitive to errors and hence data quality assessment has been made before analyzing the data. Based on the results from various quality check methods, it can be said that the study used data of reasonable quality.

The background characteristics of women at the reproductive age have been assessed. For each zone, very small percentages of women were residing in urban areas as compared to rural areas. Even if small percentages of women at the reproductive age have been found in urban areas of the two zones, the proportion of women who were residing in urban areas was much higher for Misrak Gojjam Zone than Wag Hemra Zone (11.7% Vs. 4.5%). In Misrak Gojjam Zone 13.5 per cent were literate, while in Wag Hemra Zone only

1.9 per cent were literate. This implies that efforts have to be made to improve the status of women with respect to education in the study areas. Indeed, not only in the study areas but in the Amara region as a whole (CSA, 1998).

Among women at the reproductive age, 19.5 percent, and 16.2 per cent were migrants for Misrak Gojjam and Wag Hemra Zones, respectively, while 68.0 per cent and 69.6 per cent were currently married women, in the same order. Among the ever married women 24.1 per cent and 13.7 per cent dissolved their marriage due to divorce or widowed for Misrak Gojjam and Wag Hemra Zones, respectively.

Among these women, 27.9 per cent and 29.6 per cent were childless in Misrak Gojjam and Wag Hemra Zones, respectively. Women with 10 and above births accounted for 4.4 per cent and 1.4 per cent in Misrak Gojjam and Wag Hemra Zone, respectively. The proportion of women who were living in a household with size 10 and above members was higher for Misrak Gojjam Zone as compared to Wag Hemra Zone (4.1 per cent Vs. 2.8 per cent).

Among these women, only 9.8 per cent and 4.9 per cent were members of a household with a working radio for Misrak Gojjam and Wag Hemra Zone, respectively. Based on the proxy indicator of household economic status, 36.9 per cent and 4.9 per cent of the reproductive women were living in a household with high economic status for Misrak Gojjam and Wag Hemra Zones, respectively. In the same way, 12.1 per cent and 4.2 per cent were residing in a household with a high sanitation status for Misrak Gojjam and Wag Hemra Zones, respectively. Such an observed variations in the background characteristics of the reproductive women may have a strong implication for variations in childhood mortality by zone.

Using the Brass methods of estimation and Trussell equations, it is found out that childhood mortality rates were relatively higher for Misrak Gojjam Zone compared to Wag Hemra Zone, using both the West and North mortality patterns of the Coale-Demeny Model Life Tables. The study also revealed a decline in childhood mortality in years between 1986 to 1992 for both zones, and the decline was relatively higher for Wag Hemra Zone compared to Misrak Gojjam Zone The fast decline in childhood mortality rate for Wag Hemra Zone relative to Misrak Gojjam Zone might be a result of the prevalence of peace and stability in Wag Hemra Zone immediately before and after the change in Government in 1991.

Further assessments of variations in childhood mortality between the two zones is made using a statistically sound procedure that was suggested by Trussell and Preston (1981). Using this procedure the study revealed a higher childhood mortality for wag Hemra Zone compared to Misrak Gojjam Zone, which was not the case before the application of this method. With out controlling any of the variables in the analysis (in the case of univariate analysis), for instance, it is found out that childhood mortality was about 6 per cent lower in Misrak Gojjam Zone than Wag Hemra Zone. In the case of multivariate approach, i.e., if each factor in the model has been controlled, childhood mortality was about 11 percent higher for Wag Hemra Zone than Misrak Gojjam Zone. Recall that the lower childhood mortality that were observed for Wag Hemra Zone in the previous discussions (before the application of Trussell and Preston procedure) is reversed at this point. Such a reverse in the direction of difference in childhood mortality between the two zones may be a result of the removal of the non-additive effect of the exposure term on childhood mortality. Thus, one can argue that the higher childhood mortality rates observed for Misrak Gojjam Zone before the application of the Trussell and Preston

procedures may not be attributed to socio-economic factors, but it may be due to the longer exposure time to the risk of dying for children in Misrak Gojjam Zone compared to Wag Hemra Zone. In general, it can be said that childhood mortality was higher for Wag Hemra Zone compared to Misrak Gojjam Zone, and the difference may be attributed to differences in the socio-economic background characteristics of the two populations.

Assessments of zonal variation in the interrelationship between childhood mortality and its covariates have been made. In the descriptive analysis, for almost all factor levels, childhood mortlity was higher for Wag Hemra Zone when compared with Misrak Gojjam Zone. In fact, in urban areas, childhood mortality was relatively higher for Misrak Gojjam Zone as compared with Wag Hemra Zone for some exceptional factor levels.

With regard to the multivariate approach, being a recent migrant, being divorced and single, and parity of women had shown a statistically significant positive association with childhood mortality for each zone. Household size had shown a strong negative association with childhood mortality for each zone, but its magnitudes vary by zone. That is, for each additional member of a household childhood mortality decreased by about 9.9 per cent and 36.7 per cent for Misrak Gojjam and Wag Hemra Zones, respectively. Educational level had a negative association for each zone but its magnitude was statistically significant only for Misrak Gojjam Zone. Availability of a radio in a household had also shown a negative association with childhood mortlity but its effect was statistically significant only for Misrak Gojjam Zone.

Population density and percentage adult (15 years and older) literate population of the wereda had shown a statistically significant association with the survival chance of children, but their directions and magnitudes were different for each zone. Population

density, for instance, had shown a statistically significant negative association for Misrak Gojjam Zone, but it had shown a statistically significant positive association for Wag Hemra Zone. Per cent adult literate population had shown a statistically significant positive association for Misrak Gojjam Zone, but it had shown a statistically meaningful negative impact for Wag Hemra Zone. Household economic and sanitation status did not show statistically meaningful impact on childhood mortality.,

Some of the Ordinary Least Square (OLS) regression assumptions have been checked and some of these assumptions have been in the required directions except some minor deviations that may not have marked impact on the analysis. Therefore, one can use the study results to forward policy recommendations that can be used for population and development planning.

6.2. Recommendations and Conclusion

1. The study indicated that children born to women who were residing in drought prone and remote areas had a lower chance of survival. Thus, special efforts must be made in drought prone areas to introduce services likely to increase survival probabilities for children.
2. As we observe from the findings of various studies and from this study, educated mothers experience lower childhood mortality than non-educated mothers. Thus improvements in educational levels of women will have a marked role in childhood mortality decline. Hence, a method has to be devised to implement clear and strong education policies that can improve the status of women, without which change in attitude and practice towards better child care activities are difficult, if not impossible, to attain.

3. As we understood from this study, migration aggravates childhood mortality. Therefore, there is a need to devise methods by which the push factors could be minimized, if not removed. Among others, implementing rural based development strategy, which is, in fact, the development policy of the Government of Ethiopia and Regional States, may minimize the outflow of people from rural to urban areas..
4. Divorced mothers reported a higher proportion of children dead than the other groups of women. Therefore, efforts have to be made to minimizes divorce rates, such as by improving the status of women with respect to decision making.
5. Parity of women has a strong positive association with childhood mortality. Thus every effort that minimizes the level of fertility may reduce childhood mortlity. Hence, efforts have to be made to improve family planning programs that may have a significant role in not only to bring fertility transition but also mortlity transitions.

Even if some important variables such as disease status, nutrition status, etc., of the child are not considered in the study, we have had some knowledge about levels, trends, differentials and covariates of childhood mortality for the study areas. Such type of study at large scale, in terms of variable and area coverage, may have a great role for population and development planning that aimed at improved people's welfare in the Amara National Regional State. Thus, further studies concerning childhood mortality are highly recommended.

APPENDIXES

Appendix I: Construction of Household Economic and Sanitation Status Indicators

1. 1 Construction of proxy indicators for household economic status

1.1.1 For Rural Areas:

a). High status: A household is grouped into a high status category:

- If the wall of the housing unit is made of stone and cement, blockets or bricks, or
- If the roof of the housing unit is made of corrugated iron, or
- If the number of rooms of the housing unit is 3 and above, or
- If the household mostly used kerosene for cooking food

b) Medium status: a household is grouped into a medium status category:

- If any of the conditions in '1.1.1.a' don't satisfied, and
- If the number of rooms of the housing unit is 2, or
- If the household used charcoal for cooking food.

c) Low status: a household is grouped into a low status:

- If any of the conditions in '1.1.1.a' and '1.1.1.b' don't satisfied, and
- If the wall of the housing unit is made of wood and mud, wood and thatch or bamboo, and
- If the roof of the housing unit is made of thatch, wood and mud bamboo, and
- If the number of rooms of the housing unit is 1, and
- If the household mostly used fire wood, leaves, dung, or manure for cooking food.

1.1.2. For Urban Areas

a). High Status: a household is grouped into a high status category:

- If it is residing in its own housing unit , and the housing unit has the following characteristics:
  - the wall is made of stone and cement, or
  - the roof is made of concrete, or
  - the ceiling is made of chipwood/board, wooden or concrete or
  - the floor is made of wood tiles, plastic tiles or cement bricks, or
  - the number of rooms is 4 and above, or
- if the household is residing in a rented housing unit and the amount of rent it is paying is Birr 20 and above, or
- if the household mostly used electricity, gas, kerosene, electricity and kerosene or electricity and gas for cooking of food.

b) Medium Status:- a household is grouped into a medium status category:

- if the household is residing in its own housing unit and, the housing unit has the following characteristics:
  - if any of the conditions mentioned in '1.1.2.a' don't satisfied, and
  - if the ceiling is made of fabrics (sheets of cloths) or
  - if the floor is made of bamboo or
  - if the number of rooms are 2 or 3, or
- if the household is residing in a rented housing unit, and the amount of rent it is paying is Birr 10 to 19, or
- if the household mostly used charcoal, wood and kerosene, wood and gas, electric and wood or electric and charcoal for cooking of food.

c) Low Status:- a household is grouped into a low status category:

- if the household is residing in its own housing unit with the following characteristics
  - the wall is made of wood/mud, wood/thatch, stone and mud or reed/bamboo and
  - the roof is made of corrugated iron, thatch, wood/mud or bamboo and
  - has no ceiling and
  -the floor is made of mud and
  - the number of rooms is only one, or
- if the household is residing in a rented housing unit, and the amount of rent it is paying is Birr 0 to 9, and
- if the household mostly used wood, dung, wood and charcoal or wood and dung for cooking of food.

1.2. Construction of proxy indicators for household sanitation status

1.2.1. For Rural Areas:

a) High Status:- A household is grouped into a high status category:

- If it was using tap water or toilet

b). Medium Status:- A household is grouped into a medium status category:

- If it was using water from protected well or separate kitchen

c) Low Status:- A household is grouped into a low status category:

- if it was using water from unprotected well or river, and
- if it has no toilet and
- if it has kitchen with animals or has no kitchen .

1.2.2. For Urban Areas:

a) High Status:- A household is grouped into a high status category:

- If it was using tap water, or
- it was using modern private or shared kitchen , or
- if it was using flush private or shared toilet, or pit private toilet.

b) Medium Status: A household is grouped into a medium status category:

- If any of the conditions mentioned in '1.2.2.a' don't satisfied, and
- if it was using water from protected well, or
- if it was using traditional private or shared kitchen, or
- if it was using pit shared toilet.

c). Low Status: A household is grouped into a low status category:

- If any of the conditions in '1.2.2.a' and '1.2.2.b' don't satisfied and
- if the household used water from unprotected well or river and
- if it has no kitchen and toilet.

Appendix II: Index of Childhood Mortality (Proportional Factor) By Age Groups of Mother and Zone: 1994

Age Groups	Misrak Gojjam Zone	Wag Hemra Zone	Percentage Difference
1	2	3	4=(2-3)/3 x 100
15 - 19	0.9769	0.9277	5.30
20 - 24	0.9271	0.8865	4.58
25 - 29	0.9914	0.9822	0.94
30 - 34	1.0648	1.1238	-5.25
35 - 39	1.0925	1.2456	-12.29
40 - 44	1.1640	1.2091	-3.73
45 - 49	1.1076	1.2796	-13.44

Source: Calculated by the author from 1994 Census data tape

Appendix III: Calculation of Expected Proportion Dead (PD^s):Coal-Demeny, West Model Life Table with Sex Ratio 1.05.

3.1. Misrak Gojjam Zone

Age of Mothers, i	Age of Child, x	Rural (Level = 12.0, e_0 = 46.0)			Urban (Level = 14.3, e_0 = 51.6)		
		$q^s(x)$	$k^s(i)$	$PD^s(i) = q^s(x)/k^s(i)$	$q^s(x)$	$k^s(i)$	$PD^s(i)$
15-19	1	0.1438	0.932	0.1544	0.1115	1.064	0.1047
20-24	2	0.1804	1.008	0.1789	0.1375	1.106	0.1242
25-29	3	0.1965	0.992	0.1982	0.1490	1.058	0.1409
30-34	5	0.2150	1.011	0.2126	0.1622	1.062	0.1527
35-39	10	0.2337	1.033	0.2263	0.1768	1.080	0.1638
40-44	15	0.2474	1.022	0.2422	0.1877	1.068	0.1758
45-49	20	0.2661	1.013	0.2626	0.2032	1.059	0.1919

Source: Calculated by the author from 1994 Census data tape

3.2. Wag Hemra Zone

Age of Mothers, i	Age of Child, x	Rural (Level =14.0, e_0=51.0)			Urban (Level =14.4, e_0=52.0)		
		$q^s(x)$	$k^s(i)$	$PD^s(i) = q^s(x)/k^s(i)$	$q^s(x)$	$k^s(i)$	$PD^s(i)$
15-19	1	0.1152	0.966	0.1194	0.1102	1.062	0.1037
20-24	2	0.1425	1.011	0.1410	0.1358	1.003	0.1354
25-29	3	0.1545	0.987	0.1566	0.1472	0.959	0.1535
30-34	5	0.1683	1.004	0.1675	0.1601	0.973	0.1646
35-39	10	0.1834	1.025	0.1789	0.1746	0.991	0.1762
40-44	15	0.1946	1.014	0.1920	0.1853	0.979	0.1893
45-49	20	0.2106	1.006	0.2094	0.2007	0.972	0.2066

Source: Calculated by the author from 1994 Census data tape

Appendix IV: Health Facilities, Manpower Directly Related to Health and Ratios to Population

6.1: Distribution of Health Facilities by Zone

Health Facility/Diseases	Misrak Gojjam		Wag Hemra		Ratio of 1996 (Facility : Population)	
	1996	1998*	1996	1998*	Misrak Gojjam	Wag Hemra
Projected Population	1783703	1871377	288652	302324	-	-
Hospital	1	1	-	1	1:1783703	0:288652
Hospital Beds	60	-	-	-	1:4811	0:288652
Health Centers	3	4	1	2	1:594568	1:288652
Health Center Beds	20	-	7	-	1:89185	1:41236
Clinics (Health Stations)	66	57	21	19	1:27026	1:13745
Health Post	25	15	-	-	1:71348	0:288652
Drug Shops	24	-	1	-	1:74321	1:288652
Malaria:						
- Malaria Cases Reported	10322	-	522	-	-	-
- Death Due to Malaria Among Cases Reported	78 (0.76%)	-	8 (1.68%)	-	-	-

Source: Ministry of Health. NB: * Excluding private organizations

6.2: Distribution of Professions by Zone

Professions	Misrak Gojjam	Wag Hemra	Ratio (No. Of Professionals : Population)	
	1998*	1998*	Misrak Gojjam	Wag Hemra
Projected Population	1871377	302324	-	-
Physicians (Doctors)	18	4	1:103965	1:75581
Nurses	104	19	1:17994	1:15911
Health Assistants	261	57	1:7170	1:5304
Total Health Related Professionals	430	106	1:4352	1:2852

Source: Ministry of Health. NB: * Excluding private organizations

Appendix V: Female Populations According to Different Responses Concerning Children Ever Born: 1994

Age Groups of Women	Female Population			Proportion of Women With	
	Total No.	Zero Parity	Parity Not Stated	Zero Parity	Not Stated
Misrak Gojjam Zone					
15-19	18831	14492	249	0.7696	0.0132
20-24	14194	4332	145	0.3052	0.0102
25-29	12814	1405	76	0.1096	0.0059
30-34	9957	511	32	0.0513	0.0032
35-39	8877	325	21	0.0366	0.0024
40-44	7177	258	24	0.0359	0.0033
45-49	5151	168	18	0.0326	0.0035
Wag Hemra Zone					
15-19	2813	2293	189	0.8151	0.0672
20-24	2432	884	85	0.3635	0.0350
25-29	2299	347	43	0.1509	0.0187
30-34	2011	152	19	0.0756	0.0094
35-39	1599	107	17	0.0669	0.0106
40-44	1358	100	14	0.0736	0.0103
45-49	900	81	15	0.0900	0.0167

Source: Calculated by the author from 1994 Census data tape

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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.

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