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THE ROLE OF MATERNAL CHARACTERISTICS ON NUTRITIONAL STATUS OF ETHIOPIAN CHILDREN

BY MICHAEL TIRFE

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The Role of Maternal Characteristics on Nutritional Status of Ethiopian Children

By Michael Tirfe

Faculty of Business and Economics

Department of Economics

Approved by Board of Examiners:

Dr. Tassew Woldehanna Advisor	_____ Signature
_____ Examiner	_____ Signature
_____ Examiner	_____ Signature

Declaration

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

Name Michael Tirfe

Signiture _____

Addis Ababa University, Faculty of Business and Economics,

Department of Economics

Date: July, 2006

Place: Addis Ababa

Confirmed by Supervisor

Name Dr. Tassew Woldehanna

Signiture _____

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Contents

Tables

Abstract

Many Ethiopian children suffer from the burden of malnutrition. Studies show that half of the children are either stunted or underweight. The prevalence rate of child malnutrition in Ethiopia is higher than the average prevalence rate for Sub Saharan Africa countries for which the Demographic and Health Survey was conducted. The implication is that timely interventions are critical which require a good knowledge of the major causes of child malnutrition. This paper examines the role of maternal characteristics (education, relative household status, and employment) on nutritional status of Ethiopian children as measured by stunting and underweight. Separate estimations were performed for rural and urban areas. The result showed that mothers' education level and their relative household status are important determinants of the nutritional status of children. In addition, household economic status and age of a child showed a strong association with nutritional status.

Chapter One

Introduction

1.1 Background

Child welfare has attracted the attention of researchers, policy makers and others. It has been a subject of extensive debates and controversies.

In general, the concept of welfare is complex and multifaceted: it includes social, political, economic, cultural and traditional dimensions (Kedir, 1997). Inadequate welfare has been the case in many parts of the world, specifically in the developing world. The burden of this unfavorable welfare situation is not evenly shouldered among different sections of society. Women and especially children suffer heavily from the adverse impacts of poverty.

Child welfare is similar to adult welfare in that it encompasses both material and nonmaterial aspects. However, it exhibits characteristics that are distinct from that of adult welfare (Chowdhury, 2005).

Chowdhury (2005) emphasized that childhood poverty occurs at the most vital period of physical and mental development such that deprivations in terms of nutrition, healthcare, education, or security even for a relatively short period of time can have long lasting and irreversible consequences on child development. Consequently, productivity and welfare

in adulthood could be adversely affected following early childhood poverty which in turn might lead to intergenerational transmission of poverty.

Despite the importance of ensuring the welfare of children, many children in different parts of the world have been deprived of basic services and care that are essential for their development. Empirically, Moore (2004) presented findings from a survey data collected during the 1990's on nearly 1.2 billion children from 46 countries. Accordingly, over one billion children, that is more than half of the children in developing countries, suffered from a severe deprivation of at least one basic human need and one third of them were deprived of two or more basic needs.

Regarding the measurement of child welfare, traditional money metrics welfare measures such as consumption expenditure and income have some weaknesses in measuring child welfare. As a result, non money metrics measures of welfare have been increasingly in use to supplement the traditional measures of welfare.

Recent approaches have focused on using measures that encompass health and nutritional status dimensions of child welfare. In this regard, nutritional status indicators have been widely used. Specifically, anthropometric measures have turned out to be the most ideal indicators of child nutritional status which is why they have been utilized extensively in measuring child welfare.

1.2 Statement of the Problem

Malnutrition affects the welfare of individuals. Particularly, the consequences of malnutrition are severe and they have irreversible and long lasting implications on those individuals who survive malnutrition in their early childhood (Setboonsarng, 2005).The adverse impacts of malnutrition on individuals include poor cognitive development and poor health which could reduce productivity in adulthood (Zere and McIntyre, 2003). At aggregate level, malnutrition affects countries' economic performance through increasing health outlays for treating malnourished children and reducing labor productivity (World Bank, 2006).

In the Ethiopian case, studies have shown that a large proportion of children have been suffering from malnutrition and that child malnutrition is a serious problem. Information obtained from the Ethiopia 2000 Demographic and Health Survey (DHS) confirms this situation. The survey showed that there was a very high prevalence of chronic child malnutrition in that more than one out of two under five children (52 percent) were stunted and 26 percent were severely stunted. Similarly, 47 percent of the children were underweight and 16 percent were severely underweight. With respect to acute/short term malnutrition, 11 percent of the children were wasted and 1 percent were severely wasted.

Recent information shows that the prevalence rate of child malnutrition is still very high. According to the Central Statistical Authority (2004), the prevalence of stunting, wasting, and underweight was respectively 46.9 percent, 8.3 percent and 37.1 percent. These

figures are very high even compared to other developing countries which are severely affected by the problem of child malnutrition. Silva (2005) stated that the prevalence rate of child malnutrition among Ethiopian children is higher than the average prevalence rate for Sub Saharan African countries for which the Demographic and Health Survey was conducted.

Moreover, child malnutrition in Ethiopia exhibits a considerable variation between rural and urban areas. To be specific, malnourished children are overrepresented in rural parts of the country than their urban counter parts. For instance, the prevalence rate of stunting in rural Ethiopia was 48.5 percent which is significantly higher than that of urban areas where 26.9 percent of children were stunted (Central Statistical Authority, 2004). Similar patterns explain the situation with regard to wasting and underweight.

The implication of this high prevalence of child malnutrition is that a good knowledge regarding the major factors that contribute to the problem is essential in order to avoid its adverse consequences. The causes and determinants of child malnutrition are complex, interrelated, and multidimensional. In the literature, since mothers are the main providers of primary care to their children, understanding the contribution of maternal characteristics on child nutrition has been identified as a key towards addressing the problem of child malnutrition.

For instance, Borooah (2002) found out that mothers' literacy benefits children in terms of reduced risk of malnutrition. Appoh and Krekling (2005) showed that mothers'

practical knowledge about nutrition has important implication on nutritional status of children. On the other hand, Khasnobis and Hazarika (2006) demonstrated that improved women's relative household status leads to better nutritional status of children which seems important particularly in developing countries where women have lower social and economic status.

In light of this, therefore, identifying the role of maternal socioeconomic characteristics particularly education and household status on nutritional status of Ethiopian children can assist the effort towards alleviating the burden of child malnutrition. Thus, this paper focuses on examining the role of maternal characteristics on nutritional status of Ethiopian children.

1.3 Objectives of the Study

The general objective of the study is to assess the importance of maternal socioeconomic characteristics which include education, household status, and employment on nutritional status of Ethiopian children. Specifically, the paper aims at examining the role of maternal characteristics on nutritional status of rural and urban children separately. In addition, it assesses whether the effects of maternal characteristics on nutritional status of children vary on the basis of nutritional status indicators utilized i.e., height-for-age (stunting) and weight-for-age (underweight).

1.4 Organization of the Study

Chapter two reviews the theoretical and empirical literature on child malnutrition. Chapter three discusses the data used and the methodology adopted for the empirical analysis. Chapter four presents the descriptive analysis of the data and the findings from the bivariate and multivariate analysis. Finally, chapter five concludes.

Chapter Two

Review of Literature

2.1 Theoretical Literature

2.1.1 The Concept and Measurement of Welfare

The concept of poverty is multidimensional and multifaceted such that it is an outcome of complex interactions of social, economic, cultural and political factors (Kedir, 1997). The multidimensionality has led to the difficulty of providing a universally acceptable and unambiguous definition of welfare (Chowdhury, 2005). Among others, how poverty should be compared across nations, and how it is perceived among different families of the same generation and across different generations contribute to the difficulty (Ibid, 2005).

Poverty has various manifestations. These include the following: lack of income and productive resources sufficient enough to ensure sustainable livelihoods; hunger and malnutrition; ill health; limited or lack of access to education and other basic services; increased morbidity and mortality from illness; inadequate housing and homelessness; unsafe environments; social discrimination and exclusion; and lack of participation in decision making in civil, social, and cultural life (United Nations, 1995 cited in Bradbury, 2003).

Ravallion (1996) stated that the common practice in defining welfare is using a single monetized measure as an indicator of household well being. That is total household

expenditure and income over a given period of time serve as indicators of standard of living.

Using cutoffs, these continuous measures of welfare are divided into sub groups that reflect the duration and intensity of poverty (Baulch and Masset, 2002). These cutoffs must be able to represent the level of resources below which it would be difficult to take part in normal activities of a society (UNICEF, 2005) [a]. Usually, the normal food energy requirement of a human body which is 2,100 calories per person per day either with or without a modest allowance for essential non-food expenditures represents a cutoff (Baulch and Masset, 2002). Such a cutoff provides the basis on which households are categorized as poor and non-poor. Individuals or households that fail to attain the minimum level of income or consumption expenditure as defined by the cutoff are said to be in poverty (Setboonsargn, 2005).

Despite the extensive use of income and consumption expenditure as a measure of welfare, there are some drawbacks that limit their applications.

Setboonsargn (2005) stated that income as an indicator of poverty is limited by its weakness in terms of reliability, cost effectiveness, timeliness, and comparability across countries. Income information mainly collected at household level is laborious and costly particularly in the context of developing countries where the majority of the poor live. Moreover, such economies are characterized by informal economic activities and low level of monetization which make collection of accurate income and expenditure data

extremely difficult if at all possible. Even where there is a monetary exchange, income information collected through household interviews (a common method of obtaining such data) may not be accurately obtained. Furthermore, price variability across time and places, local currency adjustment, aggregations, and calculations make such data problematic in that comparison across countries and geographical areas becomes very difficult.

Another reason to question income as welfare measure comes from its variability from time to time (UNICEF, 2005) [a]. Household income at any given point of time may not well approximate the total resources available to a household. This follows from the fact that permanent income of a household could be higher or lower than current income and that a household may hold assets which allow consumption smoothing all through temporary income falls.

On the other hand, most consumption expenditure and income data are collected at household level. The underlying assumption in such cases is that there is a well functioning family within which family resources are shared equitably and reasonably with necessities taking priority (Ravallion, 1996). This is an unrealistic assumption and it could possibly lead to inaccurate conclusion drawn with regard to the welfare of different members of a household, particularly children and women (Bradbury and Jantti, 1999). For instance, the assumption that children equally share the resources may distort the reality when they are subject to deprivation of their basic needs should parents consume a disproportionately larger share of family resources or the extra protection they receive if

parents make a sacrifice to ensure children do not go with out. The assumption also ignores the possibility for gender based discrimination in intra-household resource allocation between boys and girls (Blackman and Litchfield, 2001).

Equivalence scale has been widely accepted to establish the equivalent income for families of different size and composition. However, the use of different conversions can lead to different poverty rates. Atinkson (1992) stated that large differences in equivalence scale could lead to different conclusions drawn with respect to the extent of poverty and the composition of the poor population.

Ravallion (1996) emphasized that the use of income information in measuring welfare is a limited concept and it would be better to supplement it by other non-income indicators. The use of supplementary data such as those on nutritional and health status, access to health and education, life expectancy and infant mortality can help complete aspects of welfare not captured by income and expenditure data.

Baulch and Masset (2002) found out that the association between monetary and non-monetary measures (including indicators of nutritional status and education) is weak both in static and dynamic context.

In view of these facts, it is now a common practice to approach welfare from a multidimensional perspective. This is particularly the case with respect to child welfare.

Chowdhury (2005) mentioned that child poverty encompasses deprivation of both material and non-material dimensions of life as in the case of adults. Nevertheless, the welfare of children differs from that of adults' since welfare of children is a critical determinant of their future well being (White et al, 2005).

According to Blackman and Litchfield (2001), child welfare goes beyond household income and it covers issues of health such as malnutrition and vaccination, and access to education. Welfare of children should therefore be measured by making use of indicators on different dimensions of welfare which include income poverty, health, education, caregiver's time use, and physical and social surrounding. The sections that follow provide a review of theoretical and empirical literature on nutritional status of children as a measure of welfare.

2.1.2 Nutritional Status Indicators and Child Welfare

Among others, health and nutrition are the most critical components of household basic needs in developing countries (Behrman and Deolalikar, 1998). Nutritional status of children below age five is among the many indicators of household well being and it is one of the determinants of child survival (Zere and McIntyre, 2003). Setboonsarng (2005) underscored that nutritional status measures are comprehensive and they assist in capturing aspects of welfare that are inadequately reflected while using other indicators. The use of nutritional status as an indicator of welfare of a child is appealing since health

of a child has a long term welfare implication and dictates to great extent productivity all through adulthood.

According to Behrman and Deolalikar (1998), health status in micro empirical studies can be described by the following measures: clinical measures of bodily attributes; anthropometric measures of height, weight, triceps skinfold thickness, arm circumference etc; respondent reported diseases symptoms; reports on incapacity for undertaking normal respondent activities.

These nutritional indicators differ from each other on the basis of cost considerations, measurement error they entail, and the dimension of health they refer to. Clinical measures of bodily attributes are costly because data collection and analysis are expensive and time consuming. Therefore, they are less practical and socioeconomic data sets rarely have these measures of health status. The last two measurements are relatively cheaper and frequently in use. Although anthropometric measurements are not cheaper, they are commonly utilized for they are relatively easy to assess health and nutritional status.

2.1.2.1 Anthropometric Indicators of Child Nutritional Status

In practice, anthropometric measures are the most commonly used indicators of child nutritional status. Anthropometric indicators are relatively inexpensive and non invasive

measures of welfare and nutritional status of an individual or a population group and this has contributed to their use in many welfare studies (Cogill, 2001).

According to Cogill (2001), anthropometric assessment is based on four building blocks: age, sex, length (height), and weight. Separately, each of these provides a piece of information about a person. When they are combined together, anthropometric indices result which provide information about nutritional status of a person. The commonly used anthropometric indices in assessing nutritional status of children are weight-for-age, length-for-age or height-for-age, and weight-for-height.

The body of a child responds to poor nutritional intake into two ways (Oyekale, 2000). On the one hand, growth failure for a reasonably longer period of time results in low height-for-age. On the other hand, short term impacts of food shortage are reflected in terms of low weight-for-height.

Height-for-age reflects cumulative linear growth such that it captures failure to attain expected length when compared to a healthy and well nourished child of the same age. A deficit in height-for-age is an indicator of past or chronic malnutrition and/or severe or frequent illness (Cogill, 2001). It is, therefore, an indicator of long term, and cumulative effects of poor nutrition and health status (Setboonsarng, 2005). Nevertheless, it is less sensitive to short-term changes in nutritional status caused by temporary food shortages (Zere and McIntyre, 2005). Low height-for-age develops slowly with deficits in height increasing if conditions remain unfavorable throughout the growth period of a child

(Micklewright and Ismail, 2001). This measure can be used for evaluation purpose but not for monitoring since it does not change in short-term such as 6-12 months (Cogill, 2001). In the literature, low height-for-age when compared to some reference population is referred to as stunting.

Weight-for-height identifies children suffering from current or acute malnutrition. It measures short-term effects such as changes in food supply or short-term nutritional stress brought about by illness (Cogill, 2001). It can develop rapidly and at any age (Micklewright and Ismail, 2001). It provides information on mortality risk of children (Ibid, 2001). As a result, it may be used for screening or targeting purpose in emergency setting but it is not recommended for the purpose of evaluating changes since it is susceptible and seasonal (Cogill,2001). It is useful in that it does not require knowledge of age for which reliable information is often scant particularly in developing countries (Zere and McIntyre, 2003). Low weight-for-height is termed as wasting.

While the consequences of stunting remain throughout the life of an individual once exposed to it, wasting can be reversed quickly enough under favorable conditions (Glewwe et al, 2003).

Weight-for-age which identifies the conditions of being underweight for a specific age group is a composite measure of stunting and wasting (Cogill, 2001). The common application of underweight is in monitoring growth and assessing changes in the magnitude of malnutrition (Ibid, 2001). Since stunting and wasting can distinguish

between short-run and long-run malnutrition, they are commonly used in studies of child nutritional status (Zere and McIntyre, 2003).

These anthropometric measurements will have to be compared with some healthy reference population in order to determine nutritional status of a child that is to conclude whether a child is malnourished or not (Behrman and Deolalikar, 1998). The World Health Organization recommends the use of the US National Center for Health Statistics (NCHS) population as a reference with which comparison should be done.

On the basis of the reference population, z-score (a standard deviation score) can be constructed for each of the anthropometric indices. Z-score measures the degree to which a child's measurement of height or weight for a given sex and/or age deviates from that of the median score of the reference population (Chowdhury, 2005).

Mathematically, the z-score of a particular child for stunting is given as

$$z_i = \frac{H_i^{s,a} - H_r^{s,a}}{SD_r}$$

Where z_i is z-score of child i; $H_i^{s,a}$ is the height of child i of sex s and age a; $H_r^{s,a}$ refers to the median height of children of sex s and age a from the reference population r; SD_r is the height standard deviation of children of the same age and sex from the reference population.

Accordingly, children whose height is short relative to the reference population will have lower height-for-age z-score and they are regarded as stunted if their z-score falls below some cutoff point. The standard cutoff points are -2 and -3 standard deviation (SD) such that the former refers to moderate malnutrition and the latter refers to severe malnutrition. For instance, a child whose z-score for height-for-age is less than -2 (SD) is regarded as being mildly stunted and severely stunted if the z-score falls below -3 (SD).

2.1.2.2 Advantages of Anthropometric Indicators of Nutritional Status

The overall health and welfare of individuals and populations are reflected in terms of changes in the body dimensions (Cogill, 2001). Anthropometry assists in assessing and predicting performance, health, and survival of individuals and it reflects the economic and social well being of a population.

Micklewright and Ismail (2001) argued that anthropometry has three main attractions in the measurement of welfare. First, it is a way of measuring net nutritional status which is simply the difference between input of nutrients and claims made by body for maintenance, physical activity (including work) and diseases. Malnutrition reduces energy and mental concentration, and increases morbidity and mortality risk which adversely affect individual development including school achievement, health, and productivity in latter life. Therefore, nutritional status measurement is relevant to

assessing the welfare of a child and it is a good candidate for inclusion among vectors of welfare measure.

Secondly, anthropometric status reflects household income or consumption and hence anthropometric indicators may serve as a proxy for the latter. Consequently, errors of construction and interpretation, measurement difficulty in informal and less monetized activities, and the difficulty to make direct cross country comparisons which are associated with income data will no longer be a threat for anthropometric data are free from such problems.

Thirdly, data on anthropometric status is obtained at an individual level. Thus, it provides information on individuals. In contrast, income or expenditure data are mostly aggregated and often they are available at a household level. In order to make inference from such aggregate data regarding the welfare of an individual calls for an assumption that household members share resources evenly which is increasingly questioned for it abstracts welfare analysis far from the reality.

Shetty (2003) stressed the use of anthropometric indices since the methods applied for calculating the indices are relatively accurate and precise. The procedures involved are simple and non invasive, and they allow the monitoring and evaluation of changes over time and seasons. Furthermore, Olaniya (2002) stated that such data are unlikely to have significant systematic and measurement errors. Oyekale and Oyekale (2000) underscored that anthropometry is relatively cheaper and easier to construct.

According to Setboonsarng (2005), anthropometric measures reflect gender empowerment, intra-household resource distribution and equality, and the quality of health environment. Thus, they allow the capturing of welfare dimensions not adequately reflected in other indicators. Cogill (2001) stated that anthropometry can be applied to predict who will benefit from interventions, to identify social and economic inequity and to evaluate the responses to interventions.

However, it is important to be aware that they have their own drawbacks. Micklewright and Ismail (2001) pointed out weakness of using anthropometric measures. To start with, genetic inheritance and environmental factors of interest play a strong role in the determination of body size. In fact, genes explain most of the variance in individuals' height. This threatens the unstated assumption that genetic factors are absorbed into unobserved additive error term in regressions that explain anthropometric status.

Secondly, there are limitations to the use of international standards (the US National Center for Health Statistic Reference Population) in making cross country comparisons. For instance, wasting is rare even in many underdeveloped regions and as a result, it cannot accurately measure differences in nutritional status. Thirdly, a welfare ranking in the same sense as income data is not possible for anthropometric measures such that they do not provide a monotonically increasing measure of welfare. For example, although the heavier a child weighs may imply a good nutritional status, excessive weight brings increased health risk and adverse impacts on nutritional status.

Lastly, questions have been raised about the appropriateness of standard reference populations such as the US sample (Behrman and Deolalikar, 1998). The use of such reference leads to the overstatement of health problems in developing countries.

2.1.2.3 Consequences of Child Malnutrition

Generally speaking, child malnutrition causes numerous undesirable outcomes including both physical and emotional suffering (Smith and Haddad, 2000). The adverse consequences of child malnutrition extend from individual to aggregate or macro level.

At an individual level, malnutrition in early years of life has a substantial damaging effect in that malnourished children face growth failures, mental retardation, increased severity of infections, and low birth weight (Reid, 2000). When children are malnourished, limited bodily resources are conserved and directed away from brain and cognitive development for fighting infections (Moore, 2004). Impaired brain and cognitive development may result in learning difficulty in school and with regard to important life skills. In addition, malnutrition in early years of life impairs physical development and it reduces stature and physical development. These adverse mental and physical developments in turn shape future market opportunities and earning prospects through reducing schooling and post-schooling productivity (Behrman and Hoddinot, 2001). Those surviving malnutrition as children are less productive both physically and intellectually, and suffer from chronic illness (UNICEF, 1998 cited in Smith and Haddad,

1999). These damaging effects of malnutrition on health, brain development, intelligence, educability, and productivity are largely irreversible (World Bank, 2006).

According to World Bank (2006), malnutrition undermines economic growth and perpetuates poverty. Failures to deal with the problem have manifested themselves in terms of inadequate progress towards the achievement of the Millennium Development Goals (MDGs) which include not only reducing poverty and hunger by half by the year 2015 but also goals on education, child and maternal health, and HIV/AIDS. Moreover, malnutrition poses a serious health problem. It causes more than half of all child deaths world wide resulting in a major waste of human energy (Smith and Haddad, 2000). It is also a major contributor to the burden of diseases (mostly in developing countries) which subsequently has led to increased opportunity cost of health spending distorting economic resource allocation (World Bank, 2006).

With this in mind, it is, therefore, essential to direct timely interventions. Investments in people's health and nutritional status play a key role in improving general welfare, promoting economic growth, and poverty reduction for improved health and sanitation are preconditions to escape poverty and contribute to economic growth (World Bank, 1993 cited in Setboonsarng, 2005).

World Bank (2006) stated that apart from ethical, human rights and national security arguments for improving nutrition, there are also strong economic arguments for investing in nutrition.

First, improving nutrition enhances productivity and economic growth. Good nutrition plays a critical role in building human capital which contributes to sustainable and equitable economic growth. Though there is a dualistic relationship between nutrition and economic growth, the impact of improved nutrition on growth is relatively stronger. Losses of productivity resulting from malnutrition are linked to direct losses in physical productivity, indirect losses from poor cognitive development and schooling, and losses in resources from increased health care costs.

Secondly, the costs of not addressing malnutrition are very high which are reflected in terms of higher budget outlays. Health services and care requirements of malnourished children are different from normal children and they are expensive. Malnourished children's schooling performance is poor and often, they repeat years. In a sense, this suggests that caring for such children is very costly.

Thirdly, returns from investments meant for improving nutritional status outweigh their cost by far.

A concluding remark is that the consequences of malnutrition are numerous extending from individual level to macro level and they provide solid justification for investments targeting malnutrition.

2.1.2.4 Causes of Child Malnutrition

Often, it is assumed that the primary cause of malnutrition is food insecurity (Smith and Haddad, 2000). Studies suggest that food is not the only and not even the main cause of malnutrition (World Bank, 2006). Many children in food secure environments and those in non poor families are malnourished because of poor maternal knowledge, inappropriate caring practices, inadequate access to health services, water and sanitation (Ibid, 2006). The World Bank (2006) evidence shows high malnutrition rates in regions and households where food is plentiful which includes the Arsi region in Ethiopia.

The causes of malnutrition are complex, multidimensional and interrelated such that they range from factors as broad as political instability and socioeconomic growth to those as specific as diarrheal disease (Smith and Haddad, 2000). Likewise, the solutions for dealing with malnutrition vary from efforts to maintain political and economic stability at national level to those focusing on enhancing access to sanitation and health services in individual communities.

Smith and Haddad (1999) adapted a conceptual framework developed by the United Nations Children's Fund in explaining the causes of child malnutrition[1]. The framework is comprehensive such that it incorporates biological and social causes as well as causes at micro and macro level. It has three layers of causality namely the basic level, the

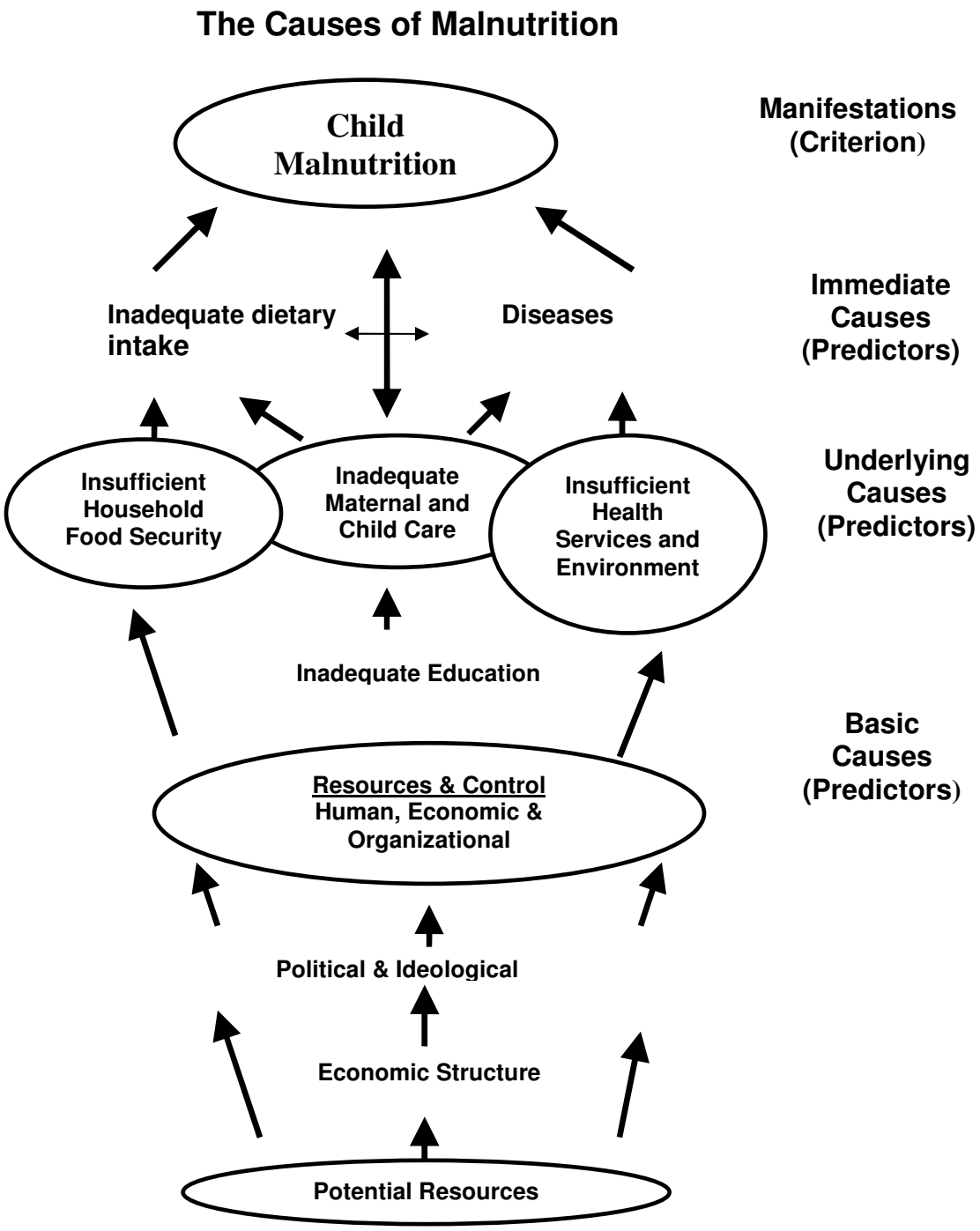
[1] Figure 1 presents the conceptual framework adapted by Smith and Haddad (1999)

underlying level, and the immediate level. Each level of causality corresponds respectively to the basic, the underlying, and the immediate determinants of child nutritional status. In addition, each level corresponds to different levels of collectivity; the immediate level refers to an individual, the underlying level reflects family and/or community, and the basic level corresponds to a nation or a society as a whole (Shrimpton, 2003).

The immediate determinants of child nutritional status are dietary intake (energy, protein, fat, and micronutrients) and diseases (Smith and Haddad, 1999). Dietary intake refers not only to the quantity but also the quality of diet. The framework presents the dual importance of both diseases and nutrient intake in generating child malnutrition (Shrimpton, 2003).

Inadequate dietary intake and illness interact in a negative synergy (World Bank, 2006). A child suffering from inadequate dietary intake is more susceptible to diseases, and diseases in turn depress appetite of a child, inhibit absorption of nutrients in food and compete for the energy of a child (Smith and Haddad, 1999). This implies that in solving the problem of malnutrition both dietary intake and illness are equally important (Shrimpton, 2003).

Figure 1: The Conceptual Framework for Child Malnutrition



Source: Smith and Haddad (2000)

Influencing the immediate determinants of nutritional status of a child are the underlying determinants. The underlying causes are household food security, maternal and child care, and health, water and sanitation services (Smith and Haddad, 1999). According to Shrimpton (2003), household food security refers to the adequacy of food availability at a household level in terms of both quantity and quality. The necessary resources for ensuring household food security include income for food purchases and in kind transfers (Smith and Haddad, 1999). Care for mothers and children concerns appropriate provision of time, attention and support in households and communities in order to support the physical and mental needs of a child and the mother (Ibid, 1999). Caregiver's control of economic resources, autonomy in decision making, and physical and mental status determine the adequacy of care. Availability of health services such as immunization and treatments for child illness such as diarrhea, and adequate drinking water and feces disposal system relate to health, water and sanitation services (Shrimpton, 2003). As in the immediate determinants, all the underlying determinants are equally important because solving only one may not fully ameliorate the problem at this level.

On top of the underlying determinants are the basic determinants. The basic determinants refer to potential resources available to a community or a country, and the rule governing how resources are shared at societal level (Shrimpton, 2003). Availability of natural resources such as agricultural land, water for irrigation, petroleum and gas, iron and other metal ores, access to technology, and the quality of human capital indicate resources available to a country. The utilization of these resources hugely depends on political, economic, cultural, and social factors (Smith and Haddad, 1999).

Shrimpton (2003) pointed out that interventions at different levels of causality require different time scale and exhibit varying degree of sustainability. Individual level actions bring results in the short run but they may not be sustained over the long run. Dealing with the underlying determinants is relatively complicated and requires more time. The basic causes are the most complex and addressing the problem at this level requires longer time. Although actions focused on the underlying and basic determinants require a longer time before they effect changes, they can lead to more sustainable and population wide solutions.

On the other hand, Shrimpton (2003) identified one drawback of the conceptual framework. That is, it recognizes insufficiently the influence of maternal health and poor foetal growth on the occurrence of malnutrition. The most damaging effects of malnutrition occur during pregnancy and in the first two years of life (World Bank, 2006). Thus, it is essential to incorporate maternal health and nutrition, and foetal growth that are temporally linked to child survival and growth (Shrimpton, 2003). In summary, the UNICEF nutritional framework facilitates assessment, analysis, and decision on actions to be taken in resolving nutritional problem at the broader level.

2.1.2.5 Household Level Socioeconomic Determinants of Child Nutritional Status

In the literature, the main household level socioeconomic determinants of child nutritional status include education of parents (in particular that of mothers), employment

status of mothers, women's status relative to men, household economic status, and access to water and sanitation services. In one way or the other, all these are related to at least one of the three underlying causes of child malnutrition namely household food security, care for children and mothers, and household health environment (Smith et al, 2005). The mechanism by which they influence nutritional status of children is discussed as follows.

Household economic status

The economic status of a household where a child lives has been identified as one of the key determinants of child nutritional status. Smith et al. (2005) stated that household economic status significantly affects access to food (a necessary condition for food security). It also dictates possession and utilization of child care resources on a sustainable basis. Relatively better economic status of a household permits more spending on food, clean water, hygiene, and preventive health care (Alderman et al, 2005). In addition, it allows a more diversified diet and effective child care arrangements. On the other hand, increase in household income at community level leads to improved access to high quality health care, improved water and sanitation systems and greater access to information.

Maternal socioeconomic characteristics

Included in this category which is a focus of this study are mothers' education, mothers' employment status and their household status relative to men.

Mothers' education

In many developing countries particularly in Africa, tradition has laid the responsibility of child care on women which begins at conception and continues until infancy, teenage and adulthood (Oyekale and Oyekale, 2000). The implication is that women are key players in the growth and development of a child. In enhancing the quality of care and nutritional status of children, the role of mothers' education is widely recognized.

Hobcraft (1993) presented Caldwell's (1979) suggestion regarding the pathways by which mothers' education might enhance child survival other than through enhanced economic status. Education improves the ability of mothers to implement simple health knowledge and facilitates their capacity to manipulate their environment including interaction with medical personnel. Furthermore, educated women have greater control over health choices for their children.

Smith and Haddad (2000) emphasized that education of women has several positive effects on the quality of care rendered to children since women are the main care takers of children. Their ability to process information, acquire skills, and model positive caring behavior improves with education. Educated women use health care facilities, interact more effectively with health professionals, comply with treatment recommendations, and keep their environment clean. Also, more educated mothers are committed to child care and interact very well with their children.

It is underscored by Gibson (1999) that education of mothers improves child health by altering intra-household allocation of resources in a manner that favors children.

Women's status relative to men

Conceptually, the status of women is multidimensional (Mason, 1986). Smith et al. (2005) define women's status as the relative power of women in household, communities, and nations they live in.

The status of women is an important determinant of two resources for care: their physical and mental health status, and control over household resources (Smith and Haddad, 2000). The physical conditions of women strongly affect the quality of care they provide to their children even before they are born. Poor physical and mental status of women constrains the quality of care rendered to their children which includes the quality of breast feeding.

On the other hand, women's control over resources promotes household food security and nutrition because women show a tendency to spend resources on nutrition inputs such as food (Haddad, 1999). Improved control over resources gives women a better opportunity to provide good care which includes better food preparation and storage practices, hygienic practices, improved care for children during illness (including diagnosis of illness, care seeking and home treatment), and motivation for supporting child development.

Weak control over household resources, tighter constraint on time, restricted access to information and health services, poor mental health, and lack of self confidence and self esteem typically characterize women with relatively lower status which in turn reflect on their children's health and the quality of care provided.

Employment status of women

The effect of maternal employment on the well being of children has been controversial and it appears difficult to determine the net effect. Crepinsek and Burstein (2004) underscored that employment of mothers can have both positive and negative implication on children's dietary intake. On the one hand, the employment of mothers adds to family income and this may help to ensure stable supply of quality food through increased expenditure. On the other hand, mothers' employment may leave them with lesser time for caring and supervision of the activities of their children, and preparation of food. This appears more apparent under the assumption that no care taker would be motivated as mothers.

Mentioned in Crepinsek and Burstein (2004), the presence of other adults in a household, that household's income net of a mother's earning and age of children are likely to affect the net effect of maternal employment.

Water and sanitation

Access to unsafe water and unsanitary disposal of wastes are regarded as the main causes of infectious diseases such as diarrhea and intestinal parasites (UNICEF cited in Smith et

al, 2005). Where there is a better access to safe water and quality sanitation, the incidence of various illnesses will decline (Smith and Haddad, 2000). World Bank (2006) stated that improving access and quality not only reduces transmission of waterborne diseases but also saves women the extra time they spend on carrying water which can be allotted to child care and feeding or income generating activities.

2.2 Empirical Literature

2.2.1 Global and Regional Trends

This section exclusively uses the publication by the World Bank (2006) as its source. Child malnutrition has increasingly emerged as a serious problem calling for immediate actions to address its adverse consequences. Though most developing countries are on track to reach the income poverty target of the Millennium Development Goals, this may not be the case when it comes to child nutrition goal. It appears that only 34 percent of these countries are on track towards the Millennium Development Goal of reducing child malnutrition by half. More worryingly, the nutritional status of children in twenty six developing countries most of which are African countries has been deteriorating.

Nearly one-third of the world's children suffer from either underweight or stunting. Among the developing regions, Asia hosts the highest rates and the largest number of malnourished children. In East Asia, Latin America, Eastern Europe, and Sub Saharan Africa, many countries suffer heavily from the burdens of malnutrition. The prevalence of malnutrition has been declining in many parts of the developing world but Sub Saharan Africa is the only exception where the prevalence of child malnutrition is on the rise.

Comparison between developing and developed countries shows that there is indeed a substantial difference in the prevalence of child malnutrition. In developing countries, 27 percent (more than 147 million) children under age five are stunted and 23 percent (more

than 126 million) are underweight. In contrast, only 2.6 percent and 1.1 percent of children in the developed world are stunted and underweight respectively. In Africa, between 35 million and 50 million children under age five are affected by malnutrition such that 24 percent of the children are underweight and 35 percent are stunted.

The forecast with respect to underweight shows that underweight prevalence in developing countries is expected to decline by some 36 percent over the period from 1990 to 2015. This is far below the Millennium Development Goal of reducing child malnutrition by half. It is important to bear in mind that these figures obscure important interregional disparities. Much of the improvement is expected to come from Asia where prevalence is projected to fall from 35 percent to 18 percent. In the case of Africa, the prevalence of child underweight is projected to rise from 24 percent to 27 percent. Particularly, the situation in East Africa is critical in that the prevalence of underweight is expected to rise by 25 percent in 2015 than it was in 1990. Regarding Ethiopia, the data set provided by the World Bank (2006) shows that the country is seriously affected even by African standards.

In sum, World Bank (2006) identified that child malnutrition remains a serious heath problem in many developing countries. Though the years ahead promise a decline in the prevalence of child malnutrition for many developing countries, this might not be observed for many African nations.

2.2.2 Empirical Studies on the Determinants of Child Malnutrition

This section reviews some of the studies that investigated the determinants of child malnutrition. The review begins with studies conducted elsewhere and then it reviews studies in Ethiopia.

Wamani et al. (2004) conducted a study in rural district of Homia, Uganda. The purpose of the study was to examine the association of four socioeconomic indicators namely mothers' education, fathers' education, household asset index, and land ownership with growth which is used as a proxy for health and nutrition inequities among infants and young children. A sample of 720 child/mother pair was the source of the data and a logistic regression model was used for undertaking the multivariate analysis. Simultaneously adjusting all socioeconomic indicators in conditional regression showed that that mothers' education is the only independent socioeconomic predictor of stunting. Children from non-educated mothers were significantly likely to be stunted than children whose mothers' attained an above primary level education. Ownership of land which is perceived to be ultimate source of food and socioeconomic status showed no association with inequalities in health and nutrition of children even in the bivariate analysis. This was attributed to the fact that the majority of the households had very small land holdings which reduces differentials in nutritional status among children. An interesting finding of the study is that the risk of being stunted varies by sex of a child such that boys face a higher risk of being stunted. Particularly, this gender differential in stunting is significant among the poor household.

Olaniya (2002) conducted a study to examine the role of household resources and community factors on nutritional status of children in Nigeria. The household and community level variables include parental education, household income and assets, and access to water supply and sanitation services. In addition, parental height, sex of household head, and age and sex of a child were included. The data used in the study came from the 1999 Multiple Indicator Cluster Survey. Two separate regressions for weight-for-height and height-for-age were estimated. The result showed that household resources and community level variables are important determinants of child nutritional status. Parental education, birth order, and health care and sanitation service availability were found to be significant determinants of child health.

Oyekale and Oyekale (2002) investigated the role of mothers' educational level on the health outcomes of children in Gambia and Niger. The data source for the study was the Multiple Indicator Cluster Survey. A Probit regression was conducted to identify the risk factors for stunting, wasting and underweight. The authors hypothesized that mothers' education has no role in reducing child malnutrition. The final result of the multivariate regression showed that vaccination, feeding with vitamin A rich foods and breast milk, and access to water and sanitation services increased the probability of having better nutritional status. More importantly, mothers' education was found to have a strong effect on child nutritional status such that children whose mothers had a post secondary education faced a lower risk of being malnourished.

A study by Khasnobis and Hazarika (2006) examined the effect of women's s intra-household status relative to men on food security of Pakistani children as measured by anthropometric measures of nutritional status. The measures chosen for measuring women's status included whether the woman is working for cash income, her age at first marriage, percentage age difference between her and her husband, and the difference between their years of education. The data came from the 1991 Pakistani integrated household survey. The multivariate analysis showed a strong link between women's status and child health. Higher educational attainment of mothers and cash earning had a strong positive impact on child nutritional status. Differences in age and educational achievement affected adversely the nutritional status of children. The authors underscored that this positive association of women's status with nutritional status of children implies that bargaining is the mechanism which governs household resource allocation.

Shan et al. (2003) studied the prevalence and correlates of stunting among children in rural Pakistan. Their study also aimed at exploring the role of sex bias in the rural villages. The study covered a total of 1878 children below the age of three from 64 villages of rural Sindh in Pakistan. A logistic regression was used to determine the risk factors for stunting. The finding revealed that more than half of the children in rural Sindh were stunted and a quarter of the children were wasted which indicated chronic and long term nature of malnutrition. The multivariate analysis showed that education of mothers, household income, and overcrowding are important risk factors for stunting. In

addition, the study result led to the rejection of the belief that there is a sex bias regarding feeding and caring practices which is in favor of male children.

Appoh and Krekling (2005) investigated the role of maternal nutritional knowledge on child nutritional status as measured by weight-for-age z-score in the Volta region of Ghana. The study sample included 110 child/mother pairs in which case half of the children were malnourished and the remaining were well nourished. Index for nutritional knowledge was calculated on the basis of mothers' responses to eight nutrition related questions. The questionnaire gathered information on mothers' knowledge about the importance of colostrum, the time breastfeeding was initiated and complimentary food was introduced, the type of complimentary food fed to the children, and whether mothers had food taboos.

The multivariate analysis demonstrated that there is a significant association between nutritional knowledge index and nutritional status of children. More importantly, the regression analysis reveals that mothers' educational status which was found to have a significant association in the bivariate analysis no longer predicts nutritional status of children. According to the authors, maternal schooling affected child nutritional status through its association with nutritional knowledge, higher economic activity, and marital status. Therefore, they concluded that formal education without knowledge about nutrition may not be helpful in dealing effectively with child malnutrition.

Although not many, some empirical studies have been carried out on nutritional status of Ethiopian children. Christiaensen and Alderman (2001) investigated whether maternal nutritional knowledge can augment the role of income. Their analysis was based on individual, household and community level data obtained from the 1995/96, 1997 and 1998 Welfare monitoring Surveys (WMS) as well as data from the 1995/96 household income and expenditure survey (HICES) and the 1998 Health and Nutrition Survey (HNS).

Their final result identified that household resource, parental education, food prices are important determinants of chronic malnutrition in Ethiopia. In contrast, community sanitation, health, and communication infrastructure appeared to have insignificant effect on height of children. Applying simulation, they found out that improving food security and enhancing income growth would still leave child malnutrition at unacceptably high level and it would take them a longer period of time before their effect on child health is felt. The simulation showed that nutritional knowledge of mothers has a significant complementary effect on income in reducing child malnutrition. In addition to enhancing income growth and increasing women's primary education access, improving maternal nutrition knowledge as measured by a community's ability to correctly diagnose growth faltering was found to have a potential to reduce child stunting by up to 32 percent.

Using the 2000 Demographic and Health Survey of Ethiopia, Girma and Genbo (2002) studied the impacts of socioeconomic factors on maternal and child nutritional status. They estimated three separate regressions for rural, urban and the whole sample.

The final result concluded that the risk of stunting is positively associated with age, birth order, and previous birth interval. Household economic status was found to have a negative impact on stunting such that children in medium and higher economic status households faced a lower risk of stunting. Parental education had a significant negative effect on the risk of being stunted. The study identified the effect of mothers' employment as insignificant.

The same data set was used by Silva (2005) to examine the relationship between access to water and sanitation services at household and neighborhood level on children's nutritional status. The Probit regression result demonstrated that child's age, household wealth, and mothers' education are important determinants of child nutritional status which is consistent with the findings by Girma and Genbo (2002). Mother's height was also found to have a significant impact on child's nutritional status.

With regard to access to water and sanitation services, access to the service at community level exhibited a significant effect on the probability of being malnourished. In particular, access to water and sanitation services as measured by the proportion of households with access to the services emerged as an important determinant of the probability of being underweight. Access to water showed a strong impact on rural children. The study underscored that the external impact of community access to water and sanitation on nutritional status diminishes as the proportion of households with access to the services in a community increases.

Alemu et al. (2005) studied the determinants of child nutritional status using a data collected on eight years old children mainly from food insecure parts of the country namely Tigray, Amhara, Oromiya and SNNP, and from the capital.

The multivariate analysis identified the determinants of wasting. The final result revealed that household wealth, the highest education level of an adult female in a household, caregiver's membership of a religious group had a strong effect on wasting. In addition, land size a household possesses, food aid received and school feeding programs were found to be a significant determinants of wasting. The number of female adults, access to safe drinking water, and absence of crop failure showed a significant association with nutritional status of children but in opposite direction than normally expected.

Chapter Three

Data and Methodology

3.1 Data

This research utilizes the Ethiopia 2000 Demographic and Health Survey (DHS) as its source of data which is a comprehensive and nationally representative population and health survey. The survey was conducted by the Central Statistical Authority (CSA) and technical assistance was rendered by the ORC MACRO International. The data set was collected over a period of twelve months from 02/01/2000 to 05/01/2001.

An important feature of the data set which is of course its quality is that it avails an in depth information on demographic and health aspects of households. Information regarding fertility and family planning behavior, child mortality, nutritional status of children, utilization of maternal and child health services, and knowledge of HIV/AIDS and sexually transmitted diseases (STDs) is available from the data set.

Nevertheless, the DHS data set is challenging in that it contains no information on expenditure or income of households which serves as an indicator of economic status of households. The implication is that it is necessary to construct an asset index using information on household characteristics such as ownership of durable assets and therefore the index serves as a measure of household economic status.

3.2 Methodology

3.2.1 Theoretical Framework

Following the work of Behrman and Deolalikar (1998), the theoretical foundation of the model lies on household production function. Accordingly, a household is assumed to have a preference function of the form

$$U = U\left(H^i, C^i, T^i{}_l; IC, HC, CC, \varepsilon\right), \quad \text{where } i = 1,....., I \tag{1}$$

H^i, C^i, and T_l^i refer respectively to the health, consumption and leisure time of household member i. The remaining variables stand for individual characteristics (IC), household characteristic (HC), community and environmental factors (CC), and ε stands for unobserved characteristics.

In turn, the health of a household member i is a product of a number of factors. It is assumed to be a function of consumption and time use of individual i, the education level achieved by the individual and the key person in a household who makes health and nutrition related decisions of the household.

Thus,

$$H^i = H\left(N^i, C^i, E^i, E^m, I, T_h^i, HC, CC, \mu\right) \tag{2}$$

where N^i is the nutrient intake of individual i; E^m is the education level of the key person who makes health related decision in a household, mostly the mother; I refers to the household size; and T_h^i is the time individual i spends on health related activities.

Nutrition intake of individual i depends on consumption of food, education, and household and community characteristics.

$$N^i = N\left(C_i^{\ f}, E^m, HH, CC, \Omega\right) \tag{3}$$

Where C_i^f is food consumption of individual i.

Nutrient intake is expected to have an impact on the productivity of labor and therefore the following wage equation follows.

$$W_i = W\left(H^i, E^i, N^i, C_i^f, HH, CC, \eta\right) \tag{4}$$

The household budget constraint can thus be constructed as

$$P_c C + P_h H = WL + \psi \tag{5}$$

Where P_c and P_h refer to the price of non-health good and health good respectively; ψ stands for non-wage income and WL denotes wage income.

Maximization of household preference subject to health and nutrition production functions, the wage equation, and the budget constraint leads to a set of reduced form demand functions. One such function is the health demand function as given below.

$$H^i = H(P_c, P_h, E, IC, CC, HH, \mu, \varepsilon) \quad (6)$$

This final equation presented above allows for health demand to be expressed as a function of the right side variables all of which are exogenous. In the present study, a child's nutritional status as measured by anthropometric indicators is the dependent variable and the explanatory variables include maternal and household socioeconomic characteristics which are discussed in the following section.

3.2.2 Empirical Model

The study uses anthropometric measurements of height-for-age and weight-for-age as measures of child nutritional status. Height-for-age which is referred to as stunting is a measure of long term nutritional status and weight-for-age which defines underweight captures both short term and long term nutritional status. The nutritional status measures are expressed as z-scores and thus they are continuous.

The multivariate analysis makes use of the Ordinary Least Squares regression model in identifying the role of maternal socioeconomic characteristics on child nutritional status

controlling for other important household socioeconomic and demographic factors. Separate regressions-one for rural areas and the other for urban areas- are estimated for both stunting and underweight. The description of the explanatory variables is presented below.

3.2.2.1 Description of Variables

The socioeconomic and demographic explanatory variables used in this study are those that are closely related to at least one of the underlying determinants of child nutritional status (household food security, care for children and mothers, household health environment) as in the work by Smith et al. (2005).

Household economic status

The DHS data set as mentioned earlier does not have any information on income or expenditure of households. Such data are essential in order to have knowledge as to the economic status of a household which is identified in the literature as an important determinant of child health status. Therefore, it is essential to look for an alternative indicator of household economic status and this study uses an asset index.

In developing countries, assets that a household acquires can serve as indicators of the long-run economic status of that household. The World Bank suggests the use of

household consumer durables, housing quality, and water, sanitary and other amenities in measuring the relative economic position of households (Houweling et al, 2003).

Of the alternative approaches suggested for constructing an asset index using variables that indicate household economic status, this study employs the Principal Component Analysis (PCA) following the work by Filmer and Prichett, (2001). Principal component analysis allows the extraction of few uncorrelated linear combination of variables that capture common information most successfully from a set of correlated variables (Ibid, 2001).

Household quality (captured by floor, roof and wall material), ownership of consumer durables (such as radio, television, bicycle, car etc.) and type of toilet facility and source of drinking water are variables selected in this study on which the PCA analysis is to be applied for constructing an asset index. However, it is important to note that assets that are relevant among rural households such as ownership of oxen and land are not included which might lead to a possible loss of information on the economic status of these households. The asset index is expected to have a positive effect on nutritional status.

Maternal characteristics

The variables included within this category are the level of mothers' education, employment status of mothers, and women's household status relative to men.

Mothers' education and employment status are expressed in terms of dummy variables. The dummy variables capturing mothers' education measure educational level categorized as no education, primary education, and secondary and above education. As mentioned in the previous section, the level of education that mothers achieved is expected to have a positive influence on nutritional status of a child. That is to say children with better educated mother are likely to have better nutritional status score than those whose mothers are less educated.

In this study, employment of mothers is defined as having employment in the one year period before the DHS survey was conducted or being employed at the time of the survey. It is not possible to determine a priory the effects of mothers' employment on children's nutritional status. As indicated earlier, mothers' employment can improve nutritional status of children through increasing household resources. However, it can also affect nutritional status adversely if it results in reduced care and attention. Therefore, the expected impact of mothers' employment could be either positive or negative.

In contrast to employment and educational attainment of mothers, women's household status relative to men is conceptually difficult to directly measure it. This arises from the fact that women's status is a multidimensional concept (Mason, 1986). As a result, providing a single definition becomes difficult. Smith et al. (2004) defined women's status as the power women have relative to men in households, communities, and nations

at large. They expressed women's status as an index. In this study, the same approach is followed in measuring women's status.

Based on the work by Smith et al, (2005) and Khasnobis and Hazarika (2006), the variables from which the index is constructed are a woman's employment status, her age at first marriage, the age difference between her and her husband and the educational achievement difference between them.

The earlier a woman marries, the less likely she is to complete her schooling and embark on income generating career. Thus, that woman is more probable to have a lower status relative to her spouse. The age difference between a woman and her spouse is also a good indicator of the relative bargaining power that woman has. The larger the age difference, the lower the status of a woman will be. Education dictates earning capacity and options outside home. Therefore, a woman is more likely to have a lower status relative to her spouse if the educational achievement difference is large between her and her partner. Once again, the Principal Component Analysis is used to derive the index that measures women's relative status to men. It is expected that this index shows a positive link with nutritional status of children. In other words the higher status women have, the less likely that their children will have poor nutritional status.

Child Characteristics

This category of explanatory variables includes sex of a child and a child's age. Age of child is defined in terms of age groups. As in many studies, child nutritional status is

expected to deteriorate as a child ages. Particularly, this is the case for stunting since it is an indicator of long term nutritional status which shows deficits in linear growth.

Many studies in Sub Saharan Africa have shown that sex of a child is strongly associated with nutritional status. In many instances, being male is associated with nutritional insult. But it is possible that poor nutritional status could be associated with female children given the fact that women have lower social and economic status in most developing countries. Therefore, the effect of sex could go either way.

Household health environment

Access to water and sanitation services are used to capture household health environment. Sanitation is defined as access to toilet facility which refers to flush toilet or pit latrine. Children in those households where there is toilet facility of some kind are expected to have better nutritional status score. Access to water refers to having pipe water service either into a dwelling, into a compound, or outside a compound. Having access to pipe water facility is expected to have a positive impact on nutritional status of children.

Other household characteristics

These include partners' education level, sex of household head, and household size. Partners' educational level is defined in the same way as that of mothers' education and those children from households where partners have higher educational level are

expected to have higher z scores. The effect of household size and sex of household head could go either way.

Chapter Four

Empirical Analysis

4.1 Descriptive and Bivariate Analysis of the Data

The data set is corrected for missing observations and outliers and hence a total of 8,626 observations are retained for the analysis. Of this total, 6,948 observations belong to rural areas while the balance refers to urban areas. The descriptive analysis is carried out in a manner that shows differences in maternal, and other socioeconomic and demographic characteristics between rural and urban households as well as differences in the prevalence of child stunting and underweight. Note that the corrections for missing observations and outliers might lead to a slight difference in the prevalence rate of stunting and underweight from that reported by the DHS.

4.1.1 Distribution of Child Malnutrition by Region

The data set shows that child malnutrition rate in Ethiopia is very high. Stunting which refers to long term growth retardation affected a significant proportion of children below the age of five. Of the total children in the survey, nearly one-half of them (47.7 percent) are stunted and almost a quarter of them are severely stunted (Tables 4.1.1 and 4.1.2). Similarly, the prevalence of underweight is very high in that almost half of the children (44 percent) are underweight and 14.7 percent are severely underweight. This simply means that one out two Ethiopian children is either stunted or underweight.

Table 4.1.1

Distribution of Stunting and Underweight by Region of Residence

Region of residence	Percent stunted			Percent underweight		
	Rural	Urban	Regional	Rural	Urban	Regional
Tigray	54.78	51.56	54.53	47.58	39.06	46.92
Affar	48.26	38.1	47.79	53.13	19.05	51.55
Amhara	58.22	40.00	57.38	52.07	36.36	51.34
Oromiya	47.20	48.39	47.27	43.02	37.63	42.72
Somali	57.83	38.67	49.90	50.69	29.33	47.55
Benshangul-gumuz	43.22	28.57	42.39	45.80	37.14	45.31
SNNP	54.34	33.33	53.23	52.74	24.24	51.24
Gambela	41.99	26.47	39.64	40.94	33.82	39.87
Harari	43.49	23.57	36.67	31.60	13.57	25.43
Addis Ababa		27.17	27.17		14.16	14.16
Dire Dawa	41.75	22.86	32.21	48.06	17.14	32.45
National Total	50.49	30.86	47.65	47.60	22.34	43.95

Table 4.1.2

Distribution of Severe Stunting and Severe Underweight by Region of Residence

Region of residence	Percent stunted			Percent underweight		
	Rural	Urban	Regional	Rural	Urban	Regional
Tigray	25.69	21.88	25.39	15.07	15.63	15.11
Affar	26.22	14.29	25.66	17.17	4.76	16.59
Amhara	29.73	20.00	29.28	17.15	7.27	16.69
Oromiya	22.12	18.28	21.91	14.47	5.38	13.96
Somali	30.05	10.67	27.20	19.72	10.67	18.40
Benshangul-gumuz	21.44	8.57	20.71	15.61	2.86	14.89
SNNP	31.59	9.09	30.41	21.06	4.55	20.19
Gambela	20.47	11.76	19.15	13.91	10.29	13.36
Harari	15.61	5.00	11.98	8.92	2.86	6.85
Addis Ababa		7.80	7.80		2.02	2.02
Dire Dawa	14.56	6.19	10.34	12.14	3.81	7.93
National Total	25.50	9.98	23.26	16.38	4.94	14.73

When it comes to rural-urban distribution of child malnutrition, stunted and underweight children are overrepresented in rural households. The prevalence of stunting and underweight in rural areas is by far larger than that of their urban counterparts as the tables above show. 50.5 percent of rural children are stunted compared to 30.9 percent of urban children. The prevalence of underweight in rural areas is twice larger than that of urban counterparts such that 47.6 percent of rural children are underweight in contrast to 22.3 percent of urban children.

Furthermore, the prevalence of child malnutrition shows a substantial variation by region of residence. At national level, higher prevalence of stunting and underweight is observed in Amhara, Tigray, Benshangul-gumuz and Afar. The proportion of stunted and underweight children is the highest in Amhara and Afar respectively. In contrast, the lowest prevalence of child malnutrition is observed in Harari, Dire Dawa, and Addis Ababa.

Tables 4.1.1 and 4.1.2 show that malnutrition varies by region after disaggregating the data set into urban and rural areas. Among urban areas of the different regions, urban Tigray is the most affected where over 50 percent of the children are stunted. Addis Ababa, Dire Dawa, and Harari where urbanization rate is relatively high are found to have the lowest proportion of stunted children. Note that the prevalence of stunting in urban Tigray is twice larger than that of the least affected region-Dire Dawa where the prevalence rate is 23 percent. On the other hand, rural Amhara has the highest proportion of stunted children followed by Somali and Tigray, respectively. Rural Dire Dawa has the

lowest prevalence of stunting. The observed difference in stunting prevalence rate among rural parts of the regions is not as large as urban areas of the regions.

With regard to underweight, urban Tigray is once again on top of the list having the largest percentage of underweight children. The lowest prevalence rate is observed in Addis Ababa and Dire Dawa. Among rural parts of the regions, Afar is found to have the highest underweight prevalence rate whereas rural Harari has the lowest prevalence rate.

Generally, the prevalence rate of child malnutrition in Ethiopia is very high and that it exhibits a considerable variation between rural and urban parts of the country, and among the regions.

4.1.2 Distribution of Child Malnutrition by Socioeconomic and Demographic Characteristics

This section discusses the distribution of stunting and underweight by socioeconomic and demographic characteristics of households. It starts with maternal characteristics, i.e. mothers' education and mothers' employment.

Overall, mothers' education level is very low. As table 4.1.3 shows, 80 percent of the mothers did not attend formal education and the majority of the remaining mothers attained only primary level education. Moreover, mothers' education is characterized by

significant variation between rural and urban Ethiopia such that urban mothers had better educational level than their rural counterparts. The proportion of rural mothers who had not been to school is twice larger than that of urban mothers. Whereas 88 percent of rural mothers were not educated, the comparative figure for urban areas is only 38 percent. Only 10 percent of rural mothers attained primary education level and less than 2 percent had a secondary and above education. In contrast, a quarter of urban mothers attained primary level education and more mothers succeeded into secondary and above secondary education. In short, mothers' education level is not only very low but it also shows a considerable difference between rural and urban areas.

Table 4.1.3

Education Level of Mothers and Their Partner (in Percentages)

Mothers Education				Partners Education			
Education Level	**Urban**	**Rural**	**National**	**Education Level**	**Urban**	**Rural**	**National**
No education	37.6	87.87	80.61	**No education**	24.21	70.73	64.01
Primary Education	25.06	10.74	12.81	**Primary Education**	21.57	22.39	22.28
Secondary Education	34.87	1.27	6.12	**Secondary Education**	42.63	6.36	11.6
Higher Education	2.47	0.13	0.56	**Higher Education**	11.59	0.52	2.12

Table 4.1.4

Employment Status of Mothers (in Percentages)

Employment status	Urban	Rural	National
Employed	49.79	64.32	62.22
Unemployed	50.21	35.68	37.78

With regard to the distribution of child malnutrition by educational attainment of mothers, one can see a significant difference in the proportion of stunted and underweight children (Tables 4.1.8, 4.1.9, and 4.1.10). Accordingly, stunted and underweight children are overrepresented in those households where mothers had no education in both rural and urban areas, and at national level. For instance, at national level, nearly half of the children in households where mothers did not attend formal education are either stunted or underweight which is significantly higher than the prevalence of stunting and underweight in households where mothers attained a secondary or higher education.

Table 4.1.4 shows employment status of mothers both at national level as well as in rural and urban areas. At national level, the majority of mothers (60 percent) had employment as defined in this study. Employment status of mothers does not exhibit a significant variation between rural and urban areas though it is slightly in favor of rural areas. 64 percent of rural mothers had been employed as compared to 50 percent of urban mothers. Unlike the case of mothers' education, the prevalence of stunting and underweight shows insignificant difference by employment status of mothers although the proportion of stunted and underweight children is slightly higher in those households where mothers had been employed.

With respect to child characteristics, the proportion of stunted and underweight children shows almost no variation by sex of a child both at national level and in rural and urban areas. Nevertheless, child malnutrition rate exhibits a significant variation by age group of a child (Tables 4.1.8, 4.1.9, and 4.1.10).

Among the six age groups defined, the lowest proportion of stunted and underweight children is found in the first age group (which refers to children whose age is below 6 months) in both rural and urban households. Possibly, the protective shield that children within this category receive from breastfeeding and the low degree of exposure to their surrounding environment both of which reduce the likelihood of being exposed to contagious diseases might have contributed to the observed low intensity of child malnutrition.

In both rural and urban areas, the highest prevalence of underweight is observed among children in their second year (between 12 and 24 month). On the other hand, the highest prevalence of stunting in urban areas is found among children in their fourth year (between 48 and 60 months). In rural areas, stunted children are overrepresented among children in their third year.

Access to water and sanitation capture household health environment. At national level, 17 percent of households had access to pipe water service (Tables 4.1.5 and 4.1.6) and over 80 percent of households relied on water from open well of some kind or surface water. Moreover, the distribution of households with access to water service varies between rural and urban areas. Accordingly, only 3 percent of rural households had access to pipe water services as compared to 80 percent of urban households. This suggests that the majority of rural households relied on either open well or surface water. These water sources are likely to be contaminated easily with animal disposal and human wastes which increase exposure to diseases related to the use of unsafe water sources.

Similar pattern explains access to toilet facility. Overall, less than 1 percent of households had access to flash toilet facility and all of them belong to urban areas. Some 20 percent of households used pit latrine which could be either traditional or ventilated and the remaining 80 percent of households had no access to toilet facility of any kind.

Table 4.1.5

Distribution of Households by Type of Toilet Facility Used (in Percentages)

Type of toilet facility	Urban	Rural	National
Flash toilet	4.09		0.59
Pit latrine			
Traditional pit latrine	69.31	9.08	17.78
Improved pit latrine	3.41	0.04	0.53
No toilet facility	23.19	90.88	81

Table 4.1.6

Distribution of Households by Source of Drinking Water (in Percentages)

Source of water	Urban	Rural	National
Piped water			
Into dwelling	0.77	-	0.11
Into compound	35.81	0.03	5.2
Outside compound	44.93	5.86	11.5
Water from open well			
Open well	1.45	7.02	6.22
Open spring	4.43	39.9	34.77
Covered well	4.01	5.9	5.63
Covered spring	2.13	4.5	4.16
River	5.8	32.53	28.67
Pond/Lake/Dam	-	3.94	3.37
Surface water			
Rain	-	0.23	0.2
Other	0.68	0.009	0.17

The rural-urban distribution of access to toilet facility is in favor of urban areas where over three-quarters of the households had access to toilet facility of some kind. Specifically, 5 percent of urban households used flash toilet facility and the remaining 70 percent relied on either traditional or ventilated toilet facility. In contrast, the majority of rural households (90 percent) had no toilet facility and the remaining 10 percent relied only on pit latrines. In both the rural and urban areas, stunted and underweight children are overrepresented in households that had no access to either water or toilet facility (tables 4.1.8, 4.1.9, and 4.1.10).

With respect to education of partners, it is found out that the majority of partners had not been to school. In addition, it shows a significant difference between rural and urban areas in that partners in rural areas had lesser educational attainment than their urban counterparts. In households where partners have lower educational level, the prevalence of stunting and underweight is found to be the highest (tables 4.1.8, 4.1.9, and 4.1.10).

Table 4.1.7

Sex of Household Head (in Percentages)

Sex	Urban	Rural	National
Male	86.1	90.96	90.26
Female	13.9	9.04	9.74

As table 4.1.7 shows the majority of households were headed by males in both rural and urban areas such that not more than 15 percent of the households were headed by

females. Also, no significant difference is observed with respect to the prevalence of child malnutrition (tables 4.1.8, 4.1.9, and 4.1.10).

Table 4.1.8

National Distribution of Stunting and Underweight by Socioeconomic and Demographic characteristics

Socioeconomic and demographic characteristics	Percent stunted	Percent underweight
Mother's education		
No education	50.15	47.39
Primary education	45.77	36.83
Secondary and above	20.75	15.70
Partner's education		
No education	51.50	49.08
Primary education	47.04	40.85
Secondary and above	30.7	25.04
Mother's employment status		
No employment	45.40	40.94
Employed	49.02	45.77
Sex of household head		
Male	47.72	44.09
Female	47.03	42.60
Sex of a child		
Male	47.54	43.63
Female	47.78	44.27
Type of toilet facility		
No toilet	50.88	47.30
Pit toilet	34.57	30.26
Flush toilet	10.42	8.33
Source of drinking water		
Surface water	26.67	40.00
Open well	50.70	47.47
Piped water	33.22	26.67
Age group of a child		
Less than 6 months	8.29	5.18
≥ 6 and < 12 months	25.85	32.61
≥ 12 and < 24 months	54.99	56.47
≥ 24 and < 36 months	52.87	52.93
≥ 36 and < 48 months	57.28	45.81
≥ 48 and < 60 months	54.99	45.26

Finally, a concluding remark is that the socioeconomic and demographic characteristics of households show a considerable variation between rural and urban households.

Furthermore, households with poor socioeconomic status hosted a disproportionately larger share of stunted and underweight children regardless of their location (rural or urban).

4.1.3 Bivariate Analysis

The bivariate analysis is based on Chi Square test which is presented in tables 4.1.9 and 4.1.10.

This Chi Square test is performed on categorical socioeconomic and demographic household characteristics and it allows the examination of the association between these variables and nutritional status of children.

The Chi Square test shows a significant association between stunting and the majority of household characteristics in rural areas. Exceptions in this regard are employment status of mothers, sex of household head, and sex of a child for which no significant association with stunting is observed. Among urban households, the test shows all variables except sex of household head are significantly associated with stunting.

Table 4.1.9

Child Stunting by Socioeconomic and Demographic Characteristics in Rural and Urban Areas and Chi square Test of Significance

Socioeconomic and demographic characteristics	Rural		Urban	
	Percent stunted	Chi square test results	Percent stunted	Chi square test results
Mother's education				
No education	51.09	29.95***	37.19	44.92***
Primary education	48.53		37.78	
Secondary and above	27.84		19.18	
Partner's education				
No education	52.06	26.48***	41.90	37.39***
Primary education	48.65		37.15	
Secondary and above	40.83		23.43	
Employment status of mothers				
In the past one year				
No employment	49.50	1.52	28.18	3.98**
Employed currently or in the past year	51.04		33.56	
Sex of household head				
Male	50.39	0.34	31.09	0.1772
Female	51.59		29.45	
Sex of a child				
Male	50.68	0.11	28.45	3.13*
Female	50.29		33.22	
Type of toilet Facility				
No toilet	50.95	5.88**	49.26	61.48***
Pit toilet	45.90		26.14	
Flush toilet			10.42	
Source of drinking water				
Surface water	36.36	12.2***		
Open well	51.02		40.67	14.59***
Piped water	42.79		28.97	
Age group of a child				
Less than 6 months	8.80	735.46***	5.65	73.54***
> 6 and < 12 months	27.93		12.5	
> 12 and < 24 months	57.98		37.44	
> 24 and < 36 months	56.38		30.23	
> 36 and < 48 months	60.66		37.30	
> 48 and < 60 months	57.66		39.92	

Note: ***, ** and * refer to 1 percent, 5 percent and 10 percent significance level respectively.

Table 4.1.10

Child Underweight by Socioeconomic and Demographic Characteristics in Rural and Urban Areas and Chi Square Test of Significance

Socioeconomic and demographic characteristics	Rural		Urban	
	Percent underweight	Chi square test results	Percent underweight	Chi square test results
Mother's education				
No education	48.58	29.11***	30.84	38.26***
Primary education	42.36		22.79	
Secondary and above	25.77		13.47	
Partner's education				
No education	50.00	48.59***	33.1	29.01***
Primary education	43.7		23.32	
Secondary and above	35.56		17.14	
Employment status of mothers in the past one year				
No employment	45.70	5.53***	20.88	1.4399
Employed currently or in the past year	48.65		23.80	
Sex of household head				
Male	47.48	0.3532	22.87	1.201
Female	48.73		19.20	
Sex of a child				
Male	47.04	0.8726	22.93	0.2343
Female	48.14		21.75	
Type of toilet facility				
No toilet	47.83	1.5163	34.93	35.41***
Pit toilet	45.27		19.11	
Flush toilet			8.33	
Source of drinking water				
Surface water	50.00	1.7151	12.5	34.2496***
Open well	47.78		37.8	
Piped water	44.50		19.04	
Age group of a child				
Less than 6 months	5.86	636.43***	1.61	52.57***
> 6 and < 12 months	35.34		15.18	
> 12 and < 24 months	60.52		32.6	
> 24 and < 36 months	56.74		28.37	
> 36 and < 48 months	49.73		22.62	
> 48 and < 60 months	49.56		20.99	

Note: ***, ** and * refer to 1 percent, 5 percent and 10 percent significance level respectively.

In the case of underweight, only few household characteristics establish a significant association with nutritional status of children as compared to stunting. In the rural sample, mothers' and their partners' education, employment status of mothers, and age of

a child are the only ones that are significantly associated with being underweight. In urban areas, on the other hand, household health environment captured by access to toilet facility and piped water, mothers' and their partners' education, and age of a child have a significant association with underweight.

In sum, mothers' education, partners' education, and age of a child are the only ones that are strongly associated with nutritional status of children in all cases.

4.2 Multivariate Analysis

As indicated earlier, the multivariate analysis is based on four separate OLS regressions: two for stunting (HAZ) and two for underweight (WAZ). The estimation results are presented in tables 4.2.1 and 4.2.2.

To ensure the efficiency of the estimation results, tests for constant variance of the errors and multicollinearity were conducted. The test for heteroscedasticity shows that in all regressions except the HAZ regression of urban areas, the assumption of constant error variance is not satisfied. Therefore, heteroscedasticity robust regressions are estimated and the reported errors variances are robust. On the other hand, the test for multicollinearity among the right hand side variables shows that multicollinearity is not a problem in all regression. The pair-wise correlation coefficient test and the Variance

Inflation Factor (VIF) test confirmed this[1]. In addition, the Chow F test for testing parameter stability shows that the regressions for urban and rural areas are different for both stunting and underweight[2].

4.2.1 The HAZ Regression

The estimation results of the HAZ regression in table 4.2.1 show that whereas employment status of mothers, sex of household head, sex of a child, and education level of partners have insignificant effect on HAZ score in both rural and urban regressions, the remaining socioeconomic and demographic characteristics are significantly associated with nutritional status of a child at least in one of the two regressions.

The wealth index which is an indicator of household economic status appears to have no significant effect on the HAZ score of a rural child. Conversely, wealth index has a significant and positive effect on the HAZ score of an urban child. Specifically, an improvement in the wealth index by just a unit brings 0.17 units improvement in the HAZ score of an urban child. Thus, as the economic status of urban households gets better, the nutritional status of a child improves.

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[1] We can suspect multicollinearity if the pair-wise correlation coefficient is greater than o.8 or if the VIF of a variable exceeds 10 (Gujarati, 2003). Refer to appendix 1 for the pair-wise correlation test result.
[2] See appendix 2

With regard to maternal characteristics, it can be seen in table 4.2.1 that women's relative household status index and mothers' educational level are significant predictors of child nutritional status. As in the finding in Khasnobis and Hazarika (2006), the multivariate analysis suggests that long term nutritional status of children is strongly associated with women's intra-household status relative to men. In both rural and urban areas, there is a positive association between the index and the HAZ score of a child which implies an improvement in women's status improves nutritional status.

In the bivariate analysis, it was shown that mothers' education has a significant association with stunting. Even after controlling for household level socioeconomic and demographic characteristics, the effect of mothers' education remains strong and significant in both rural and urban regressions though the effect looks stronger in urban areas. In addition, the effect of mothers' education on stunting is stronger than the other household characteristics except that of age of a child.

When compared to a child whose mother attained a secondary or higher education (which is the base category), an urban child whose mother had no education or attained only primary education level has a lower HAZ score. A child whose mothers belongs to the base category has a HAZ score higher by 0.35 units than a child whose mother had either no education or reached only a primary level education.

Table 4.2.1

Robust OLS Estimation Results for HAZ Scores

	Rural			Urban		
[1]Variables	Coefficients	Standard errors	t Values	Coefficients	Standard errors	t Values
Wealth index	0.064	0.053	1.21	0.173	0.059	2.94***
Maternal characteristics						
Women's relative status	0.067	0.026	2.59**	0.122	0.046	2.63***
Mother's education						
No education	-0.268	0.157	-1.71*	-0.359	0.113	-3.18***
Primary education	-0.241	0.16	-1.5	-0.347	0.109	-3.19***
Employment of mother	-0.025	0.037	-0.67	-0.109	0.08	-1.37
Sex of household head	0.04	0.062	0.65	0.004	0.079	0.003
Education of partner						
No education	-0.112	0.092	-1.22	-0.347	0.149	0.015
Primary education	-0.098	0.084	-1.16	0.023	0.12	-0.64
Sex of a child	0.001	0.035	0.02	-0.008	0.116	-0.1
Age group of a child						
≥6 months and <12 months	-1.121	0.08	-14.1***	-1.059	0.177	-5.99***
≥12 months and <24 months	-2.116	0.07	-30.12***	-2.215	0.151	-14.67***
≥24 months and <36 months	-2.123	0.07	-30.41***	-2.049	0.152	-13.49***
≥36 months and <48 months	-2.219	0.069	-32.12***	-2.241	0.148	-15.19***
≥48 months and <60 months	-2.192	0.07	-31.28***	-2.339	0.149	-15.68***
Household size	0.011	0.008	1.34	0.032	0.016	1.96*
[2]Water and sanitation						
Has access to toilet facility	0.044	0.074	0.59	0.225	0.12	1.88*
Has access to piped water	0.16	0.084	1.91*	-0.137	0.13	-1.06
Constant	0.193	0.18	1.07	0.217	0.234	1.18
	Number of observations		6948	**Number of observations**		1173
	F(17,6930)		90.74	**F(17,1155)**		27.79
	Prob>F		0	**Prob>F**		0
	R-squared		0.1821	**R-squared**		0.2903
	Adjusted R-squared		0.1801	**Adjusted R-squared**		0.2798

Note: ***, ** and * refer to 1 percent, 5 percent and 10 percent significance level respectively.

[1] While secondary or higher education is the base category for mothers and their partners' education, children whose age is less than 6 months form the base group for age group of a child.

[2] Access to toilet facility refers to having either a flush toilet or a pit latrine and access to piped water refers to having piped water service into a dwelling, into a compound or outside a compound.

On the other hand, the rural regression shows that a child with uneducated mother has a lower HAZ score compared to a child in the base category although the HAZ score of a child whose mother attained a primary level education is not significantly different from that of a child in the base group. This positive association between mothers' education and nutritional status of children is in agreement with the literature which underscores better educational status of mothers improves the nutritional status of their children through improving caring practices, facilitating interaction with health professionals, and enhancing health seeking behavior.

Whereas sex of a child is found to have an insignificant effect on stunting, age of a child has a strong effect on the HAZ score of a child. This is true regardless of whether a child is from a rural household or an urban household. A child in a higher age group is found to have an inferior z score compared to a child in the base category (children in their first 6 months). The rural regression shows that a child in his/her third year (between 36 and 48 months) has the lowest HAZ score compared to the base category. In contrast, a fourth year urban child has the lowest HAZ score compared to the base category. This finding is in conformity with the expectation that the nutritional status of a child deteriorates as a child ages. This could be a result of increased exposure to contaminated environment and contagious diseases as a child grows.

Household access to piped water facility (which could be into a dwelling, into a compound, or outside a compound) turns out to have a significant effect (at 10 percent level) on a rural child. Accordingly, a child from a household having access to pipe water

facility has a HAZ score higher by 0.16 units than a child in a household without access to the service.

The type of toilet facility a household has access is a significant determinant of child nutritional status but for an urban child only. A child from a household using toilet facility (either flush toilet or pit latrine) has a HAZ score higher by 0.23 units than a child from a household without access to any kind of toilet facility.

The coefficient on household size shows a positive and statistically significant association with the HAZ score of an urban child. This is similar to the finding by Christiaensen and Alderman (2001) who found that household size affected positively children's standardized height. According to them, this positive association may be an outcome of economies of scale in time for child care and expenditure as household size increases.

In summary, the findings from the HAZ regression show that asset index, age of a child, and household health environment are significantly associated with height-for-age z-score of a child. With respect to maternal characteristics, it appears that mothers' education and mothers' intra-household status relative to men have a significant positive effect on child nutritional status. In addition, the effect of mothers' education on nutritional status is found to be a stronger than the other household characteristics except that of a child's age group.

4.2.2 The WAZ Regression

The WAZ estimation results presented in table 4.2.2 show that the economic status of a household is found to have a statistically significant and positive effect on the WAZ score of both a rural child and an urban child. An increase in the wealth index by a unit improves the WAZ score of a rural child by 0.11 units and that of an urban child by 0.15 units.

Unlike the HAZ regression, women's intra-household relative status appears to have a statistically significant effect on nutritional status of an urban child only. Accordingly, an improvement in the index by a unit increases the WAZ score of a child by 0.10 units.

Similar to the finding in the HAZ regression, mothers' education has a significant association with underweight in both rural and urban areas. In both cases, children in the base category have a higher WAZ score as compared to those in the other categories. Once again, the effect of mothers' education is stronger compared to the other explanatory variables.

Table 4.2.2

Robust OLS Estimation Results for WAZ Scores

	Rural			Urban		
Variables[1]	**Coefficients**	**Standard errors**	**t Values**	**Coefficients**	**Standard errors**	**t Values**
Wealth index	0.111	0.038	2.89***	0.145	0.046	3.14***
Maternal characteristics						
Women's relative status	0.008	0.019	0.4	0.102	0.036	2.79***
Mother's education						
No education	-0.391	0.114	-3.43***	-0.326	0.087	-3.68***
Primary education	-0.366	0.116	-3.15***	-0.226	0.085	-2.65***
Employment of mother	-0.054	0.027	-2.03***	-0.065	0.063	-1.04
Sex of household head	-0.044	0.045	-0.97	0.016	0.091	0.18
Education of partner						
No education	-0.191	0.067	-2.86***	-0.022	0.177	-0.19
Primary education	-0.117	0.061	-1.91***	-0.027	0.094	-0.28
Sex of a child	-0.012	0.026	-0.47	0.0002	0.062	0.00
Age group of a child						
≥6 months and <12 months	-1.401	0.058	-24.23***	-0.971	0.139	-7***
≥12 months and <24 months	-2.094	0.051	-41***	-1.608	0.118	-13.58***
≥24 months and <36 months	-2.011	0.051	-39.61***	-1.53	0.119	-12.84***
≥36 months and <48 months	-1.818	0.05	-36.2***	-1.389	0.116	-12***
≥48 months and <60 months	-1.83	0.051	-35.92***	-1.544	0.117	-13.19***
Household size	-0.008	0.006	-1.36	0.016	0.013	1.27
Water and sanitation[2]						
Has access to toilet facility	-0.044	0.054	-0.81	0.181	0.094	1.93*
Has access to piped water	-0.028	0.061	-0.46	-0.053	0.102	-0.52
Constant	0.5	0.131	3.82***	-0.065	0.182	-0.36
	Number of observations		6948	**Number of observations**		1173
	F(17,6930)		126.91	**F(17,1155)**		27.8
	Prob>F		0.0000	**Prob>F**		0.0000
	R-squared		0.2374	**R-squared**		0.2904
	Adjusted R-squared		0.2355	**Adjusted R-squared**		0.2799

Note: ***, ** and * refer to 1 percent, 5 percent and 10 percent significance level respectively.

[1] While secondary or higher education is the base category for mothers and their partners' education, children whose age is less than 6 months form the base group for age group of a child.

[2] Access to toilet facility refers to having either a flush toilet or a pit latrine and access to piped water refers to having piped water service into a dwelling, into a compound or outside a compound.

Employment status of mothers' which has no significant effect on height-for-age has a significant association with the WAZ score of a rural child. Employment of mothers has a negative impact on WAZ score such that a child whose mother had been employed has an inferior nutritional status than a child whose mother had no employment. Absence of substitute caretaker in place of mothers or the lack of capacity of the substitute caretaker to appropriately care might explain this adverse impact of mothers' employment.

Similar to the findings in the HAZ regression, a strong and statistically significant association is found between the WAZ score of a child and age group. Children in a higher age group show an inferior nutritional status as compared to those in the base category. On the other hand, of the two indicators of household health environment, only access to toilet facility has a statistically significant association with weight-for-age z-score.

Interestingly, partners' education has a statistically significant effect on the WAZ score of a rural child. Children in households where partners were highly educated (having secondary and above education) have a higher weight-for-age z-score compared to children in the other categories.

To conclude, mothers' education, mothers' relative household status and mothers' employment are strongly associated with underweight. Also, age of a child, wealth index, partners' education, and access to toilet facility affect the WAZ score of a child.

Chapter Five

Conclusion and Recommendation

5.1 Conclusion

Malnutrition has been on top of the agenda now that a large number of children are suffering from it. The causes of malnutrition are many and multidimensional. They extend from proximal determinants such as diseases to general factors such as economic and political environment of a country. Moreover, the adverse consequences of malnutrition are many such that they affect not only individuals but also the economic activity of a country.

The analysis of the DHS data has shown that malnutrition is a serious problem among Ethiopian children. It is indicated that stunting and underweight prevalence rates are very high such that almost half of the children covered by the survey were either stunted or underweight. This is significantly high even by Sub Saharan Africa standard. Moreover, the prevalence rate of child malnutrition shows a significant difference between rural and urban children in which case stunting and underweight prevalence rates are disproportionately higher in rural parts of the country.

In addition, the socioeconomic and demographic characteristics of households exhibit a significant difference between rural and urban households. It is found out that urban households have generally better socioeconomic status compared to rural households. Accordingly, almost 90 percent of rural mothers' and nearly three-quarters of their

partners had not been to school. The comparative figures for urban areas are respectively 38 percent and 24 percent. It has been shown that over 90 percent of rural households had no toilet facility which is three times larger than that of urban areas and only 5 percent of rural households had access to piped water compared to 80 percent of urban areas.

A Chi Square test to examine the strength of the bivariate association between categorical variables and the nutritional status indicators shows that mothers' education is significantly associated with stunting and underweight alongside age of a child. The association between employment status of mothers' and nutritional status is found to be weaker.

The multivariate analysis shows that women's relative household status and mothers' education are important determinants of child nutritional status in rural and urban areas. The effect of mothers' education on height-for-age and weight-for-age is strong even compared to the other household characteristics. Similarly, women's status has a strong positive effect on nutritional status. In contrast, employment status of women is a weak predictor of nutritional status of children such that it emerged as a significant contributor to only weight-for-age z-score of a rural child.

The multivariate analysis also demonstrates that age of a child and wealth index of households have a statistically significant effect on nutritional status. While age of a child is found to have a negative effect, economic status of a household as measured by the wealth index has a positive effect. Household health environment as measured by access

to water and sanitation, and partners' education are associated with nutritional status but not in all cases.

5.2 Recommendation

The objective of this paper was to examine the importance of maternal characteristics on nutritional status of Ethiopian children. The findings of the empirical analysis show that mothers' education and their household status relative to men are indeed significant contributors to nutritional status of children.

Consequently, intervention programs focusing on mothers' or in general women's status would contribute to the effort towards alleviating the problem of child malnutrition in Ethiopia. In particular, taking into account the low level of mothers' education at national level and especially in rural parts of the country, policy actions that are meant to improve the educational status of women are critical in addressing the problem through improving their income earning capacity and also enhancing the quality of care and attention they can provide to their children.

In addition, interventions for improving household status of women are important. This seems crucial since women in Ethiopia have a lower economic, social, and cultural status. Therefore, effort should be directed towards changing the attitude of society with respect to practices which undermine the status of women, for instance early marriage. Also,

bridging the educational attainment gap between women and men, and encouraging women's participation in income generating activities can improve women's status and thereby their children's nutritional status.

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Appendix 1

Pair-wise correlation coefficient test for Multicollinearity

Table 1
Pair-wise correlation coefficient for the explanatory variables from the urban sample

	wealth	womenstat	mothpriedu	noedumoth	partpriedu	noedupart	toiletfac
Wealth	1.0000						
womenstat	0.3838	1.0000					
mothpriedu	0.0274	-0.0955	1.0000				
noedumoth	-0.3809	-0.3200	-0.4489	1.0000			
partpriedu	0.0066	-0.1817	0.1272	0.1022	1.0000		
noedupart	-0.4129	-0.6035	-0.0743	0.4324	-0.2964	1.0000	
Toiletfac	0.5889	0.2865	-0.0225	-0.2241	-0.0753	-0.2459	1.0000
pipewater	0.5931	0.2016	0.0577	-0.2376	0.0363	-0.2176	0.2012
mothemplo	-0.1345	0.0018	-0.0447	0.0191	0.0209	0.0183	-0.1114
Childsex	0.0365	0.0020	-0.0182	-0.0104	0.0267	-0.0262	-0.0666
Sexhead	0.0654	0.1129	-0.0162	-0.0981	0.1128	-0.0775	0.0163
Agegro1	-0.0280	0.0185	-0.0139	0.0113	0.0011	-0.0279	-0.0277
Agegro2	-0.0084	0.0398	0.0304	-0.0505	0.0234	-0.0250	-0.0019
Agegro3	-0.0124	0.0084	-0.0248	0.0281	-0.0058	-0.0209	0.0097
Agegro4	-0.0002	-0.0363	-0.0104	0.0054	0.0039	0.0339	0.0316
Agegro5	-0.0219	-0.0323	0.0684	0.0028	-0.0641	0.0303	-0.0730
housesize	-0.0239	-0.1029	-0.0054	0.1292	-0.0145	0.1523	0.0688

	Pipewater	mothemplo	childsex	sexhead	agegro1	agegro2	agegro3
pipewater	1.0000						
mothemplo	-0.0833	1.0000					
Childsex	0.0382	0.0026	1.0000				
Sexhead	0.0962	0.0830	0.0325	1.0000			
Agegro1	-0.0021	-0.0276	-0.0964	-0.0383	1.0000		
Agegro2	0.0222	-0.0389	-0.0249	-0.0159	-0.1592	1.0000	
Agegro3	-0.0467	0.0219	-0.0339	0.0199	-0.1539	-0.2321	1.0000
Agegro4	-0.0341	0.0479	0.0233	0.0179	-0.1700	-0.2562	-0.2478
Agegro5	0.0323	-0.0083	0.0638	-0.0047	-0.1661	-0.2504	-0.2422
housesize	-0.0674	-0.0512	-0.0012	-0.1184	-0.0341	-0.0412	0.0099

	agegro4	agegro5	housesize
Agegro4	1.0000		
Agegro5	-0.2674	1.0000	
housesize	0.0526	-0.0220	1.0000

Table 2
Pair-wise correlation coefficient for the explanatory variables from the rural sample

	wealth	womenstat	mothpriedu	noedumoth	partpriedu	noedupart	toiletfac
Wealth	1.0000						
womenstat	0.1729	1.0000					
mothpriedu	0.1103	0.2025	1.0000				
noedumoth	-0.1444	-0.2471	-0.9333	1.0000			
partpriedu	0.0769	0.3282	0.1683	-0.1715	1.0000		
noedupart	-0.1727	-0.5627	-0.3235	0.3645	-0.146	1.0000	
toiletfac	0.5374	0.1135	0.1000	-0.1287	0.0588	-0.1454	1.0000
pipewater	0.4204	0.0593	0.0555	-0.0644	-0.0067	-0.0299	0.0970
mothemplo	-0.0664	-0.0527	-0.0144	0.0048	-0.0128	0.0213	-0.0321
childsex	-0.0106	-0.0010	0.0146	-0.0140	0.0006	0.0013	-0.0080
sexhead	0.0080	-0.0030	0.0398	-0.0504	-0.0032	-0.0211	-0.0110
Agegro1	0.0131	0.0125	0.0032	-0.0002	0.0121	-0.0160	0.0077
Agegro2	-0.0014	0.0113	0.0279	-0.0269	0.0184	-0.0154	-0.0010
Agegro3	-0.0148	0.0068	-0.0162	0.0091	0.0064	-0.0008	0.0005
Agegro4	-0.0162	-0.0160	-0.0047	0.0097	-0.0321	0.0268	-0.0221
Agegro5	0.0087	-0.0417	-0.0176	0.0202	-0.0241	0.0318	0.0088
housesize	0.0453	-0.1217	-0.0523	0.0605	-0.0785	0.0959	-0.0261

	pipewater	mothemplo	childsex	sexhead	agegro1	agegro2	agegro3
pipewater	1.0000						
mothemplo	-0.0154	1.0000					
childsex	0.0026	0.0359	1.0000				
sexhead	0.0257	0.0252	0.0221	1.0000			
Agegro1	0.0077	-0.0134	0.0024	0.0170	1.0000		
agegro2	-0.0040	-0.0089	-0.0168	-0.0149	-0.1653	1.0000	
agegro3	0.0051	0.0232	0.0124	-0.0005	-0.1693	-0.2436	1.0000
agegro4	-0.0087	0.0098	0.0066	0.0087	-0.1773	-0.2550	-0.2612
agegro5	-0.0087	-0.0100	-0.0010	0.0002	-0.1680	-0.2417	-0.2475
housesize	0.0048	-0.0280	-0.0182	-0.1205	-0.0118	-0.0386	-0.0341

	agegro4	agegro5	housesize
agegro4	1.0000		
agegro5	-0.2592	1.0000	
housesize	0.0306	0.0635	1.0000

Appendix 2

The Chow test

A chow test is employed to test for parameter stability across rural and urban areas. The test is conducted for both HAZ and WAZ regressions.

$$F(k, n-2k) = \frac{(e'e - e'_u e_u - e'_{r2} e_{r2}) \Big/ k}{(e'_{u1} e_u + e'_r e_r)/(n-2k)}$$

Where $e'e$ is the sum of the squares of the errors from the restricted regression (one with the whole observations) and $e'_u e_u$ and $e'_r e_r$ are from the unrestricted regression (that is the separate regression for rural and urban). n and k refer respectively to the number of observation and the total number of parameters estimated.

The calculated F-values for HAZ and WAZ regressions are respectively $F_{haz}(17,8087) = 1.58$ and $F_{waz}(17,8087) = 1.91$. Thus, the test results leads to the rejection of the null hypothesis that the rural and urban regressions are not different.