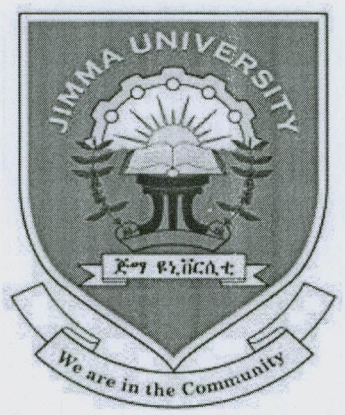
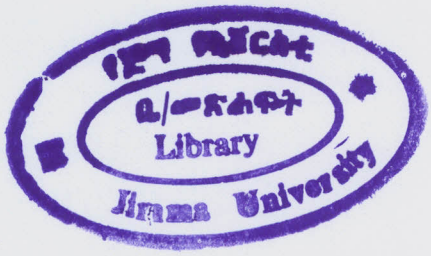
Socio-Economic Determinants of Nutritional Status of Children in Ethiopia

A Thesis Submitted to the School of Graduate Studies of Jimma University to Partial Fulfillment for the Requirements for the Award of the Degree of Master of Science (MSc) in Economics (Economic Policy Analysis)

By:

Anware Mohammed





JIMMA UNIVERSITY

COLLEGE OF BUSSINESS & ECONOMICS

MSC PROGRAM

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Under the guidance of

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And

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DECLARATION

I honestly declare that this thesis entitled "Socio-Economic Determinants of Nutritional Status of Children in Ethiopia", has been carried out by me under the guidance and supervision of Professor KK Kaushik and Mr. Muhdin Muhammed.

The thesis is original and has not been submitted for the award of any degree or diploma to any University or Institution.

Researcher's Name	Date	Signature
Anware Mohammed	26-06-2015	

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ABSTRACT

This study aims to assess the nutritional status and associated factors of children age five years and below in Ethiopia. The study uses secondary data obtained from 2011 Ethiopian demographic and health survey SPSS stored data. A total of 9622 of children aged five years and below which contain the necessary information were considered in this study, analysed within a theoretical framework based on a health production function. Descriptive, binary and multiple logistic regression analyses were performed using STATA version 12 and R version 3.1.1. Thirty five percent and 37 percent of children were underweight and stunted. The results from bivariate chi-square analysis indicated that a number of variables were significantly related to underweighting and stunting. In addition to analyzing underweighting and stunting for the whole sample, we have also separately analyzed for urban and rural households, and found that the determinants differed. Electric power and television access, longer period of formal schooling of mothers and higher wealth status of households negatively affect underweighting of children belongs in urban Ethiopia. With increasing urban child age risk of underweighting increased. Similarly in rural areas, instead of mothers' fathers longer period of formal education was observed to have negative effect on underweighting of children. In addition, those factors had insignificant correlation with underweighting in urban, having short distance to health services, mothers used contraceptive, absence of fever and diarrhea recently, toilet access, radio possession of households were negatively associated with underweighting of children living in rural Ethiopia. In other way, mother uses contraceptive, absence of diarrhea recently, household's television possession, and having higher wealth status negatively affect rural child stunting. Older and vaccinated rural children have greater possibility to be stunted. Having electric power in the household, longer period of formal schooling of mothers, and television possessions of households shown to be associated with less child stunting in urban. Moreover, the risks of stunting increased with age of child in urban and rural. Regional variations have also strong impact on child stunting and underweighting in urban and rural parts of Ethiopia. Finally, based on the results of the study, the paper proposes several policies aimed at improving the delivery of nutrition to more effectively address the problem of malnutrition.

***Key words**: Height-for-age Z-score, weight-for-age Z-score, underweighting, stunting*

ACRONYMS

COHA	Costs of Hunger in Africa
CSA	Central Statistical Authority
CSDH	Commission on the Social Determinants of Health
EHNRI	Ethiopian Health and Nutrition Research Institute
HCE	Ethiopian Households Consumption – Expenditure
HH	Household
MOFED	Ministry of Finance and Economic Development
MDG	Millennium Development Goal
NCHS	National Center for Health Statistics
NUTSA	Nutritional Status
SNN	Southern Nations and Nationalities
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization
WFP	World Food Program
WMS	Welfare Monitoring Survey

CHAPTER-ONE

1. INTRODUCTION

1.1. BACKGROUND OF THE STUDY

Nutrition and poverty are two very closely related themes. Many elemental aspects of being poor, such as hunger, inadequate health-care, unhygienic living conditions, and the stress and strain of precarious living, tend to impair a person's nutritional status. In consequence, being poor almost always means being deprived of full nutritional capabilities. An understanding of the processes through which chronic malnutrition comes to afflict a household or community can reveal a good deal about the process leading to endemic poverty. Such analyses may also yield useful guides for policy. For example, by delineating the relative roles of food, health care and environment in the genesis of malnutrition, such analyses may help policy-makers to rationalize priorities among different components of anti-poverty programs.

Global chronic under nutrition in children is highly prevalent and remains a big challenge. The United Nations Food and Agriculture Organization estimates that about 805 million people of the 7.3 billion people in the world, or one in nine, were suffering from chronic undernourishment in 2012-2014. Almost all the hungry people, 791 million, live in developing countries, representing 13.5 percent, or one in eight, of the population of developing counties. There are 11 million people undernourished in developed countries (FAO, 2014). According to this report 214 million (23.8%) of all the hungry people of the world are found in sub-Saharan African countries. The target set by the Millenium goals was to halve the proportion of hungry people by 2015. For developing countries as a whole, the goal was to halve the proportion of hungry people from the base year(s) of 1990-2, or from 23.4% to ll.7%. As the proportion in 2014-one year before the year the goals are supposed to be achieved is 14.5%, the goal is unlikely to be met, although there has been significant reduction. Only those countries, East Asia, South East Asia, and Latin America and the Carribbean regions have met the goal[1].

Children are the most visible victims of undernutrition. Globally 161 million under-five year olds were estimated to be stunted in 2013. The global trend in stunting prevalence and numbers

[1] http://www.worldhunger.org

affected is decreasing. Between 2000 and 2013 stunting prevalence declined from 33% to 25% and numbers declined from 199 million to 161 million. In 2013, about half of all stunted children lived in Asia and over one third in Africa. Globally, 51 million under-five year olds were wasted and 17 million were severely wasted in 2013.Globally, wasting prevalence in 2013 was estimated at almost 8% and nearly a third of that was for severe wasting, totaling. If current trends continue, the MDG 1 target (halving the 1990 underweight prevalence by 2015 at the global level) will not be met. Three regions, however, have already met or exceeded the target: East Asia and the Pacific, Latin America and the Caribbean, and Central and Eastern Europe and the Commonwealth of Independent States (CEE/CIS). Africa has experienced the smallest relative decrease, with underweight prevalence of 17 per cent in 2013, down from 23 per cent in 1990; Asia reduced underweight prevalence during the same period from 32 per cent to 18 per cent. (UNICEF et al., 2014b)

Hunger and malnutrition are devastating problems, particularly for the poor and unprivileged countries like Ethiopia. About 29.9 percent of the total populations of Ethiopia (30.4% in rural and 25.7% in urban areas) are found to be under the poverty line. In addition 33.6 percent of the Ethiopian population are living below the food poverty line and cannot meet their daily minimum nutritional requirement of 2200 calories (MOFED, 2013). The poor nutritional status of children continues to be a serious problem in Ethiopia. According to 2014 EDHS mini report nationally, 40 percent of children under age five are stunted, and 18 percent of children are severely stunted. The percentage of children stunted is higher in rural areas (42 percent) than in urban areas (24 percent). Stunting levels are above the national average in Affar (49 percent), Tigray (44 percent), SNNP (44 percent) and Amhara (42 percent), and relatively low in Gambela and Addis Ababa (22 and 23 percent, respectively). Twenty five percent of children under age five are underweight (have low weight-for-age), and 7 percent are severely underweight. Rural children are more likely to be underweight (27 percent) than urban children (13 percent). Addis Ababa has the lowest proportion of underweight children, at 7 percent, while Affar has the highest prevalence of underweight children, at 46 percent. (CSA, 2014)

Malnutrition of children has multi social and economic impacts for a country. According to the Social and Economic Impact of Child Undernutrition summary report of Ethiopia twenty eight percent of child deaths are associated with undernutrition. There are an estimated 378,591

additional annual cases of child mortality associated with child undernutrition, in the period from 2004 to 2009. As many as 81% of all cases of child undernutrition and its related pathologies 7 go untreated. Fourty four percent of the health costs associated with undernutrition occurs before the child turns 1 year-old. Undernutrition is estimated at 55.5 billion Ethiopian birr (ETB), which is equivalent to 16.5% of GDP (African Union Commission et al., 2014).

Since children are the economic assets to the world and their future development outcome can be influenced by their nutrition and health status, the mechanism and consequences of malnutrition problems need to be understood better. This is true in a country like Ethiopia where malnutrition is common. Therefore, there is a need to assess the factors associated with nutrition status of children so that interventions can be planned to children to achieve growth and development. Thus, this study aimed at examining the relationship between the socioeconomic factors and the nutritional status of children and also aimed at using the findings as the basis for policy recommendations on nutrition interventions in Ethiopia.

1.2. STATEMENT OF THE PROBLEM

In 2013, an estimated 6·3 million live born children worldwide died before age 5 years. Nearly half of all deaths in children under 5 are attributable to undernutrition. This translates into the unnecessary loss of about 3 million young lives a year (UNICEF, 2014b). Undernutrition puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and contributes to delayed recovery. In addition, the interaction between undernutrition and infection can create a potentially lethal cycle of worsening illness and deteriorating nutritional status. Poor nutrition in the first 1,000 days of a child's life can also lead to stunted growth, which is irreversible and associated with impaired cognitive ability and reduced school and work performance (African Union Commission et al., 2014).

High malnutrition rates in Ethiopia also pose a significant obstacle in achieving better child health outcomes. The figures also show the extent to how much of the country's potential work force is faced with growth retardation.

Even though the problem of child malnutrition in Ethiopia has been sufficiently documented, the reasons behind it are still poorly understood. There is also inconsistency across studies regarding the determinant factors behind child nutrition. The researcher shares the idea and the main

reason behind the need to study socio-economic determinants and differentials of nutritional status in Ethiopia is, so far, there are not money detailed studies conducted to explore all aspects of nutritional status in Ethiopia. While most studies on health and nutrition of both children and adults look into the effects of nutrient consumption and food availability, few studies focus on the relationship between nutritional status and non-nutritional factors, like educational attainment, availability of water and sanitation, etc. And among these already few studies that look into socioeconomic aspects, fewer still give emphasis to children's nutritional status: most either focus on adult health on the one hand, or infant mortality on the other. In response, this study aims to address the gap in knowledge regarding the relationship between the nutritional status of children and their socioeconomic environment.

1.3. OBJECTIVE OF THE STUDY

1.3.1. GENERAL OBJECTIVE

The general objective of this study is to assess nutritional status and identify the associated factors of nutritional status of children aged five years and below in Ethiopia.

1.3.2. SPECIFIC OBJECTIVES

The specific objectives of this study are:

- To assess the nutritional status of under- five children in Ethiopia.
- To identify the relationship between the types of nutritional status (underweight and stunting) related to various possible predictors.
- To make the necessary policy recommendations to make for a more effective and economically efficient delivery of nutrition.

1.4. SIGNIFICANCE OF THE STUDY

The findings from this research are hoped to be useful in many ways. The findings could be helpful for policy making, monitoring and evaluation activities of the government and different concerned agencies. Since the study will attempt to reveal the major responsible factors and their relative contribution to the malnutrition of children, the end user governmental and non-governmental organizations could take intervention measures and set appropriate plans to tackle

the existing nutrition problems by identifying and giving priority for the very poor and vulnerable groups.

This study is expected to contribute its part by filling the information gap concerning nutritional status of children aged five and below in the country. Finally, the study could be used as a stepping stone for further studies.

1.5. ORGANIZATION OF THE STUDY

This study presented in five chapters. The first chapter gave a general background of the study, statement of the problem, objective, its significance and limitation of the study. Chapter 2 deals with the review of literature on nutrition in Ethiopia and the rest of the world, whereas chapter three specify the data and methodology of the study such as sources of data and variables to be included in the study with their coding and description. Methods of data analysis described in this chapter. Chapter 4 report results from the statistical data analysis and provides discussions. Finally, the last chapter will provide conclusions and policy recommendations based on the findings of the study.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. THEORETICAL LITERATURE REVIEW

2.1.1. CONCEPTS AND DEFINITIONS

In an agriculturally oriented country like Ethiopia, the concept of food security is often confused with nutritional status. Since this section focuses on nutritional status, it is useful to distinguish clearly between the two. Household food security is concerned with the regularity of household calorie availability, whether derived from the household's own production or from household purchasing power. Household nutritional status, on the other hand, refers to the nutritional status of its individual members, which in turn results from a combination of nutrient intake, physical output, and disease. Nutritional status of preschool children is used as a proxy for the family's nutritional well-being. This convention is adopted for two reasons. First, preschool children, along with pregnant or lactating women, show nutritional stress earlier than other household members (Martorel, 1982). Second, international reference standards exist for evaluating the nutritional status of preschool children, thus permitting comparisons over time and across countries.

To the extent that nutrient intake is a function of household food expenditure and calorie acquisition behavior, the nutritional status of a household member is directly affected by the level of household food security. But a complete study of household nutritional status is much broader and must necessarily consider calorie and nutrient composition, intra household food distribution, physical and mental growth, individual activity levels, sanitary environment, frequency and severity of disease, infections, parasitic infestations, household fertility and birth spacing behavior, household feeding and childcare habits, and the condition of women in general, but more particularly with pregnant and lactating women. All of these factors influence the household's ability to respond to the nutritional needs of its members. Furthermore, each of the different factors may experience seasonal variations in their degree of influence. (Randal, 1992)

Malnutrition refers to deficiencies, excesses or imbalances in intake of energy, protein and/or other nutrients. Contrary to common usage, the term 'malnutrition' correctly includes both under-nutrition and over-nutrition. Under-nutrition is the result of food intake that is continuously insufficient to meet dietary energy requirements, poor absorption and/or poor biological use of nutrients consumed. This usually results in loss of body weight. Over-nutrition refers to a chronic condition where intake of food is in excess of dietary energy requirements, resulting in overweight and/or obesity (WHO, 2005).

The word "anthropometric" is generally meant to represent the measure of people's growth indicators such as weights and heights (related to their age and sex). It is used for growth assessment and is a single measurement that best defines the nutritional status of a child (Blossner and De Onis, 2005). According to this measure, the nutritional status of children is determined by comparing growth indicators with the distribution of the same indicators for "healthy" (as reference group), and identifying "extreme" or "abnormal" departures from this distribution. The international reference standard that is most commonly used (and recommended by the WHO) is that of the data on the weights and heights of a statistically valid population (US National Center for Health Statistics (NCHS)) of healthy infants and children in the US.

There are three ways of expressing these comparisons: Z-score (standard deviation (SD) score), percent of median, and percentile. But the interest here is on the SD score (Z-score) and it is defined as the difference between the value for an individual and the median value of the reference population for the same age, height, or weight divided by the standard deviation of the reference population. Based on this comparison method, the three most commonly used anthropometric indicators for infants and children are:

1) Weight-for-height (W/H): measures body mass relative to height, without making use of age data and represents a short-term indicator useful to monitor short-term changes in nutritional status. It exhibits the situation of acute malnutrition or 'wasting'. Wasting is usually caused by a recent nutritional deficiency and may manifest significant seasonal variations according to changes in the availability of food or disease prevalence (Cogill, 2001).

2) Height-for-age (H/A): is a longer-term index and represents linear growth of a child. It gives information about chronic malnutrition or 'stunting' which reflects the accumulation of past outcomes (Cogill, 2001).

3) Weight-for-age (W/A): Measures body weight relative to age, and is a composite measure of the other two useful to assess nutritional changes over time, so it can confound short and long-term health problems. It is an index of both acute and chronic malnutrition (Cogill, 2001). It provides the information about 'underweight'.

The cut-off point to define abnormal anthropometry with Z- scores is -2 standard deviations. A more general rule of thumb for evaluating anthropometric Z-scores has been developed by WHO, with a score of less than -3 indicating "severe" malnutrition, between -3 and -2.01 "moderate" malnutrition, -2 to -1.01 "mild" malnutrition and -1 and above considered normal.

2.1.2. THEORETICAL FRAMEWORK

While it is clear that malnutrition is primarily caused by an inadequate diet, the literature suggests that malnutrition can also be caused by claims on that diet so great as to cause such despite a nutrient intake that in other circumstances might be deemed adequate (Fogel 1992). Various studies treat the nutrition problem as a multi-factorial one, necessitating action based on a multi-sectoral approach alongside policies aimed directly at food subsidization and nutrient fortification (Payne 1992; WHO1998). Anand and Harris (1992), Gopalan (1992) and Tomkins and Watson (1989;cited by Payne 1992) agree that an individual's command over resources greatly influences his or her health, and thus suggest approaching the problem of undernutrition through income subsidies, employment provision, strategies to improve housing and ensuring access to health care and medical care. In addition, Srinivasan (1992) and the WHO(1998) highlight the importance of clean water in the prevention of disease and maintaining health, while Todaro and Smith (2003) underscore the importance of parental literacy in the production of child health. Finally, Thomas (1994) and Gertler and Zeitlin (2002) add that the productivity of an individual's production of health depends on individual characteristics such as education, age, gender, and family background, and household and community characteristics.

In response to the above propositions, the writers at this point propose a multidimensional approach to the analysis of nutritional status. The following theoretical framework is synthesized

from J. R. Behrman and A. B. Deolalikar's "Health and Nutrition" (1988), Paul Gertler and Jennifer Zeitlin's "Do Investments in Child Education and Nutrition Improve Adult Health?" (2002), and Leonid Federov and David E. Sahn's "Socio-Economic Determinants of Children's Health in Russia" (2003), which in turn are based on Michael Grossman's seminal work, "On the Concept of Health Capital and the Demand for Health" (1972). In the work cited, Grossman suggested that health can be thought of as a form of human capital: an individual's health stock at any point in time is determined by an initial genetic endowment, subsequent behavioral choices (for example, nutrition, medical care, smoking, exercise), and exogenous shocks from the public health environment (for example, contracting cancer from toxic waste).

Household Preference Function

The determinants of an individual's health and nutrition usually are decisions made by the individual or the household in which he or she lives given assets, prices, and community endowments. Therefore a natural starting point is the determination of individual health and nutrition at the household level.

The model is structured assuming that the household maximizes a single preference function subject to constraints (to be enumerated below). For simplicity, a static or one-period model is considered. The researchers now turn to an algebraic statement of the one-period, household model with constrained maximization of a joint utility function.

Assume that the household has a preference function:

$$U = U(H_i, C_i, C_P, T^i{}_L, E_{i|c}, S, \xi),\ \text{i} = 1,2,....\text{I} \qquad (1)$$

Where

H_i is the health of household member i.

C_i is the consumption of household member i of private goods

C_P is the consumption of household member i of pure public goods,

$T^i{}_L$ is the leisure time of household member i,

$E_{i|c}$ is the education of household child i.

S is the number of surviving children,

ξ are taste norms, and

I is the number of individuals in the household.

(All of these variables and others defined below may be vectors with multiple dimensions.)

Utility is presumed to depend on the health of each of the household individuals, with a negative impact of poor health and mortality. Private goods consumption, pure public goods consumption and leisure of each household member have positive impact. The education of each child is included because of possible altruistic interests of the parents and concern about the child's expected prospects as an adult which may affect the parents' material well-being in their old age. The number of surviving children is presumed to improve parental welfare whether for altruistic, insurance, or other reasons. The utility function finally is conditional on norms, here assumed to be exogenous. What follows are the functions on which the maximization of the household preference function is constrained.

Production Function Determining Health

The health of the i^{th} individual is produced by a number of choices relating to the consumption and time use of that individual, the education of that individual and of the key person(s) in the household making and implementing health-related decisions, and the individual, household, and barangay endowments:

$$H_i = H(N^i, C_i, C_P, I, E_i, E_m, T^i{}_L, T^i{}_H, T^m{}_H, \eta^i, \psi, \Omega) \qquad (2)$$

Where

N^i is the nutrient intake of the i^{th} individual,

E_i is the education of the i^{th} individual,

E_m is the education of the person often the mother who makes critical health-related decisions and implements them within the household, hereafter referred to as "mother"),

$T^i{}_H$ is the time of the i^{th} individual devoted to health-related procedures,

$T^m{}_i$ is the mother's time devoted to health-related procedures,

η^i is the endowment of the i^{th} individual,

ψ is the endowment of the household,

Ω is the endowment of the barangay, and the other variables are defined above.

Nutrient intakes (N^i) are emphasized because of their presumed importance in health determination, and its impact on health is assumed to be positive. Other consumption items (C_i, C_p) include goods and services with a range of direct effects on health (e.g. medicine, cigarettes, and driving vehicles). The household size (I) is included to represent possible scale and congestion effects.

The individual's time use is included because the nature of his or her occupation (not explicitly included above), the extent of leisure time ($T^i{}_L$) and the time devoted to health-related activities ($T^i{}_H$) may have strong health effects. The individual's education (E_i) and that of the mother may affect health through affecting the choice of health practices, through better information and through affecting the effectiveness of the use of given health-related inputs (e.g. food preparation, disease treatment, etc.).

The last three variables, the individual's endowments (η^i), the household endowment (ψ), and the barangay endowments (Ω), differ from the other variables in that they are not presumed to be choice variables of the household during the period being modeled. Examples, respectively, would be: individual's age, initial health and genetic make-up; the household's tenure status and type of housing; and access to water and basic utilities, and the presence of medical, health care and waste disposal facilities in the barangay. While the individual's endowments may posit direct effects to his or her health through biological mechanisms, the endowments of the

household and the barangay affect the individual's health by way of its claims to the individual's disease environment and subsequently, its impact to the individual's nutrient-utilization capabilities.

Income Constraint

In the modeled period, the household faces a budget constraint:

$$P_C C + P^i{}_E E^i + X = p^i{}_L (T^i - T^i{}_E - T^i{}_H) + Y^i + F \qquad (3)$$

Where

P_C is the price (or vector of prices) of consumption good(s) C,

$P^i{}_E$ is the cost of education specific to child i,

X is all other household expenses for the period (e.g. rent, utilities expense, etc.),

$P^i{}_L$ is the wage rate of the i^{th} individual,

T^i is total time of the i^{th} individual,

$T^i{}_E$ is the school time of the i^{th} child,

$T^i{}_H$ is the time devoted for health of the i^{th} child,

Y^i is the non-labor income of the i^{th} individual, and

F is transfers less taxes (assumed to be lump-sum for simplicity).

The reduced form under the assumption that the underlying functions have desirable properties so that the maximization of (1) subject to (2) and (3) is obtained, the constrained maximization of preferences leads to the reduced form demand function for health:

$$H^i = H(N^i, C^i, C^p, I, E^i, E^m, T^i{}_L, T^i{}_H, T^i{}_E, T^m{}_H, P_C, P_E, R, P^i{}_L, Y^i, F, \eta^i, \psi, \Omega) \qquad (4)$$

Which provides a consistent framework within which to examine the impact of changes in, among others, household and barangay endowments, on the health-related consumption of

different types of individuals. Equation (4) thus gives the relationship of primary interest in this study.

2.2. REVIEW OF RELATED LITERATURE

Various studies in different/same countries may find different results over the importance of the determinant factors behind children's nutrition and health outcomes. Estimates may differ depending on various factors including the nature of the data and estimating methodology.

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) using logistic analysis showed 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. Using data from four regions of Brazil, Thomas et al. (1990b) attempted to estimate the impact of household characteristics on child height and survival. Applying the quasi-maximum likelihood estimation techniques for the binomial model and instrumenting income by logarithm of household expenditure and including unearned income, its square and a set of month dummies, income appears to have no effect on child height in all four of the regions. Consistently, as food availability is one of household resources, both Alderman (1990) and Maxwell et al. (2000) did not found it to be a significant factor; rather care and health were find to be important inputs. Moreover, Maxwell et al. (2000) did not find higher incomes leading to significantly improved care practices and behaviors.

Most of the studies in Ethiopia including Christiaensen and Alderman (2001); SCUK (2002), Woldemariam and Timotewos (2002); Yimer (2000); Tesfaye (2009); Bilisuma (2004); Alemu et al. (2012); Abay Asfaw (1995), and Silva (2005) found household wealth/income as an important determinant of child nutritional/health status. Because, according to SCUK (2002), for example, better off households have better access to food and higher cash incomes than poor households, allowing them a better quality diet, better access to medical care and more money to spend on essential non-food items such as schooling, clothing and hygiene products. The studies mentioned above proxy wealth/income in either one or the other of the following variables: housing quality, cattle and land ownership/rental, households' access to food, cash income/expenditure etc.

Different literatures showed also that health access and health variable s have significant impact on child malnutrition status. Kamiya (2011) in Japan showed that distance to health services, coverage of vitamin A supplementation and the bednet were associated with weight-for-age. All the variables reflecting sanitation and water, the prevalence of childhood diarrhoea had a negative impact on height-for-age, the latrine coverage positively correlated with height-for-age, and households' average time to get water had negative impacts on weight-for-age and weight-for-height. Girma et al. (2002); Alemu et al. (2011) used logistic regression for urban and rural population separately and showed presence of diarrhea, toilet access and water safety have a significant correlation with child stunting. Kesitegile (1994) showed presence of latrine and sanitation has positive correlation with child underweighting in Bostwana by using logistic regression analysis.

For example, using data from the 1986 Brazilian Demographic and Health Survey, Thomas et al. (1990b) found total income to have a positive and significant effect on child height in both urban and rural sectors and the effect is much larger in magnitude in the rural sector. On the contrary, Abdulhamid (1996) was unable to establish a significant relationship between poverty (income) and nutritional status of children in urban Ethiopia.

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. 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) using logistic regression analysis showed 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, acquires skills, and model positive caring behaviour 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.

Using household data from three consecutive welfare monitoring surveys of Ethiopia over the period 1996-1998, Christiaensen and Alderman (2001) using linear regression analysis found that both female and male adult (parental) education has a strong positive and statistically significant effect on the child's nutritional status, and the effect of female education is about twice as large as that of male education. This study also shows that maternal nutritional knowledge is key determinants of chronic child malnutrition in Ethiopia. Other studies also report similar results from female's education (Dejen, 2008; Woldemariam and Timotiows, 2002; Alemu et al., 2005b; Silva, 2005). For example, using woreda level data on children under age of 24 months, SCUK(2002) confirmed that children whose mothers attended school were less likely to be malnourished than the children of uneducated mothers. Kamiya (2011) uses logistic regression in order to show the socio economic determinants of five and below years old children in Japan. The study done by Kamiya (2011) show that Educational attainment of mothers did not exert any positive impact on childhood nutrition, contrary to numerous previous studies, when it was estimated together with education of fathers.

Nevertheless, there are some studies which could not find a significant relationship between female's education and child nutritional status (Sentayehu, 1994). Various reasons could be attached to this result. According to SCUK (2002), for instance, this could be because, although educating mothers (and other care givers) will undoubtedly lead to an improvement in the way some young children are cared for, many mothers will never be able to act on their new knowledge because they are simply poor. This means that poverty could cause bottlenecks, not allowing other public policies to influence child health (Attansio et al., 1992).

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) using logistic regression analysis underscored that employment of mothers can have both positive and negative implication on children's dietary intake.

On the one hand, 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, employment status of women (care giver) is found to be insignificant in some studies (see Alemu et al., 2005a; Bilisuma, 2004; Woldemariam and Timotewos, 2002). It is argued that this could be because the time allocated to earning income may be at the expense of time spent in feeding and caring for children, and thus the net effect of these two opposing effects makes employment status of the caregiver an insignificant variable. The presence of other adults in a household, household's income; net of a mother's earning and age of children are likely to affect the net effect of maternal employment on children nutrition/health status (Crepinsek and Burstein (2004).

In Sub-Saharan Africa, male children five years of age are more likely to become stunted than females, which might suggest that boys are vulnerable to health inequalities than their female counterparts in the same age groups. In several of the surveys, sex difference in stunting was more pronounced in the lowest social economy groups (Henry et al., 2007). A number of studies in Africa suggest that rates of malnutrition among boys are consistently higher than among girls (MoFED, 2013; Sahn and Stifel, 2003; Christiaensen and Alderman, 2001)

Household size is also important in the analysis of child nutritional and health status for it has direct implications on household resources. Senauer and Garcia (1991) using linear regression analysis found household size to have a significant positive impact on height of children. The authors argue that this could be because household full income is a function of wage rates and the number of economically active family members, and thus this variable may be reflecting a full income effect.

On the other hand, as household size gets larger there is a big chance of having economically inactive members in the household and this leads to an adverse impact on the available resources and thereby on child nutrition outcomes. For example, according to Alderman (1990) in Ghana, those children in households with a full sibling less than 2 years of age were found to be significantly shorter than cohorts without such a sibling implying the influence of prenatal conditions or competition for resources.

In general, factors that are contributing to health problem and malnutrition may differ among regions, communities and over time. Socioeconomic, demographic and health characteristics of communities', households and individuals are important in determining child nutrition. Thus,

identifying the underlying causes of health problem and malnutrition in a particular locality is important to solve the nutritional and health problems. Our studies therefore intended to work on identifying the main predictors of malnutrition in Ethiopia based on the different literatures findings and try to fill the gap of different literatures.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. SOURCES OF DATA

This study used secondary data. Secondary data for the analysis was obtained from the Ethiopia Demographic and Health Survey (EDHS) 2011. The survey was conducted by the Central Statistical Agency (CSA) under the auspices of the Ministry of Health. This was the third Demographic and Health Survey (DHS) conducted in Ethiopia, under the worldwide MEASURE DHS project, a USAID-funded project providing support and technical assistance in the implementation of population and health surveys in countries worldwide. The data set that we have used in this thesis was obtained from MEASURE DHS project.

3.2. STUDY POPULATION

The 2011 EDHS sample was designed to provide estimates for the health and demographic variables of interest for the following domains: Ethiopia as a whole; urban and rural areas of Ethiopia (each as a separate domain); and 11 geographic areas (9 regions and 2 city administrations), namely: Tigray, Affar, Amhara, Oromiya, Somali, Benishangul-Gumuz; Southern Nations, Nationalities and Peoples (SNNP), Gambela, Harari, Addis Ababa and Dire Dawa. In general, a DHS sample is stratified, clustered and selected in two stages. In the 2011 EDHS a representative sample of approximately 14,500 households from 540 clusters was selected. The sample was selected in two stages. In the first stage, 540 clusters (145 urban and 395 rural) were selected from the list of enumeration areas (EA) from the 2007 Population and Housing Census sample frame (EDHS, 2011). Households comprised the second stage of sampling. A complete listing of households was carried out in each of the 624 selected EAs. A representative sample of 14,500 households was selected for the 2011 EDHS.

The 2011 EDHS used three questionnaires: the Household Questionnaire, the Woman's Questionnaire, and the Man's Questionnaire. The Woman's Questionnaire was used to collect information from all women aged 15-49 from the selected households. The data used to study "Determinants of Nutrition Status of Children" were collected in the birth history section of the Woman's Questionnaire from 16,515 women aged 15-49. The background characteristics of the

14,070 women aged 15-49 was fully obtained in the 2011 EDHS. The study has used the birth history data of the respondents (mothers) from Ethiopian DHS 2011 and the data are reported retrospectively. Because we are only interested nutritional status of children aged five and below, we only considered a total of 9622 out of 10481 children age 5 years and below which have the necessary full information for this study and those whose information didn't register properly were ignored from the analysis.

3.3. MODEL SPECIFICATIONS

3.3.1. LOGISTIC REGRESSION

Regression methods are essential to any data analysis which attempts to describe the relationship between a response variable and any number of predictor variables. Logistic regression analysis extends the techniques of multiple regression analysis to research situations in which the outcome variable is categorical, that is, taking on two or more possible values. In this paper, the risk factors for weight for-age and height-for age were identified using logistic regression analysis .Logistic regression is a statistical technique for predicting the probability of an event, given a set of predictor variables. The procedure is more sophisticated than the linear regression procedure. The binary logistic regression procedure empowers one to select the predictive model for dichotomous dependent variables. It describes the relationship between a dichotomous response variable and a set of explanatory variables. The explanatory variables may be continuous or discrete. The logistic model, as a non-linear regression model, is a special case of generalized linear model (McCullagh and Nelder, 1989) where the assumptions of normality and constant variance of residuals are not satisfied.

Logistic model, as compared to its competitor, the probit model, is less sensitive to outliers and easy to correct a bias (Copas, 1988). Nevertheless, the two methods differ in their idea. In instances where the independent variables are categorical or a mix of continuous and categorical, logistic analysis is preferred to discriminate analysis (Agresti, 1996). The assumptions required for statistical tests in logistic regression are far less restrictive than those for ordinary least squares regression.

3.3.1.1. BINARY LOGISTIC REGRESSION

Binary logistic regression is used to model binary response variables. Such binary discrete phenomena usually take the form of a dichotomous indicator or dummy variable. The model for binary logistic regression analysis assumes that the outcome variable Y is categorical and usually dichotomous, that is, the dependent variable can take the value 1 with the probability of success P=P(yi=1/xi) or 0 the probability of failure (1-P)=1-P(yi=1/xi).The model can be describe as follow by considering a Bernoulli random variable Yi, i=1, 2,…n.

Assume Ynx1 be a dichotomous outcome random variable with categories 1 (a child is undernourished and 0 (is not undernourished). Let the conditional probability that the outcome of interest in a study "the i^{th} child suffer from undernutrition" be denoted by $P(Y_i=1/xi) = P(xi)$. Let $X_{(nx(k+1))}$ denote the collection of k-predicator variables of the response.

$$X = \begin{pmatrix} 1 & x_{11} & x_{12}....x_{1k} \\ 1 & x_{21} & x_{22}.....x_{2k} \\ . & . & . & . \\ . & . & . & . \\ 1 & x_{n1} & x & x_{nk} \end{pmatrix}_{nx(k+1)} = \begin{pmatrix} x_1 \\ x_2 \\ . \\ . \\ . \\ x_n \end{pmatrix} \qquad Y = \begin{pmatrix} y_1 \\ y_2 \\ . \\ . \\ y_n \end{pmatrix}_{nx1}$$

Where, X is called regression matrix and without the loading column of 1s is termed as predictor data matrix. Then, the conditional probability that the i^{th} child is undernourished given the predictor variables X_i is denoted by $\pi_i = \pi(y_i = 1/x_i, \beta)$

The baseline-category logit model with a predictor X is

$$\log\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k, \ 0 \le \pi \le 1 \qquad (1)$$

The binary logit model has an alternative expression in terms of the response probabilities. This is

$$\pi_j = \pi(y_i = 1/x_i) = \frac{e^{x_i\beta}}{1+e^{x_i\beta}}, \ i = 1,2,...,n \qquad (2)$$

Where $\pi_i = \pi(y_i = 1/x_i)$ the probability of i^{th} child is undernourished given child's characteristics x_i.

$\beta \varepsilon R^k, \beta = (\beta_0, \beta_1, ..., \beta_k)^T$, β is a vector of unknown logistic regression coefficients with dimension of(k + 1) × 1.

ODDS RATIOS

The odds defined as the ratio of the probability that the event will occur to the probability that the event will not occur. That is, the odds of event E (in this study, the children is undernourished, y= 1) is given by

$$odds(E) = \frac{\pi(E)}{\pi(not\ \mathrm{E})} = \frac{\pi(E)}{1 - \pi(E)} \qquad (3)$$

The odds ratio is the ratio of the odds of an event occurring in one group to the odds of occurring in another group. The odds ratio (OR) is a popular measure of the strength of association between exposure and disease. In a cohort study, the odds ratio is expressed as the ratio of the number of cases to the number of non-cases in the exposed and unexposed groups (Cornfield, 1951).

In binary logistic regression, odds ratio is the exponential of the estimated coefficient $\hat{\beta}$ (exp($\hat{\beta}$)). For continuous covariate, exp ($\hat{\beta}$)is the predicted change in odds of being under nutrition for a unit increase in explanatory variable. For categorical independent variable, exp($\hat{\beta}$)is the predicted change in odds of being under nutrition for a given category of the predictor variable with respect to the reference category.

The three equations (1), (2) and (3) are suitable representation of success probability, the log odds, and odds respectively. Furthermore, these representations facilitate interpretation of parameter estimation. The estimated logistic coefficients $\hat{\beta}_j$ s are interpreted as the change in the log-odds for every unit increase/decrease (depending on the variable change in x) holding other predictors constant (Agresti, 1996).

3.3.1.2. ASSUMPTIONS OF LOGISTIC REGRESSION

In order to valid my analysis; the model has to satisfy the assumptions of logistic regression. When the assumptions of logistic regression analysis are not met, we may have problems, such as biased coefficient estimates or very large standard errors for the logistic regression coefficients, and these problems may lead to invalid statistical inferences. Therefore, before we can use our model to make any statistical inference, we need to check that our model fits sufficiently well and check for influential observations that have impact on the estimates of the coefficients. Logistic regression is popular because it enables the researcher to overcome many of the restrictive assumptions of OLS regression.

According to Hosmer and Lemeshow, 1989 there are, however, other assumptions one should consider for the efficient use of logistic regression such as:

- ✓ Logistic regression will be difficult to intercept if not coded meaningfully. The convention for binomial logistic regression is to code the dependent class of greatest interest as 1and the other class as 0. Since logistic regression assumes that P(Y=1) is the probability of the event occurring, it is necessary that the dependent variable should represent the desired outcome.
- ✓ Logistic regression does not assume a linear relationship between the dependent and the independent variables. It can handle nonlinear effects even when exponential and polynomial terms are not explicitly added as additional independent variables because the logit link function on the left hand side of the logistic regression equation is non -linear. However, it is also possible and permitted to add explicit interaction and power terms as variables on the right-hand side of the logistic equation, as in OLS regression.
- ✓ The dependent variable does not need to be normally distributed, but it typically assumes a distribution from an exponential family (e.g. Binomial, Poisson, multinomial, normal); binary logistic regression assumes binomial distribution of the response but makes no assumption about the distribution of the independent variables.
- ✓ The categories (groups) must be mutually exclusive and exhaustive; a case can only be in one group and every case must be a member of one of the groups.
- ✓ Logistic regression requires the dependent variable to be binary or dichotomous.

3.3.1.3. ASSESSING THE GOODNESS OF FIT

3.3.1.3.1. THE HOSMER-LEMESHOW TEST

The Hosmer-Lemeshow test is used to check the overall model fit. The test divides subjects into deciles groups g (usually10) based on predicted probabilities, and then computes a chi-square from observed and expected frequencies. Then a probability (π) value is computed from the chi-square distribution with 8 degrees of freedom to test the fit of the logistic model. The Hosmer-Lemeshow test statistics is given by

$$\hat{C} = \sum_{K=1}^{g} \frac{(O_k - E_k)^2}{V_k} \rightarrow \chi^2_{(g-2)} \qquad (4)$$

where $E = n\pi_k$, $V_k = np_k(1-p_k)$, g is the number of groups, O_k is observed number of events in the k^{th} group, E_k is expected number of events in the k^{th} group, and V_k is a variance correction factor for the k^{th} group.

If the observed number of events differs from what is expected by the model, the statistic $\hat{C}$ will be large and there will be evidence against the null hypothesis that the model is adequate to fit the data. This statistic has an approximate chi-square distribution with (g-2) degree of freedom.

3.3.1.3.2. LIKELIHOOD-RATIO TEST

The likelihood ratio chi-square (G^2) statistic is the test statistic commonly used for assessing the overall fit of the logistic regression model. The likelihood ratio test, also called log-likelihood test it is based on (-2 times log likelihood). The overall significance is tested using what SPSS calls the Model Chi square, which is derived from the likelihood of observing the actual data under the assumption that the model that has been fitted is accurate. There are two hypotheses to test in relation to the overall fit of the model.

3.3.2. SELECTION OF PREDICTOR VARIABLES

In logistic regression, as in other multivariate statistical techniques, one may want to identify subset of independent variables that are good practice of the dependent variable. The number of variables to be included in the model should be of the minimum possible that is persimmons and deliver optimum information.

The logistic regression procedures have several methods available for model selection. Variables can be entered into the model using Enter, Forward step, Back ward step, and etc.

As described by Hosmer and Lemeshow (2001), there are certain steps that can be followed in the selection of variables for a logistic regression model. First, the selection process should begin with a careful univariate analysis of each the variables. For this purpose, the Pearson"s chi-square and/or the likelihood ratio chi-square tests may be used. Up on completion of the univariate analysis we select variables for the multiple logistic regression analysis. Any variable whose univariate test has a p-value less than 0.20 should be considered as a candidate for multiple logistic regression analysis. Once the variables have been identified, we begin with a model containing all of the selected variables. In the Bivariate analysis 0.20 levels be used as screening criterion for variable selection is based on the work (Zoran Bursac and Heath Gauss, 2007) on logistic regression. Finally, following the fit of the multiple logistic regression models, the importance of each variable included in the model should be verified. This should include an examination of the Wald statistic for each of the variables and the comparison of each estimated coefficient with the coefficient from the univariate model containing only that variable.

3.3.3. VARIABLES INCLUDED IN THE STUDY

3.3.3.1. THE RESPONSE VARIABLE

Height-for-age, weight-for-height and weight-for-age Z-scores which give the information about stunting, wasting and underweighting will be used as measure of health outcomes, respectively.

In this study, a height and weight measurement of children, taking age into consideration, was converted into Z-scores based on the National Center for Health Statistics (NCHS) reference population recommended by the World Health Organization (WHO). Thus, those below -2 standard deviations of the NCHS median reference for height-for-age, weight-for-age and weight-for-height are defined as stunted, underweighted, and wasted, respectively. All the three indicators are used to describe the level of child malnutrition/health problem. (WHO, 2002)

The nutritional status of children aged five years and below was simply assigned into categories based on going to recorded weight and height of children. Thus, those below -2 standard deviations of the NCHS median reference for height-for-age, weight-for-age and weight-for-

height are defined as stunted, underweight, and wasted, respectively. In this study the former two (height-for-age, weight-for-age) indicators are used to describe the level of child malnutrition

We will thus employ an econometric analysis involving discrete choice variables, the possible outcomes being that the child is (1) undernourished (mildly, moderately or severely), (2) not under nourished (normal or over nourished).We had two separate dependent variables

$$Y_1 = \begin{cases} 1, \text{Stunted (height - for age Z - score} < -2) \\ 0, \text{else} \end{cases}$$

$$Y_2 = \begin{cases} 1, \text{underweight (weight - for age Z - score} < -2) \\ 0, \text{else} \end{cases}$$

3.3.3.2. EXPLANATORY VARIABLES

As proxy indicators of socioeconomic, demographic and environmental characteristics the following 24 factors were included: mother's education, education of father, household income, household size, age of children in month, sex of the child, sex of household head, access to safe water, electric access, radio access, television access, type of toilet facility, age of head of household, wealth index of households, presence of diarrhea recently, presence of fever recently, presence of cough recently, vaccination status, residence, region of residence, religion, HH size number of under five children in the HH. Description for explanatory variables is given below:

Table1: Description of explanatory variables.

Variables	Expected outcome	Categories
Residence of households (residence)	Positive	1=Rural 0=Urban
Household wealth status (wealth)	Negative	0=rich 1=middle 2=poor
Mothers' education level (edcnm)	Negative	0=Higher 1=no education 2=primary 3=secondary
Radio access (radio)	Negative	0=have radio

		1=not have
Television access (television)	Negative	0=have television
		1=not have
Household size (hhsize)	Positive	Continuous
Toilet access (toilet)	Negative	0=have toilet
		1=No
Child sex (chldsex)	Positive	0=Male
		1=Female
Water status (water)	Positive	0=safe water
		1=Unsafe
Ever had Vaccination? (vacint)	Positive	0=Yes
		1=No
Had diarrhea recently?(diarha)	Positive	0=Yes
		1=No
Had fever recently? (fever)	Positive	0=Yes
		1=No
Had cough recently? (cough)	Positive	0=Yes
		1=No
Electric access (electric)	Negative	0=Yes
		1=No
Use contraceptive (contrcp)	Negative	0=Use
		1=No
Distance to health Services (disthlth)	Negative	0=Not big problem
		1=Big problem
Health access (healthacce)	Negative	0=Yes
		1=No
Marital status (martst)	Positive	0=married
		1=separated
Father education (fthredcn)	Negative	0=higher
		1=No education
		2=primary

		3=secondary
Get money for treat	Negative	0=Not big problem
(getmany)		1=Big problem
Age of Household head	Negative	Continuous
(Hhage)		
Household head sex	Male(Negative)	0=Male headed
(hhsex)		1=Female
Region of residence (region)		1=Amhara
		2=Harari
		3=Somali
		4=Benishangul-Gumuz
		5=Oromia
		6=SNNP
		7=Affar
		8=Addis Ababa
		9=Dire Dawa
		10=Tigray
		11=Gambela

3.3.4. EMPIRICAL MODEL

Based on the data provided by the EDHS Surveys, the writers specify the reduced form function (4) into an empirical model, where nutritional status of the individual child, represented by the variable NUTSTA, is expressed as a logit function of socioeconomic determinants:

NUTSTA= H (wealth, region, Residence, water, chldsex, vacant, edcnm, toilet, electric, religion, radio, television, hhsize, diarha, fever, cough, fivunder, Hhage, hhsex, contrcp getmany, disthlth, healthacce, martst, fthredcn, chdmnth2), (5)

Where the variables were as defined in table1.

The model includes a dummy variable for sex, a characteristic representative of the individual child's endowments, as well as dummies for access to safe water and access to sanitary toilet facilities, and access to electricity to capture the effects on nutrition of endowments to the household and to the community. A variable measuring household wealth index is also included to measure effects of the budget constraint, taken as proxies for nutrient intake. Moreover, variables representative of characteristics of the mother are included like contraceptive usage status to control for the effects on nutrition of on family planning action, age and schooling to examine effects of education and accumulation of experience, and marital status of mothers to look into possible effects of social capital.

CHAPTER FOUR

4. RESULT AND DISCUSSIONS

4.1. DESCRIPTIVE STATISTICS

Table 2.1-2.7 below presents the distribution of the sample according to attributes of the child and household and environmental characteristics. A total of 9622 of children aged five years and below were considered in this study.

Location

Households were also classified by location as urban or rural, in other way they can be also categorized based on the region they live. This variation of location expected to have influence on children nutritional status. Out of the total children 83.99% were taken from rural part of Ethiopia and the remaining 16.11% were from urban areas. The sample were obtained from all 9 regions and 2 administrative cities of Ethiopia.

Table 2.1: Environmental characteristics of children aged 0-5 years, Ethiopia. (n =9622)

Variables	Frequency(n)	Percentage
Residence		
Urban (0)	1540	16%
Rural(1)	8082	84%
Region		
Amhara	1065	11.07%
Harari	511	5.31%
Somali	761	7.91%
Benishangul-Gumuz	833	8.66%
Oromia	1513	15.72%
SNNP	1370	14.24%
Affar	899	9.43%
Addis Ababa	322	3.35%
Dire Dawa	587	6.10%
Tigray	1074	11.16%
Gambela	687	7.14%
Total	**9622**	**100%**

More than half of (51.63%) of the sample children were taken from four regions i.e., Oromia (15.2%), SNN (14.2%), Amhara (11.07%) and Tigre (11.16%). The minimum sample of children was taken from Addis Ababa (3.35%) and Harari (5.31%).

Household economic welfare

Households were categorized based on their wealth index status. Around thirty four percent of the total households were rich and the rest 49.36% and 16.56% of the households under study were categorized as poor and middle respectively.

Table 2.2: Household economic characteristics (n =9622).

Variables	Frequency(n)	Percentage
Wealth status		
Rich (0)	3280	34.01%
Poor(1)	4749	49.36%
Middle(2)	1593	16.63%

Household composition and education/knowledge

The average age of household age was 37 years. Average household size for the sample was 5.69. About 89% of households' heads were male, who were also typically the fathers of the children. Muslim households account 47.84% and orthodox, catholic and protestant accounts 31.52%, 0.94% and 19.70% respectively.

Out of the interviewed children's mothers 69.76% were not educated to mean that couldn't write and read. Very few mothers, 1.65% and 3.19% of children mothers were attained higher and secondary education level respectively. Most (88.18%) of children mothers were married. Almost one quarter of the total mothers (25.40%) were at primary education level. Around 36.5 % of children's mothers were used contraceptive. Among the whole children's fathers at least half of them (52.81 %) had no any education. Small proportion of fathers have attained higher education program (4.03%) and secondary education program (6.58%) but the rest 36.58% were dropped out at primary education level.

Table 2.3: Household composition and education/knowledge characteristics (n=9622)

Variables	Frequency(n)	Percentage
Mother education		
Higher(0)	**159**	**1.65%**
No education(1)	6712	69.76%
Primary(2)	2444	25.40
Secondary(3)	307	3.19%
Marital status		
Married (0)	8485	88.18%
Separated(1)	1137	11.82%
Father education		
Higher(0)	388	4.03%
No education(1)	5081	52.81%
Primary(2)	3520	36.58%
Secondary(3)	633	6.58%
Household head sex		
Male (0)	7884	81.94%
Female(1)	1738	18.06%

Child information

About 51.2% of children in the study were male. Around 1.33% of children were found between 0 and 12 months of age. And also 18.33% and 19.77% of children were found between 13 and 24 and between 25 and 36 months of age. The rest 39.57% of children were found between 37and 59 months of age. The mean ages of children were 29.48±17.21 standard deviation (SD) with a range of 59 months [0.59]. Based on the respondents response 56.82% of children had ever vaccinated.

Table 2.4: Child characteristics (n=9622).

Variables	Frequency(n)	Percentage
Age of child in month		
0-12(1)	128	1.33%
13-24(2)	1764	18.33%
25-36(3)	1922	19.77%
Greater than 36(4)	3808	39.57%
Child sex		
Male (0)	4909	51.02%
Female(1)	4713	48.98%
Ever had Vaccination		
Yes(0)	5467	56.82%
No(1)	4155	43.18%
Total	**9622**	**100%**

Access to information

Ownership of radio and TV was used as an indicator of access to communication infrastructure, which may be used as an indicator of access to communication infrastructure, which may be

Table 2.5: Households access to communication infrastructure (n=9622)

Variables	Frequency(n)	Percentage
Radio access		
Yes (0)	3565	37.05
No(1)	6057	62.95%
Television access		
Yes(0)	897	9.32%
No(1)	8725	90.68%

expected to facilitate the acquisition of nutritional information and could influence the nutritional status of children. Only 37.05% which is less than half of the total households have radio access. Similarly, very few (9.32%) of the households had television.

Access to services

Availability of safe source of drinking water, sanitation facilities, and electric power access and health services expected to influence underweighting and stunting. About 47.65%, of households

Table 2.6: Households access to Public and private services (n=9622)

Variables	Frequency(n)	Percentage
Toilet access		
Yes(0)	4585	47.65%
No(1)	5037	52.35%
Water status		
Safe(0)	3538	36.77%
Unsafe(1)	6084	63.23%
Electric access		
Yes (0)	1659	17.24%
No(1)	7963	82.76%
Distance to health		
Not big problem(0)	2455	25.51%
Big problem(1)	7167	74.49%
Health access		
Yes(0)	45	0.47%
No(1)	9577	99.53%
Get money for treat		
Not big problem(0)	2890	30.03%
Big problem(1)	6732	69.97%

had either a flush or pit latrine while 17.24% had a safe source of drinking water (which includes tap water and protected wells/ springs). About 17.24% of households had electric power access at their home. Distance to public health facilities was used as an indicator of access to public health. Almost one quarter (74.48 %) of the households said that distance from public health services were their big problem and 69.96% had big problem of finding money for treat.

Child illness

Of the total sample 15.65% and 19.95% had diarrhea and fever in the two weeks period before the survey respectively. Similarly, 20.62 % of children had cough in the same period.

Table 2.7: Child recent health characteristics (n=9622)

Variables	Frequency(n)	Percentage
Had diarrhea recently		
Yes (0)	1506	15.65%
No (1)	8116	84.35%
Had fever recently		
Yes(0)	1920	19.95%
No(1)	7702	80.05%
Had cough recently		
Yes(0)	1984	20.62%
No (1)	7638	79.38%

Anthropometric measures

Among the whole children 35.34 % (3400) were underweight. (See Table 4 in the appendix). Out of the underweight children 98.2% were found in rural Ethiopia. From the total children 25.03% and 58% of children who were underweight were from rich and poor households respectively. Most of the uneducated mothers' children were vulnerable to underweight problems; it accounts 77.26% of the whole children under study relatively. In other way, children whose mothers have attended higher education and secondary education accounts small

proportion of children 0.26% and 1.38% respectively. The rest 21.1% of underweight children mothers were terminate their education at primary level. (See Table 4 in the Appendix)

From a total of underweight children 31.47% and 3.44% of children family had radio and television respectively. Those 40.5% and 35.29% of underweight children had toilet and safe water access respectively. 52.26% of underweight children were male and 58.44% were vaccinated. Out of the total underweight children 19.59%, 23.97%, and 22.29% of children had diarrhea, fever, and cough recently respectively. (See Table 4 in the Appendix)

Distributions of underweight children were different from region to region. The highest number of underweighting children was found in Oromia region, it accounts 14.12% of the total underweight children in Ethiopia. Following Oromia SNN accounts 13.68% and Tigray 13.38% of the total underweight children in the country. Amhara and Affar region underweighting children also covered 12.88% and 12.26 % of the total underweighting children between age 0 and 59 months. The rest five regions and two administrative cities were account 33.6% of the total underweighting children. Even if most of underweighting children were found in Oromia and SNN regions as compared to the number of their population it is lower than Tigray, Amhara and Affar regions. A bivariate chi-squared test of homogeneity also suggests that there is a high degree association between each covariates and underweighting except child sex type and sex of house hold head. (See Table 4 in the Appendix).

The result show that 37.03% of children were stunted (their z-score less than -2 SD). Most of the stunted children (90.82%) were found in rural part of Ethiopia. About 58 % of the stunted children were found in those four regions, i.e, southern nations and nationalities (15.16%), Oromia region (15.04%), Tigray region (13.81%), Amhara region (13.36%). In other way, those administrative cities, Addis Ababa and Dire Dawa were account 1.37 % and 5.47% of stunted children in the country, which was the smallest. (See Table 4 in the Appendix)

Almost half (48.50%) of stunted children were found between age 3 year (37 month) and 5 year (59 months). Few(7.02%) of the stunted children were infants (age less than or equal to 1 year) and 23.29% of stunted children were found between age 2 year(25 months) and 3 year(36 months). Among the whole stunted children 52.37% were males and the remaining 47.63% were

female. Seventeen percent (17.01%) and 21.10% of the stunted children had diarrhea and fever recently. (See Table 4 in the Appendix)

Among the stunted children 67.36% of their families had no radio access but the remaining 32.64% had radio. Similarly, households had no television access accounts 96.27% of the stunted children. In addition, those household had not electric power access holds 89.76% of the stunted children and 64.86% of the stunted children had no safe water access. More than half (56.38%) of the stunted children had no toilet access. More than half (60.03%) of stunted children were vaccinated and the rest were not vaccinated. (See Table 4 in the Appendix)

Many of the stunted children mothers were not educated; 76.11% of the stunted children mothers had no education. In contradiction, the prevalence of stunting with children whose mothers' attained higher education was very small it holds 0.45% of the stunted children. Among the stunted children 67.42% of children were found from mothers who didn't use contraceptive and the remaining 32.58% of stunted children mothers were used contraceptive. About 88.44% of the stunted children mothers were married and the remaining 11.56% were separated.

Children whose fathers attend higher education program were hold 1.91% of the stunted children; it is relatively very little in number. Conversely, highest number (58.97%) of stunted children fathers were not educated (could not write or read). (See Table 4 in the Appendix)

Household with middle income status were account 17.54% of the stunted children, comparatively few portions of the stunted children. In contradiction, highest proportion (55.85%) of the stunted children households was poor. About 78.05% of the stunted children households said that distance to health services is their big problem and 99.72% of the stunted children households have no any health service near them. Almost seventy three percent (72.33%) of the stunted children had a big problem of money for treatment when they were ill. The chi-squared test of homogeneity also suggests that there was a high degree of association between each covariates and stunting except sex of the household head, marital status of mothers and presence of cough recently. (See Table 4 in the Appendix)

4.2. DETERMINANTS OF NUTRITIONAL STATUS OF UNDER FIVE YEARS OLD CHILDREN IN ETHIOPIA

4.2.1. DETERMINANTS OF UNDERWEIGHTING OF CHILDREN FOR THE WHOLE SAMPLE

Table 6 in the Appendix showed the bi-variable logistic regression output showing factors associated with underweighting of children age five and below in Ethiopia. According to these result predictors which have a p-value greater than 20% were rejected from the model. Household sex whether male or female, size of household and number of under five children in the household had p-value greater than 20% , thus this variables were omitted from the multivariable model.

After fitting the multivariable model we select a variable by using stepwise selection method by using STATA version 12 and the final logistic regression model was fitted and the final output was presented in table. Only 13 variables were remained after variable selection was taken place and the rest were removed from the final logistic fitted model.

Factors associated with nutritional underweighting were shown in Table 3 below. The wealth index of households, educational status of mothers, radio, television (satisfactory media exposure of mothers) and toilet access of households, electric access, presence of diarrhea and fever recently, age of children in month, mother contraceptive usage and region of residence were significantly associated at 5% significance level with nutritional status of children after controlling for other predictors in the model. The analysis result above showed that, as compared with children from Households with rich wealth index, children of poor and medium households were 1.19 and 1.06 times more likely to be underweight respectively. The risk of underweighting was decreasing with increasing education level of mothers. The odds of underweighting among children whose mothers have had no education and primary education were also 3.88 and 3.5 times more compared to with children whose mothers had have higher education status. In addition children belong to had secondary education mothers have 2.8 times risk of having underweight compared to those had higher education status mothers.

Table 3: Multivariable logistic regression results for factors of weight for age Z-score for the whole sample.

```
. logistic weightage i.disthlth i.contrcp i.electric i.fever i.diarha i.vacint i.chldsex i.toilet i.television i.radio i.edcnm i.wealth i.chd
> mnth2 i.region

Logistic regression                             Number of obs   =       9622
                                                LR chi2(28)     =    1190.94
                                                Prob > chi2     =     0.0000
Log likelihood = -5654.0202                     Pseudo R2       =     0.0953
```

weightage	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
1.disthlth	1.100186	.0642444	1.64	0.102	.981208	1.233592
1.contrcp	1.239246	.0674463	3.94	0.000	1.113861	1.378747
1.electric	1.30493	.1323303	2.62	0.009	1.069716	1.591864
1.fever	.7433633	.0447155	-4.93	0.000	.6606916	.8363796
1.diarha	.6448506	.0430243	-6.58	0.000	.5658054	.7349387
1.vacint	.9356057	.0433831	-1.44	0.151	.8543258	1.024619
1.chldsex	.9352856	.0424682	-1.47	0.141	.8556458	1.022338
1.toilet	1.122379	.0626793	2.07	0.039	1.006014	1.252203
1.television	1.837729	.2446145	4.57	0.000	1.415731	2.385516
1.radio	1.131613	.0586031	2.39	0.017	1.02239	1.252504
edcnm						
1	3.888554	1.387281	3.81	0.000	1.932473	7.824614
2	3.5014	1.249134	3.51	0.000	1.740096	7.045475
3	2.827959	1.094473	2.69	0.007	1.32447	6.03815
wealth						
1	1.191876	.0863781	2.42	0.015	1.034052	1.373788
2	1.057953	.0831952	0.72	0.474	.9068376	1.234249
chdmnth2						
2	4.350866	.3432187	18.64	0.000	3.727594	5.078353
3	4.723872	.3675408	19.96	0.000	4.055742	5.502066
4	3.558444	.2526006	17.88	0.000	3.096253	4.089627
region						
2	.7320707	.098725	-2.31	0.021	.5620337	.9535504
3	.7321547	.0780018	-2.93	0.003	.5941801	.9021685
4	.9237431	.0924927	-0.79	0.428	.7591401	1.124037
5	.731975	.0648934	-3.52	0.000	.6152233	.8708829
6	.7718753	.0699138	-2.86	0.004	.646321	.9218197
7	1.077294	.1103333	0.73	0.467	.8813663	1.316775
8	.4995131	.1114672	-3.11	0.002	.322552	.77356
9	.9498414	.1116065	-0.44	0.661	.7544576	1.195824
10	1.144999	.1064008	1.46	0.145	.954346	1.373739
11	.4192476	.0488125	-7.47	0.000	.3337077	.5267141
_cons	.0316643	.0118401	-9.23	0.000	.0152154	.0658955

The results also show that children residing to radio and television owner households have lower risk of underweighting. The risk of underweighting belongs to children whose HHs had no television was 1.84 times of children belong to HHs had television. In the same way, children whose HHs had no radio was 1.13 times odds of underweighting than children whose HHs had radio. Children in the age group 13-24, 25-36 and 36-59 months were found to be at higher odds of stunting as compared with children in the age group 0-12 months. The odds of underweighting were 4.7 times for children in age groups 25-36 months compared to 0-12 months of children. The risk of underweighting is 3.56 for children found in the age group 36-59 months as compared to children in the age group 0-12 months. Relatively, children found in the age group 25-36 months (from 1 to 2 year) had the highest risk of underweighting. (See Table 3 above)

The likelihood of being underweighting was found to be 1.12 times among children of families without toilet access compared with children whose families had toilet access. The results also showed that morbidity of children had positive influence on underweighting of children. As compared with children who had no diarrhea and fever recently (before two weeks), the odds of underweighting 0.64 and 0.74 times of underweighting than children who had diarrhea and fever recently respectively. Children whose mothers never used contraceptive have 24% more odds of having underweight than children whose mothers used contraceptive. (See Table 3 above)

Children residing in different region have different chance to be underweight. Children living in Harari, Somali, oromia, SNNP and Addis Ababa regions have a significant difference of odds of stunting with Amhara region children. The odds of children living in Harari, Somali and oromia region being stunted were 0.73 times children living in Amhara region. Which was less than one indicate that these region children have 27% chance to be better off than Amhara region children. The risk of Addis Ababa children to be stunted was decreased by half as compared to Amhara region children. (See Table 3 above)

4.2.1.1. DETERMINANTS OF UNDERWEIGHTING OF URBAN CHILDREN

Predictors of underweighting of urban children were shown in Table 9 in the Appendix. According to the result, Electric power and television access, mother education attainment,

wealth index of households, and child age in month were significantly influence weight for age Z-score of children aged five years and below in urban Ethiopia at 5% significance level.

In urban the households without electric power service have 1.57 times risk to be underweight than the households with electric access. The odd ratio slightly increased relative to the whole sample analysis above when rural and urban were considered together. In the same way, those households didn't have television will have 1.79 times more likely to be underweight relative to households own television. (See Table 9 in the Appendix)

Mother education attainment level significantly affects underweighting. With increasing education attainment of mothers', children chance of stunting was decreased. The odd of non-educated mother children relative to higher education attained mother to be underweight was 5.82. Similarly, children whose mothers were secondary school attained have 3.38 times odds to be underweight relative to children from higher education attained mother. Surprisingly there was no a significant odds difference in urban between poor and rich household children. But children from households with middle wealth status will have 2.4 odds to be under weight than rich household children.

Similar to non-separate analysis the risk of children to be underweight increased with increased age of children. Children between 13 and 24 months will have 4 times chance to be underweight than Children between 0 and 12 months. Similarly, Children between 36 and 59 months will have 4 times chance to be underweight than Children between 0 and 12 months. (See Table 9 in the Appendix)

The logistic regression also shows that there was a significant regional difference for odds of underweighting of children. Urban of Affar and Benishangul-Gumuz, Amhara, and Tigray region children have relatively higher chance to be underweight respectively. (See Table 9 in the Appendix)

4.2.1.2. DETERMINANTS OF UNDERWEIGHTING OF RURAL CHILDREN ONLY

Similar procedure was followed as the whole sample analysis to fit the final appropriate model for rural sample data. The multilevel logistic regression result for weight –for age Z- score was

given in Table 8 in the appendix. The weight-for age Z-score (measure of underweight) for rural children of Ethiopia was significantly affected by father education attainment level, distance to health services, contraceptive usage status of mothers, presence of fever and diarrhea recently, toilet access, radio and television access of households, wealth index of households and child age in month.

Rural children whose fathers were non-educated had 1.70 times risk to be underweight than rural children whose fathers were higher education attained. Secondary school attained fathers children in rural also have similar risk level with uneducated fathers when compared with higher education attained fathers. Rural children whose families have big distance problem to rich health service stations were 1.17 times vulnerable to be underweight than rural children whose families had health service near to them. Contraceptive usages have a positive influence on nutritional status of children in rural Ethiopia. In rural children whose mothers never use contraceptive were 1.23 times exposed to under nutrition than rural children whose mothers use contraceptive. Morbidity of children recently has also a significant contribution on children under nutrition in rural children. In our study we find that, rural children which have diarrhea and fever recently have 36.81% and 27.29% more chance to be underweight than rural children without these diseases respectively. Rural children whose families had no toilet access were 1.14 times exposed to under nutrition than children rural children whose families had toilet access. Those households without television and radio access children in rural have 1.71 and 1.13 times odds respectively than rural households with television and radio access children. Like urban, age of children have a significance influence on rural children but the effect was large in rural. Rural children whose ages were between 13 and 24 months were 4.40 times more exposed to under nutrition than rural children with ages between 0 and 12 months. The risk of being underweight of rural children between age 25 and 36 months was 5 times more than rural children between age 0 and 12 months. Older children who were between 37 and 59 months of age were 3.70 times more vulnerable to underweighting than rural children between age 0 and 12 months. Rural children who were obtained from poor households have 24.72 % more chance to be underweight than rural children from rich households. There was no significant difference between middle wealth status and rich household children in urban. (See Table 8 in the Appendix)

Some variables which was significant in urban was became insignificant predictor to nutritional status of rural children. For example, in rural area the effect of electric power access on child nutrition was insignificant while it was significant for urban children. In other way, distance to health service became very significant predictor for child underweighting in rural even if its effect was insignificant in urban and combined analysis. Presence of fever recently was also another significant factor of underweighting for only rural children.

4.2.2. DETERMINANTS OF STUNTING OF CHILDREN FOR THE WHOLE SAMPLE

In the bivariate model (Table 7 in the Appendix) except HH head sex, marital status, number of under five children in the HH, children had cough recently all variables were significant at 0.2 level of significance. Thus, we ignored these variables from the multivariable model and we fitted the model by using the remaining variables. We used stepwise variable selection method with the help of STATA version 12 and again some variables were ignored and the final logistic regression model was fitted.

The final multivariable logistic regression model for the combined sample was presented in Table 4 below. The model result indicated that region of residence, education of mother, economic status of HHs, media exposure like radio access, television access, vaccination status, electric access, contraceptive usage of mother, age of children in month were found to be determinants of stunting.

Education of mother was also important determinants of stunting. Children whose mothers have no education were 2.45 times more likely to be stunted than children whose mothers have higher education. The likelihood of being stunted was also found to be 2.28 times higher among children whose mothers have no education than children whose mothers have attained higher education. Household economic status was also another important variable explaining child stunting. As compared with children residing in households with medium or higher economic status, children residing in very poor and poor households was 1.16 times more likely to be stunted. (See Table 4 below)

The national sample also showed that children whose families have not television were two times more likely to be stunted as compared with children whose families have television. As

compared with children in the age group 6-11 months, the risk of stunting was 72 percent less for children in the age group 0-5 months.

Table 4: Multivariable logistic regression results for height for age Z-score for the whole sample.

```
. logistic heightage  i.disthlth i.contrcp  i.electric i.fever i.diarha i.vacint i.chldsex i.toilet i.television i.radio i.edcnm i.wealth i.c
> hdmnth2 i.region

Logistic regression                             Number of obs   =       9622
                                                LR chi2(28)     =    1444.44
                                                Prob > chi2     =     0.0000
Log likelihood = -5619.7718                     Pseudo R2       =     0.1139
```

heightage	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
1.disthlth	1.06949	.0622231	1.15	0.248	.9542316	1.198671
1.contrcp	1.207638	.0654071	3.48	0.000	1.086013	1.342886
1.electric	1.243298	.1235966	2.19	0.028	1.023192	1.510753
1.fever	.8908708	.054597	-1.89	0.059	.7900396	1.004571
1.diarha	.7344084	.0500686	-4.53	0.000	.6425496	.8393994
1.vacint	.8793697	.0408998	-2.76	0.006	.8027528	.963299
1.chldsex	.915526	.0416689	-1.94	0.052	.8373932	1.000949
1.toilet	1.026451	.0574516	0.47	0.641	.9198043	1.145463
1.television	2.122735	.2733876	5.84	0.000	1.649185	2.732261
1.radio	1.108768	.0573986	1.99	0.046	1.001788	1.227172
edcnm						
1	2.434861	.6845077	3.17	0.002	1.403387	4.224456
2	2.285131	.6417026	2.94	0.003	1.317891	3.962257
3	1.85909	.5847837	1.97	0.049	1.003579	3.443888
wealth						
1	1.158108	.0839978	2.02	0.043	1.004642	1.335018
2	1.07186	.0840486	0.88	0.376	.9191623	1.249925
chdmnth2						
2	6.045048	.5131986	21.19	0.000	5.118425	7.139423
3	6.247379	.5242986	21.83	0.000	5.299837	7.36433
4	6.863426	.531035	24.90	0.000	5.897691	7.987297
region						
2	.6040879	.0817857	-3.72	0.000	.4632959	.7876655
3	.455853	.0502241	-7.13	0.000	.3673185	.5657269
4	.9721271	.0975398	-0.28	0.778	.7985765	1.183395
5	.7567767	.06677	-3.16	0.002	.6366001	.8996402
6	.8441613	.0759612	-1.88	0.060	.7076699	1.006978
7	.9852389	.1017017	-0.14	0.885	.8047776	1.206166
8	.7072342	.1363647	-1.80	0.072	.4846626	1.032017
9	.8061603	.0954805	-1.82	0.069	.6391552	1.016802
10	1.173742	.1095302	1.72	0.086	.9775543	1.409303
11	.341271	.040428	-9.08	0.000	.2705598	.4304626
_cons	.0305524	.0093052	-11.45	0.000	.016819	.0554998

As compared with children in the age group 0-12 months, the risk of stunting was about 1.8 times higher for children in the age group 13-24.The risk of stunting was also 2 times higher for children of 0-12 age group as compared with children with in age group 37-59 months of age. Vaccination status was also significant predictor for stunting. Children who ever vaccinated were 1.14 times more likely to be stunted than never vaccinated children or not ever vaccinated children have 12.12% lower chance to be stunted. Children belong to households without electric access had 1.25 times chance to be stunted as compared to children belongs to households with electric service access. Similarly children whose mothers never used contraceptive have 1.2 times more likely to be stunted relative to whose mothers used contraceptive.

Region of residence was one of the significant factors of stunting in Ethiopia. The odd ratio of being stunted between children living in Harari compared to Amhara region children was equal to 0.6041, meaning that children living in Harari region have 39.59% less chance to be stunted than children living in Amhara region. The odds of Somali children to be stunted were 0.4558 times Amhara children. The risks of Oromia and SNN region children to be stunted were 24.33% and 15.58% less likely relative to Amhara region children respectively. The odd of being stunted for Gambella children relative to Amhara region children was -1.0751. The negative sign indicate that children living in Gambella region less likely to be stunted relative to children living in Amhara region. The odd ratio for Amhara region children relative to Gambella children is exp (1.0751) =2.93, which show that the odds of children living in Amhara region were 3 times children living in Gambella region. The model also showed that children who reside in Tigray, Amhara, Affar andBenishangul-Gumuz regions were more likely to be stunted than children in other regions. (See Table 4 above)

4.2.2.1. DETERMINANTS OF STUNTING OF URBAN CHILDREN

Multiple logistic regression result was shown in Table 11 in the Appendix. Very few variables like television access of households, education of mothers and child age were significant factors for urban children stunting. Most of variables which were significant in non-separate analysis like wealth status of households, vaccination status, presence of diarrhea and fever, and contraceptive usage of mothers become insignificant for urban children.

In urban children from households didn't own television were double times more vulnerable to stunting than urban children from households own television. Mother educations have also a significant influence on stunting of children in urban. Urban children belong to mothers' who have no education have 2.71 times odds to be stunted than children belong to higher education attained mothers. Similarly, urban children belong to mothers who were attained primary school were 2.26 times likely to be stunted. There was no significant difference between urban children whose mothers attained secondary school and urban children whose mothers who attained higher education. The extent of risks to be underweight was increasing with increasing children ages. Children between age 13 and 24 months had 5.48 times risks to be underweight than children between age 0 and 12 months. In the same manner, children between age 25 and 36 months were 4.04 times more vulnerable to be underweight than children between age 0 and 12 months. Children above 36 months of age have also 5.14 times odds to be underweight than children between age 0 and 12 months. (See Table 11 in the Appendix)

In urban children stunting risk is different from region to region. Amhara region children were more likely to be stunted than all urban regions in the country. Children living in Amhara region urban areas were double times more likely to be stunted than children living in Harari, Dire Dawa and Addiss Ababa urban areas. Children living in urban Amhara region were 2.82 (exp (1.03)) times more vulnerable to stunting than urban Gambella region. Urban Affar region children were 31.21% less likely to be stunted than urban Amhara region children. Urban Oromia children will have 58.4% chances to be stunted than Urban Amhara region children keeping other variables constant. Urban Tigray region children were 1% less likely to be stunted than urban Amhara region children when the other variables being constant. (See Table 11 in the Appendix)

4.2.2.2. DETERMINANTS OF STUNTING OF RURAL CHILDREN

Multiple logistic regression result was shown in Table 10 in the Appendix. Rural children stunting was significantly affected by whether mother use contraceptive, presence of diarrhea recently, vaccination status of children, whether households own television, wealth index of households, child age in month. Here in rural mother educational statuses have no significant effect on children stunting but it have in urban. Most of variables like mother contraceptive usage, presence of diarrhea recently, vaccination status of children and wealth index of

households which have no effect on child stunting of urban children have effect on rural children.

Those rural children came from mothers who never used contraceptive was 1.204 times more likely to be stunted than rural children came from contraceptive user mothers. Early morbidity of children has effect on children stunting. Rural children without recent diarrhea were 28.06% less likely to be stunted than rural children with recent diarrhea. Child vaccination is also become significant contributor for child stunting even if its effect was insignificant for underweighting. Rural vaccinated children were 13.5% less likely to be stunted than rural children never vaccinated. Rural children who obtained from households didn't own television were double times more likely to be stunted than rural children obtained from households without television access. Like underweighting household wealth index have also a significant influence on child stunting in rural children. Those children whose families were poor had 1.19 times risk to be stunted than rural children whose families were rich. There was no significant difference in stunting between children who were from rich households and poor households in rural.

Like in urban children rural children stunting is affected by child ages and the extent is high in rural than urban. The risks to be stunted were increased when the age of child increased. Rural children whose ages were between 13 and 24 age in months were 6 times more vulnerable to child stunting than rural children between 0 and 12 months of age. Similarly, the risks to be stunted were grown to 6.5 and 7 when children become between age 25 and 36 months and greater than 36 months. (See Table 10 in the Appendix)

The extents to be stunted among different region of rural Children were also significantly different. Rural Harari, Somali, Oromia, and Gambella region children have significant difference on stunting when compared to rural Amhara children. Children from rural Harari were 42.3% less likely to be stunted than children living in rural Amhara region. Similarly the risks of children who live in rural Somali region to be stunted will be minimized by half compared with children living in rural Amhara region. Children living in rural Oromia region was 20% more in favor no to be stunted than children living in rural Amhara region. Children who were from rural Gambella were better off than other regions. Children from rural Amhara region were 2.68 times more volunerable to stunting than children living in rural Gambella region. Those regions like rural Tigray, Affar, and Benishangul Gumuz region shows higher risks of stunting compared to

rural Amhara region even if the difference is not statistically significant. (See Table 10 in the Appendix)

4.2.3. MODEL ADEQUACY CHECKING

Once a logistic regression model has been fitted to a given set of data, the adequacy of the model was examined by Hosmer–Lemeshow goodness of fit tests, Log-likelihood goodness of fit test, area under the receiver operating characteristic curve. The test shows that the fitted model adequately describes the observed outcome experience in the data for the three models we used. (See Table 12 and 13; Figure1-4 in the appendix).

4.3. RESULT DISCUSSIONS

This study assess factors of the two measure of nutritional status of under five children namely weight-for age-Z score and height for-age Z-score. According to the findings 1 0ut of three (35.34%) of under five children were underweight and 37.03% were stunted. This figure show improvement or reduction compared to the earlier 2006 EDHS report.

Though the bivariate analysis shows significant urban-rural differentials in underweighting and stunting, this difference disappears in the multivariate model. This result agreed with Girama et al. (2002) and Alemu et.al. (2005). This result may happen because of that in the presence of important socioeconomic variables area of residence alone is not a predictor of nutritional status of children. However it should be noted that these socioeconomic variables are manifested differently in the urban and rural areas.

Finding of this study showed that the risk of stunting and underweighting increased with age of children in the three analyses taken place. This is not surprising, since stunting is a cumulative process that occurs over the course of many insults of dietary inadequacy and/or illnesses. This finding was in consistent with the findings of Giram et al. (2002). Giram et al. (2002) showed that children in the youngest age group, 0-5 months, were at a significantly lower risk of stunting as compared with children in the older age groups. This low risk of stunting may also be due to the protective effect of breastfeeding, since almost all children of this country are breastfed and most continue to breastfeed during their first year of life. Consistent with other studies (Kandala, et al. 2007; Khalid, 2006; Mohammed, 2008; Tesfaye, 2009;Yimer, 2000; Genebo,

1999; Samson and Lakech, 2000) in Ethiopia, this study has also shown a high risk of stunting among children age 12-23 months as compared with children in the age group 6-11 months. This may be an indication of either inappropriate food supplementation in quantity and/or quality during the weaning period, or exposure to disease. However, it should also be noted that at this point the mode of height measurement changes from lying down to standing up, and children may appear to shorten; some of the increased stunting may be as a result.

We also find that there a significant and positive association with wealth index and nutritional status (underweighting and stunting) in urban areas, but the association was not significant in rural areas. This result coincides with the findings of Girma et al. (2002) and Alemu et al. (2012).This insignificancy may partly be because that nature of the wealth index we used for this study is more sensitive to urban wealth indicator than rural ones.

Our study results reveal that educational attainment of mothers did not exert any positive impact on rural childhood nutrition, contrary to numerous previous studies, when it was estimated together with education of fathers. On the other hand, both primary and secondary schooling of fathers positively correlated with children's height- and weight-for-age, this could be because educated females migrate to urban areas to work since there were no formal institutions in rural areas to get employment. For example in our study there were only 26 and 64 mothers who attained higher education and secondary school education respectively reside in the rural area. This result corroborate with the findings of the study done in Japan by Kamiya (2011) and are in sharp contrast with the studies done in the case of Ethiopian households by Alemu et al.(2012); Tesfaye(2009) and Sentayehu (1994). There are also some studies which could not find a significant relationship between female's education and child nutritional status and various reasons could be held responsible to this result. According to SCUK (2002), for instance, this could be because, although educating mothers (and other care givers) will undoubtedly lead to an improvement in the way some young children are cared for, many mothers will never be able to act on their new knowledge because they are simply poor. This means that poverty could cause bottlenecks, not allowing other public policies to influence child health (Attansio et al., 1992). Small-scale studies in Ethiopia have also shown the importance of maternal education to child nutrition (Kandala, et al. 2007; Khalid, 2006; Mohammed, 2008; Genebo et al., 1999; and Yimer, 2000).

The coverage of radio and/or television, which represented the communication infrastructure providing information about child health improvement, was statistically significant for all the weight-for-age Z-scores and height-for-age Z-scores of rural children. For urban children only television possession has significant negative effect on stunting. The results also suggest that ownership of a television has a significant negative effect on underweighting and stunting of both rural and urban children. This result is in contradiction with the study done by Alemu et al. (2012). Their result shows that ownership of television has positive effect on nutritional status of urban and opposite result for rural. This may happen because today households who use television in urban and rural are increased. For example in our sample 764 and 776 households in urban and rural own television, but in the previous research of Alemu etal. (2012) only one individual had television in rural. Our finding is also in contradiction with the study done by Kamiya (2011) in Japan.

Finding of this study showed that use of family planning tools has negative effect on children underweighting and stunting for rural children and combined but have no effect for urban children. This may be due to the overlapping nature of education of mothers and habit of use of contraceptive methods. Education improves the ability of mothers to implement simple health knowledge and facilitates their capacity to use contraceptive. To my knowledge even if there were no one who used contraceptive as malnutrition factor Senauer and Garcia (1991) show house hold size have a significant positive effect on height. Kamiya (2011) in Japan showed that the number of children per household has no significant effect on child nutritional status.

The study result showed that presence of recent diarrhea and fever has a positive effect on underweighting in urban and rural children. In other way, presence of recent diarrhea and fever were not significant on whole and urban children stunting. But in rural areas presence of diarrheal disease recently shows significant positive effect on stunting. Since stunting is a long-term effect that occurs after repetitive dietary inadequacy and/or illnesses, it may not be affected by presence of recent diseases. In rural areas, there is possibility of diarrhea affecting children repetitively. Sommerfelt et al. (1994A) also indicated that stunting was highest among children with recent diarrhea.

Our findings indicate that there is strong negative correlation between underweighting and the presence of a latrine in rural and whole sample children which is consistent with the findings of

Kesitegile (1994). Though the bivariate analysis showed a positive association between child stunting and the availability of safe drinking water or toilet facility, the significance of these variables disappears in the multivariate model. Since water and sanitation are not only environmental measures but may also be proxies for economic status, in the multivariate model there were more direct measures such as education and wealth index that may override these less precise measures which are in line with the findings of Alemu et al. (2011); Kandala et al. (2001) and Woldemariam & Timotiows (2002).

The study further reveals that vaccination of child has a positive effect on stunting for whole sample children and rural children but insignificant for urban children. The result is in sharp contrast to our expectations. This may be due to the vaccination of children, as it itself has no role in minimizing stunting rather providing food and other facilities is more important.

Based on our finding, Tigray, Amhara and Benishangul-Gumuz regions children aged five years and below show high risk of stunting and underweighting. The observed higher risk of malnutrition in Tigray, Amhara and Benishangul-Gumuz regions may be due to differences in economic levels, and cultural and dietary practices. Earlier surveys have also shown a very high prevalence of stunting in these regions (CSA, 1998; CSA, 2007). According to 2013 MOFED report in terms of food poverty, the highest poverty is observed in Amhara followed by Tigray and Beneshangul Gumuz (MOFED, 2013). These figures are consistently similar in extent of malnutrition of children in the country. One reason to have high malnutrition prevalence Amhara, Tigray and Benishangul-Gumuz region may be due to food poverty prevalence in the region. In contrast, those regions like Harari and Addis Ababa Administration children have low risk to be stunted and underweight, because these regions are relatively better in economy and food access according to 2013 MOFED report. Our finding was also in line with the study done by Girma et al. (2002).

CHAPTER -FIVE

5. CONCLUSIONS AND POLICY IMPLICATIONS

5.1. CONCLUSIONS

In this study predictors of nutritional status of children aged five years and below have been assessed using cross sectional data obtained from EDHS (2011). We used the two measures of nutritional status namely weight-for- and height-for-age Z-scores. The former one indicates status of infants whether they are underweight or not, it measures short and long run impacts of malnutrition. But height/age indicate status of infants stunting, it measures long run impacts of malnutrition.

9622 children age between 0 and 59 months were considered for the present study. Out of these children 35.34% and 37.03% were underweight and stunted respectively. Most of the underweight and stunted children 98.2% and 90.2% respectively were found in rural Ethiopia. Male and female distribution of malnutrition is not that much dispersed in Ethiopia. Tigray, Amhara and Affar regions were found to be the most affected by child stunting and underweighting.

A bivariate chi-square test of homogeneity showed that except child sex type and sex of house hold head, there was a high degree of association between each covariate and underweighting. Similarly, except presence of recent cough and household head sex, all the remaining covariate had strong association with child stunting. Even if most of the variables have strong association in the bivariate analysis some variables didn't show significant correlation with underweighting and stunting of children aged five years and below in the multivariable logistic regression. For example household residence had no significant correlation with children underweighting and stunting. Because of the idea that this insignificancy of residence is arise due to confounding effect we decide to see its effect separately for urban and rural. Some variables which were significant in the urban sample logistic regression were found insignificant for the rural sample.

The study found evidence that socioeconomic and demographic variables have a significant influence on child underweighting and stunting. Economic status of households, educational status of a mother, radio, television (satisfactory media exposure of mothers) and toilet access of

households, electric access, presence of diarrhea and fever recently, age of children in month, mother contraceptive usage and region of residence were important determinants of underweighting for the whole children. It was also found that region of residence, education of mother, economic status of HHs, radio access, television access, vaccination status, electric access, contraceptive usage of mother, age of children in month, and region of residence were important determinants of child stunting for the whole children in Ethiopia.

In other way, electric and television access, mother education attainment, wealth index of households, child age in month and region of residence significantly influence underweighting of urban pre-school children of Ethiopia. Rural children underweighting are affected by father education attainment level, distance to health services, contraceptive usage status of mothers, presence of fever and diarrhea recently, toilet access, radio and television access of households, wealth index of households, child age in month and region of residence. Very few variables like television access of households, education of mothers, child age and region of residence were significant predictors for urban children stunting. Rural children stunting were also strongly affected by whether mothers used contraceptive, presence of diarrhea recently, vaccination status of children, whether households own television, wealth index of households, child age in month, and region of residence.

5.2. POLICY IMPLICATIONS

This last section discusses the implications of these findings for policy interventions. The discussion is divided into three factors that relate to the food-based approach, public health approach and gender approach. It concludes with reflections on the importance of developing an inter-sectoral approach to address child malnutrition, including a consideration of social capital variables.

Assure sustainable food security

Our findings confirmed the importance of household income/wealth for child nutritional wellbeing which suggests that, in order to improve child weight for age Z-score and height for age Z-score, the problem must be considered within broader policy programs that focus on income-generation to facilitate household economic wellbeing and the ability to provide children with sufficient food.

In this regard, one crucial concern involves land productivity. Since household wealth index have importance on child nutritional wellbeing indirectly showed that land ownership and, land size have a positive impact on child underweighting and stunting because wealth index is also incorporate this variables as a proxy. Because of greater capacity to produce food, policy interventions will also need to consider alternatives for people with little or no land in rural Ethiopia. Indeed, land shortage is a problem across many of the Young Lives survey sites. Our study finding also showed that Amhara, Tigray, Benishangul-Gumuz and Affar region shows high rate of malnutrition. Based on 2013 MOFED report most of the population which were under food poverty line were found in these region. This is an indication that food poverty is the main cause of malnutrition in Ethiopia. Thus assuring sustainable food security is a main task for government, individuals and concerned body in order to minimize the risk of child malnutrition in the country.

Currently, the government is undertaking initiatives to promote resettlement programs as part of its food security strategy. Destitute people are moved under the New Food Security Programme from drought-prone food insecure areas to uncultivated non-drought-prone areas within the same regions (MoRD, 2003). While proponents of this programme argue that it will help to solve the issue of insufficient land size and infertility of soil, particularly in the highland areas, other observers are more cautious because the efficacy and outcomes of the strategy have not yet been established. There were also many deleterious impacts of a similar scheme carried out under the Derg in the 1980s. The concern is that people are being moved to uninhabited, malarial areas where basic services are undeveloped. It will therefore be imperative to monitor carefully the impacts of resettlement on children and their families. In order to support poor to improve nutrition status of children policies should

- ✓ Creating job opportunities in the rural and urban areas of Ethiopia in order to increase income status of households.
- ✓ Introducing modern farming system to farmers instead of backward and uncivilized farming system. This includes provision of fertilizers, selected seeds, irrigation construction etc.
- ✓ Implementing resettlement programs broadly with provision of health, social and other basic services to the new settlement.

- ✓ Leaving tax on domestic and imported food items, imported agricultural equipment used to produce food staples like tractor and so on.
- ✓ Any export of basic food staples should have to be stopped and domestic produced staples should provide only for domestic consumption.
- ✓ Creating smooth-functioning of labour market and broad income-generating opportunities for the unskilled labour rural population.
- ✓ Provision of loan for the poor in order to create job by them and encourages new entrepreneurs.
- ✓ Strengthen the safety net program implementation.
- ✓ Make favorable conditions for those private institutions and individuals to cooperate and support the poor.

Provision of public services

Health problems, especially parasitic and diarrhoeal diseases, can be further exacerbated by poor environmental conditions, including unsafe water supplies. Our findings show that those children who have diarrhea and fever recently have high risk of malnutrition. Our results also showed children with access to toilet facility appeared to be less stunted and underweighted. Although our results counter-intuitively found that children with access to a clean water source appeared to be insignificant, we expect that it is related to an unaccounted for confounding variable and would therefore not wish to downplay the importance of sanitation services in contributing to better child health outcomes. The findings reveal that children with no access of electric are more underweighted and wasted. Government should address electric access to remote rural areas and urban. Contraceptive user women children are less underweighted and stunted. Parental education (father and mother educational attainment level) show a strong positive effect on nutritional status of children as our finding showed. Thus government, non-governmental organizations and individuals should extend their efforts in order to

- ✓ Provide health stations, toilet, sanitation services and clean water access in order to better child health outcomes.
- ✓ Health professionals should provide house to house counseling programs in order to encourage women to use contraceptive.

- ✓ Broadly implementing preventive policy of disease.
- ✓ Provide education for young and adults in the urban and rural areas of the country.

Women Empowerment

While the literature emphasizes the importance of maternal education for child malnutrition outcomes, we found that the maximum schooling level of mothers in the household had a positive impact on child nutritional status. Thus, educating women and launching adult education program is the primary and successful strategy for Ethiopia in order to achieve reduction of malnutrition of children aged five years and below children. It is imperative that the government invest in both girls' education as well as adult education programs which target women. The result also show that women contraceptive use have strong positive effect on nutritional status of children. In order to use contraceptive women's decision making capacity should have to be enhanced. Women to able to decision maker they need their own income source, thus providing job opportunity for women must be the primary strategy of a country.

5.3. RECOMMENDATIONS FOR FURTHER STUDIES

The main area for consideration for further studies is using a dynamic approach in specifying a reduced form relation between health and the inputs to the health production function. A dynamic analysis would not only examine changes to nutritional status across time but also better capture the impact of any such intervention program implemented in the different communities. Since the EDHS Survey is currently being conducted on another round for pilot areas in the country, consistent pooled data may be available for analysis in the near future.

Secondly, more and various other socioeconomic determinants may be sought for and used in studies to be undertaken on the subject of nutritional status. Examples of these other variables are proportion of household members employed, proportion of household members excluding mother employed, availability of credit for household, Households benefit from food aid, total income dummy variables to mark lean months or incidences of calamity, household recent food shortage problem, price levels of food, medicine and other means of healthcare, and precise measures for nutrient intake, such as food intake recall or amount of food purchased.

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APPENDIXES

Table 5: A bivariate chi-square test of homogeneity on nutritional status of under five children in Ethiopia based on different categories of parents (n=9622).

	Nourishment Status					
Variables	**Underweight**	**Not underweight**	**Test of χ^2**	**Stunted**	**Not Stunted**	**Test of χ^2**
Residence						
Urban (0)	312	1,228	182.37**	327	1,213	196.18**
Rural(1)	3,088	4,994		3,236	4,846	
Wealth status						
Rich (0)	851	2,429	206.73**	948	2,332	144.61**
Poor(1)	1,972	2,777		1,990	2,759	
Middle(2)	577	1,016		625	968	
Mother education						
Higher(0)	9	150	196.14**	16	143	160.37**
No education(1)	2,627	4,085		2,712	4,000	
Primary(2)	717	1,727		782	1,662	
Secondary(3)	47	260		53	254	
Radio access						
Yes (0)	1,070	2,495	70.19**	1,163	2,402	47.17**
No(1)	2,330	3,727		2,400	3,657	
Television access						
Yes(0)	117	780	215.14**	133	764	209.12**
No(1)	3,283	5,442		3,430	5,295	
Toilet access						
Yes(0)	1,377	3,208	107.79**	1,554	3,031	36.95**
No(1)	2,023	3,014		2,009	3,028	

Child sex						
Male (0)	1,777	3,132	3.27	1,866	3,043	4.14**
Female(1)	1,623	3,090		1,697	3,016	
Water status						
Safe(0)	1,200	2,338	4.92*	1,252	2,286	6.47*
Unsafe(1)	2,200	3,884		2,311	3773	
Vaccination status			5.65*			23.85**
Yes(0)	1,987	3,480		2,139	3,328	
No(1)	1,413	2,742		1,424	2,731	
Had diarrhea recently						
Yes (0)	666	840	61.72**	606	900	7.88**
No (1)	2,734	5,382		2,957	5,159	
Had fever recently			53.10**			4.69**
Yes(0)	815	1,105		752	1,168	
No(1)	2,585	5,117		2,811	4,891	
Had-cough recently						
Yes(0)	758	1,226	9.01**	740	1,244	0.08
No (1)	2,642	4,996		2,823	4,815	
Electric access						
Yes (0)	319	1,340	227.61**	365	1,294	194.16**
No(1)	3,081	4,882		3,198	4,765	
Use contraceptive						
Use (0)	1,023	2,493	94.42**	1,161	2,355	38.19**
Never(1)	2,377	3,729		2,402	3,704	

Distance-to health services						
Not-big problem(0)	715	1,740	55.65**	782	1,673	37.87**
Big problem(1)	2,685	4,482		2,781	4,386	
Health access						
Yes(0)	8	37	6.10*	10	35	4.25*
No(1)	3,392	6,185		3,553	6,024	
Marital status						
Married (0)	3,041	5,444	7.98**	3,151	5,334	0.35**
Separated(1)	359	778		412	725	
Father education						
Higher(0)	62	326	177.88**	68	320	192.23**
No education(1)	2,037	3,044		2,101	2,980	
Primary(2)	1,168	2,352		1,273	2247	
Secondary(3)	133	500		121	512	
Get money for treat						
Not-big problem(0)	917	1,973		986	1,904	
Big problem(1)	2,483	4,249	23.50**	2577	4155	15.02**
Household head sex						
Male (0)	2,804	5,080		2,932	4,952	
Female(1)	596	1,142	1.01	631	1,107	0.48
Age of children in month						
0-12(1)	341	1,787		250	1,878	
13-24(2)	766	998	480.45**	755	1,009	753.54**
25-36(3)	859	1,063		830	1,092	
>36	1,434	2,374		1,728	2,080	

Regions						
Amhara(1)	438	627		476	589	
Harari(2)	127	384		124	387	
Somali(3)	277	484	146.43**	218	543	292.90**
Benishangul-Gumuz(4)	335	498		362	471	
Oromiya(5)	480	1033		536	977	
SNN(6)	465	905		540	830	
Affar(7)	417	482		410	489	
Addis Ababa(8)	30	292		49	273	
Dire Dawa(9)	198	389		195	392	
Tigray(10)	455	619		492	582	
Gambella(11)	178	509		161	526	
Total	3,400	6,222		3,563	6,059	

*Note: * indicate that significant at 5% significance level and ** indicate significant at 1% significance level*

Table 6: A bivariate logistic regression output showing factors associated with weight-for-age Z-score (status of underweight) of under five children in Ethiopia based on EDHS (2011) data.

Variables	**Coefficients**	**P-value**
Residence		
Rural(1)	0.88943	<2e-16
Wealth status		
Poor(1)	0.70650	< 2e-16
Middle(2)	0.48304	1.8e-13
Mother education		
No education(1)	2.3719	5.45e-12

Primary(2)	1.9343	2.27e-08
Secondary(3)	1.1029	0.00353
Radio access		
No(1)	0.37689	<2e-16
Television access		
No(1)	1.39173	<2e-16
Household size	0.0023	0.801
Toilet access		
No(1)	0.4470	<2e-16
Child sex		
Female(1)	-0.0771	0.0707
Water status		
Unsafe(1)	0.0986	0.0265
Vaccination status		
No(1)	-0.10257	0.0175
Had diarrhea recently		
No (1)	-0.4452	5.42e-15
Had fever recently		
No(1)	-0.3784	3.76e-13
Had cough recently		

No (1)	-0.1563	0.0027
Electric access		
No(1)	0.9749	<2e-16
Use contraceptive		
Never(1)	0.4404	<2e-16
Distance to health		
Big problem(1)	0.3770	1.02e-13
Health access		
No(1)	0.9308	0.0171
Marital status		
Separated(1)	-0.1911	0.0048
Father education		
No education(1)	1.2581	< 2e-16
Primary(2)	0.9598	1.99e-11
Secondary(3)	0.3355	0.0477
Get money for treat		
Big problem(1)	0.2290	1.28e-06
Household head sex		
Female(1)	-0.0560	0.315
Household Age	0.003194	0.0742

Number of under five children in the HH.	-0.01723	0.515
Age of child in month	0.016451	<2e-16

Table 7: A bivariate logistic regression output showing factors associated with height-for-age Z-score (measure of stunting) of under five year children in Ethiopia based on EDHS (2011) data.

Variables	Coefficients	P-value
Residence		
Rural(1)	0.9070*	<2e-16
Wealth status		
Poor(1)	0.57339*	< 2e-16
Middle(2)	0.4626*	5.57e-13
Mother education		
No education(1)	1.8016 *	5.45e-12
Primary(2)	1.9343*	1.01e-11
Secondary(3)	1.4363*	7.58e-08
Radio access		
No(1)	0.3041*	6.96e-12
Television access		
No(1)	1.3140*	<2e-16
Household size	0.2578*	1.25e-09
Toilet access		

No(1)	0.2578*	1.25e-09
Child sex		
Female(1)	-0.0860*	0.0418
Water status		
Unsafe(1)	0.1119*	0.0110
Vaccination status		
No(1)	-0.20916*	1.06e-06
Had diarrhea recently		
No (1)	-0.16105*	0.0050
Had fever recently		
No(1)	-0.1135*	0.0303
Had cough recently		
No (1)	-0.0145	0.7810
Electric access		
No(1)	0.8668	<2e-16
Use contraceptive		
Never(1)	0.2741	6.7e-10
Distance to health		
Big problem(1)	0.3049	8.12e-10
Health access		

No(1)	0.7248	0.0436
Marital status		
Separated(1)	-0.0387*	0.5550
Father education		
No education(1)	1.1993*	< 2e-16
Primary(2)	0.9806*	1.23e-12
Secondary(3)	0.1063	0.5260
Get money for treat		
Big problem(1)	0.1804*	0.0001
Household head sex		
Female(1)	-0.0380	0.3150
Number of under five year children in the HH.	-0.0412	0.1170
Age of child in month	0.0164*	<2e-16
13-24(2)	1.7265*	<2e-16
25-36(3)	1.7422*	<2e-16
Greater than 36(4)	1.8311*	<2e-16
Household age	0.0035*	0.0466

Table 8: Multivariable logistic regression results for factors of weight-for-age Z-score for rural Ethiopia.

```
. logistic weightage i.fthredcn i.healthacce i.disthlth i.contrcp i.electric i.fever i.diarha i.water i.chldsex i.toilet i.television i.radio
>   i.wealth i.chdmnth2 i.region

Logistic regression                             Number of obs   =       8082
                                                LR chi2(28)     =     843.97
                                                Prob > chi2     =     0.0000
Log likelihood = -4953.1491                     Pseudo R2       =     0.0785
```

weightage	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fthredcn						
1	1.644947	.3616466	2.26	0.024	1.069086	2.530994
2	1.656243	.3641788	2.29	0.022	1.076366	2.548522
3	1.171898	.2995928	0.62	0.535	.710039	1.934182
1.healthacce	.2991927	.2007135	-1.80	0.072	.0803382	1.114242
1.disthlth	1.173475	.0761969	2.46	0.014	1.033244	1.332737
1.contrcp	1.234912	.0707873	3.68	0.000	1.103681	1.381747
1.electric	1.240042	.1728126	1.54	0.123	.9436533	1.629521
1.fever	.7261927	.0467437	-4.97	0.000	.6401203	.8238386
1.diarha	.6285008	.0448398	-6.51	0.000	.5464843	.7228263
1.water	.9209647	.0496919	-1.53	0.127	.8285434	1.023695
1.chldsex	.9151833	.0442065	-1.83	0.067	.8325152	1.00606
1.toilet	1.137142	.0683448	2.14	0.032	1.010777	1.279304
1.television	1.71902	.4197616	2.22	0.027	1.065194	2.774169
1.radio	1.139239	.0638867	2.32	0.020	1.020659	1.271595
wealth						
1	1.246397	.0984759	2.79	0.005	1.067589	1.455152
2	1.052273	.0870582	0.62	0.538	.8947581	1.237517
chdmnth2						
2	4.406064	.3677591	17.77	0.000	3.74114	5.189168
3	4.849703	.3987634	19.20	0.000	4.127867	5.697766
4	3.695209	.2755937	17.52	0.000	3.192679	4.276838
region						
2	.7274178	.1107822	-2.09	0.037	.5396971	.9804327
3	.7107078	.0829851	-2.92	0.003	.5653292	.8934716
4	.9165759	.0957837	-0.83	0.405	.7468209	1.124917
5	.7418189	.0686541	-3.23	0.001	.6187576	.8893551
6	.7699044	.0729043	-2.76	0.006	.6394908	.9269138
7	1.050391	.1128146	0.46	0.647	.8510009	1.296499
9	1.041454	.137821	0.31	0.759	.8035195	1.349846
10	1.135841	.1098577	1.32	0.188	.9397019	1.37292
11	.4161306	.0516786	-7.06	0.000	.3262272	.5308099
_cons	.2676977	.193769	-1.82	0.069	.0647911	1.106048

Table 9: Multivariable logistic regression results for factors of weight-for-age Z-score for Urban Ethiopia.

```
. logistic weightage i.disthlth contrcp electric i.diarha i.television i.edcnm i.wealth i.chdmnth2 i.region

Logistic regression                             Number of obs   =       1540
                                                LR chi2(23)     =     192.39
                                                Prob > chi2     =     0.0000
Log likelihood = -679.93793                     Pseudo R2       =     0.1239
```

weightage	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
1.disthlth	.7712373	.1152987	-1.74	0.082	.5753536	1.033811
contrcp	1.34489	.2318145	1.72	0.086	.9593292	1.885409
electric	1.56933	.3104719	2.28	0.023	1.064915	2.31267
1.diarha	.7599647	.1458792	-1.43	0.153	.521676	1.107098
1.television	1.790035	.309017	3.37	0.001	1.276195	2.510764
edcnm						
1	5.817768	2.804596	3.65	0.000	2.261591	14.96576
2	5.006284	2.387541	3.38	0.001	1.965939	12.74855
3	3.378208	1.713332	2.40	0.016	1.250204	9.128339
wealth						
1	.6410339	.1880241	-1.52	0.130	.3607545	1.139069
2	2.401188	1.062396	1.98	0.048	1.008824	5.71527
chdmnth2						
2	3.906703	.9542234	5.58	0.000	2.420483	6.30549
3	3.926133	.950781	5.65	0.000	2.442484	6.311
4	2.774349	.6332683	4.47	0.000	1.773647	4.339652
region						
2	.6510259	.2400479	-1.16	0.244	.3160393	1.341082
3	.7096035	.2485663	-0.98	0.327	.3571488	1.409881
4	1.273071	.5036445	0.61	0.542	.5862807	2.764393
5	.4263781	.1587043	-2.29	0.022	.2055725	.8843512
6	.7447999	.308875	-0.71	0.477	.3303991	1.67896
7	1.365625	.4979458	0.85	0.393	.6682814	2.79064
8	.451132	.1551736	-2.31	0.021	.22989	.8852933
9	.707205	.2379687	-1.03	0.303	.3656983	1.367627
10	.917041	.3235423	-0.25	0.806	.4592777	1.831058
11	.6680155	.276836	-0.97	0.330	.2965073	1.505004
_cons	.0220621	.0131069	-6.42	0.000	.0068858	.0706868

Table 10: Multivariable logistic regression results of predictors of height-for age Z-score for rural Ethiopia.

```
. logistic heightage i.fthredcn i.disthlth i.contrcp i.fever i.diarha i.vacint i.chldsex i.television i.radio i.wealth i.chdmnth2 i.region

Logistic regression                             Number of obs   =       8082
                                                LR chi2(25)     =    1106.50
                                                Prob > chi2     =     0.0000
Log likelihood = -4887.3276                     Pseudo R2       =     0.1017
```

heightage	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fthredcn						
1	1.365741	.2888489	1.47	0.141	.9022829	2.067256
2	1.379045	.2914697	1.52	0.128	.9113216	2.086821
3	.8673009	.2170305	-0.57	0.569	.5310898	1.416353
1.disthlth	1.096183	.0706432	1.43	0.154	.9661122	1.243765
1.contrcp	1.204055	.0685509	3.26	0.001	1.076923	1.346195
1.fever	.8826529	.0579536	-1.90	0.057	.7760708	1.003873
1.diarha	.7194867	.0524931	-4.51	0.000	.6236198	.830091
1.vacint	.8685957	.0431666	-2.83	0.005	.7879806	.9574581
1.chldsex	.9198586	.0447246	-1.72	0.086	.8362471	1.01183
1.television	2.038048	.4636759	3.13	0.002	1.304841	3.183253
1.radio	1.10185	.0619027	1.73	0.084	.9869643	1.230109
wealth						
1	1.192976	.0829054	2.54	0.011	1.041065	1.367054
2	1.074761	.0844424	0.92	0.359	.9213704	1.253688
chdmnth2						
2	6.033853	.5419827	20.01	0.000	5.059839	7.195364
3	6.51535	.5779252	21.13	0.000	5.475634	7.752489
4	7.049418	.5748968	23.95	0.000	6.008081	8.271243
region						
2	.5774377	.0831966	-3.81	0.000	.4353765	.7658528
3	.4535362	.0545995	-6.57	0.000	.3582111	.5742287
4	1.008682	.1054414	0.08	0.934	.8218167	1.238037
5	.7901962	.072887	-2.55	0.011	.6595092	.9467798
6	.8539834	.0797321	-1.69	0.091	.7111758	1.025467
7	1.050584	.1122133	0.46	0.644	.8521457	1.295234
9	.9557905	.1255556	-0.34	0.731	.738833	1.236457
10	1.196386	.1164057	1.84	0.065	.9886695	1.447742
11	.3722462	.0465819	-7.90	0.000	.2912818	.4757156
_cons	.0674046	.0215596	-8.43	0.000	.0360105	.1261679

Table 11: Multivariable logistic regression for factors of height-for age Z-score for urban.

```
. logistic heightage i.water i.television i.edcnm i.chdmnth2 i.region

Logistic regression                             Number of obs   =       8082
                                                LR chi2(17)     =    1023.97
                                                Prob > chi2     =     0.0000
Log likelihood = -4928.5888                     Pseudo R2       =     0.0941
```

heightage	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
1.water	1.106786	.0576672	1.95	0.051	.9993404	1.225785
1.television	2.405599	.5385795	3.92	0.000	1.551141	3.730742
edcnm						
1	2.770243	1.419925	1.99	0.047	1.014432	7.565064
2	2.49776	1.284234	1.78	0.075	.911805	6.842258
3	2.648035	1.556254	1.66	0.098	.8368962	8.378687
chdmnth2						
2	6.06809	.541241	20.21	0.000	5.094827	7.227276
3	6.359677	.5584054	21.07	0.000	5.354219	7.553948
4	6.592854	.526945	23.60	0.000	5.636893	7.710938
region						
2	.5509458	.0774818	-4.24	0.000	.4182161	.7258
3	.5075809	.0589296	-5.84	0.000	.4042795	.6372778
4	1.057909	.1085065	0.55	0.583	.8652533	1.293461
5	.7863456	.0703406	-2.69	0.007	.6598897	.9370344
6	.873307	.078999	-1.50	0.134	.7314213	1.042717
7	1.147551	.1161705	1.36	0.174	.9410272	1.399401
9	.9664159	.1250988	-0.26	0.792	.7498586	1.245514
10	1.211188	.1166202	1.99	0.047	1.002889	1.46275
11	.4041891	.0485467	-7.54	0.000	.3194095	.5114714
_cons	.0244241	.0133824	-6.78	0.000	.0083451	.0714835

Table 12: Hosmer–Lemeshow goodness-of-fit test for the whole sample model

```
. estat gof, table group(10)
```

Logistic model for weightage, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.1269	73	79.4	890	883.6	963
2	0.1824	159	148.8	803	813.2	962
3	0.2519	202	206.6	760	755.4	962
4	0.3247	271	279.2	691	682.8	962
5	0.3738	350	337.5	613	625.5	963
6	0.4159	387	381.7	578	583.3	965
7	0.4567	425	418.2	535	541.8	960
8	0.4974	462	467.0	516	511.0	978
9	0.5515	481	493.7	464	451.3	945
10	0.7672	590	587.9	372	374.1	962

```
      number of observations =      9622
            number of groups =        10
  Hosmer-Lemeshow chi2(8) =         3.68
                  Prob > chi2 =     0.8845
```

```
. estat gof, group(10)
```

Logistic model for heightage, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

```
      number of observations =      9622
            number of groups =        10
  Hosmer-Lemeshow chi2(8) =        14.84
                  Prob > chi2 =     0.0623
```

Table 13: Hosmer–Lemeshow goodness-of-fit test for urban sample

```
. estat gof, group(10)
```

Logistic model for weightage, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

```
      number of observations =      1540
            number of groups =        10
  Hosmer-Lemeshow chi2(8) =         4.75
                  Prob > chi2 =     0.7841
```

Logistic model for heightage, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

```
      number of observations =      1540
            number of groups =        10
  Hosmer-Lemeshow chi2(8) =         2.61
                  Prob > chi2 =     0.9564
```

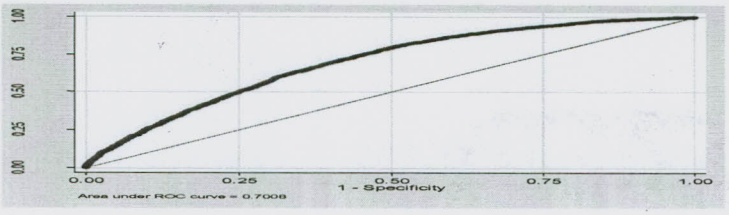

Figure 1: Area under the receiver operating characteristic curve of weight-for age Z-score for all sample children.

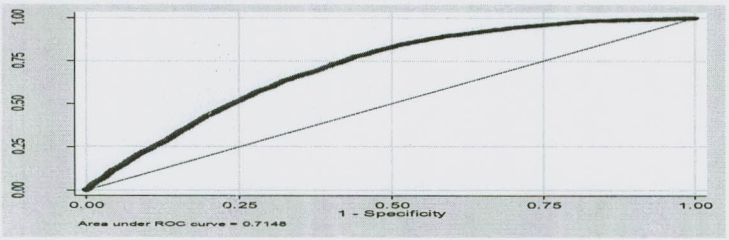

Figure 2: Area under the receiver operating characteristic curve of height-for age Z-score for all sample children.

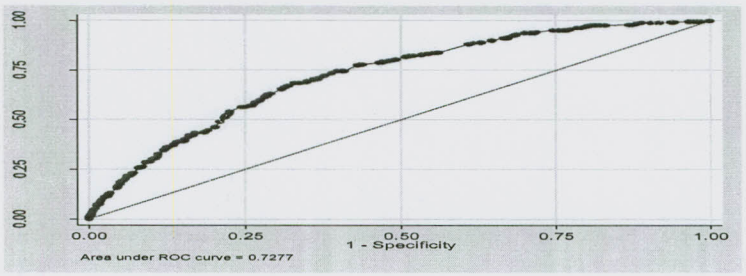

Figure 3: Area under the receiver operating characteristic curve of weight-for age Z-score for urban children.

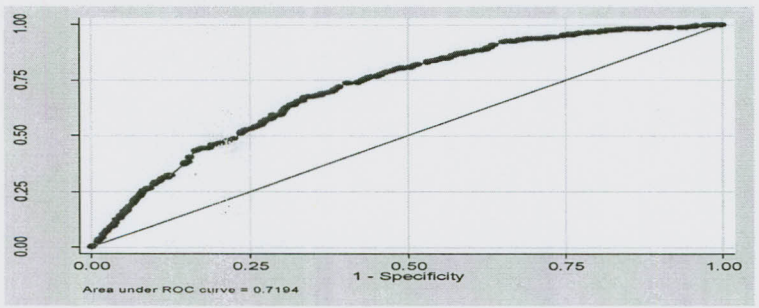

Figure 4: Area under the receiver operating characteristic curve of height-for age Z-score for urban children.