# FACTORS AFFECTING NUTRITIONAL STATUS OF UNDER FIVE CHILDREN IN HARAMAYA DISTRICT, OROMIA, ETHIOPIA

**MSc THESIS**

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# Factors Affecting Nutritional Status of Under Five Children in Haramaya District, Oromia, Ethiopia

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**POSTGRADUATE PROGRAM DIRECTORATE**

We hereby certify that we have read and evaluated this thesis entitled: '**Factors affecting nutritional status of under five children in Haramaya district, Oromia, Ethiopia**' prepared under our guidance by Fuad Redi**.** We recommend that it be submitted as fulfilling the thesis requirement.

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As a members of the Board of Examiners of the M.Sc. Thesis open defense examination, we certify that we have read and evaluated the Thesis prepared by Fuad Redi and examined the candidate. We recommend that the Thesis be accepted as fulfilling the Thesis requirements for the degree of *Master of Science in Statistics* (Biometrics).

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Chairperson Signature Date

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External Examiner Signature Date

Final approval and acceptance of the Thesis is contingent upon the submission of its final copy to the council of Graduate Studies (CGS) through the candidate's department or school graduate committee (DGC or SGC).

# DEDICATION

This thesis is dedicated to my beloved parents, Redi Abdullah and Mehbuba Goshu.

## STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this thesis. Any scholarly matter that is included in the thesis has been given recognition through citation.

This thesis is submitted in partial fulfillment of the requirement for a Master of Science of degree at Haramaya University. The thesis is deposited in the Haramaya University Library and is made available to borrowers under the rules of the Library. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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# BIOGRAPHICAL SKETCH

The author, Fuad Redi Abdella, was born in Silti District in Siltie Zone, South Ethiopia on 11 October 1990. He attended elementary education at Decha Gisilla and Titi Gora elementary schools in Silti district from 1996 to 2003, and secondary school education at Silti High School, and Preparatory education at Worabie secondary and preparatory school from 2004 to 2007. After he successfully passed the Ethiopian School Leaving Certificate Examination (E.S.L.C.E.), he joined Hawassa University in November 2008 and graduated with the Degree of Bachelor of Science in Statistics in July 2011. He was employed by Ministry of Education and place at Haramaya University, and has worked as graduate assistant in Haramaya University Chiro campus from September 2011 and he has been working there until he joined Haramaya University main campus in October 2013 to follow a study program leading to the Degree of Master of Science in Statistics (Biometrics).

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# ABBREVIATIONS

| | |
|---|---|
| BLUE | Best Linear Unbiased Estimators |
| CSA | Central Statistical Agency |
| DHS | Demographic and Health Survey |
| DV | Dependent Variable |
| EDHS | Ethiopian Demographic and Health Survey |
| FANTA | Food and Nutrition Technical Assistant |
| FAO | Food and Agricultural Organization |
| HAZ | Height for Age Z score |
| HFSS | Household Food Security Status |
| HWHO | Haramaya Wereda Health Office |
| MANOVA | Multivariate Analysis Of Variance |
| MUAC | Mid Upper Arm Circumference |
| SCUK | Save Children United Kingdom |
| SPSS | Statistical Package for Social Science |
| UN | United Nations |
| UNICEF | United Nations Children Fund |
| UNSSCN | United Nations System Standing Committee on Nutrition |
| USDA | United States Development Agency |
| VIF | Variance Inflation Factor |
| WAZ | Weight for Age Z score |
| WHZ | Weight for Height Z score |
| WHO | World Health Organization |

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# FACTORS AFFECTING NUTRITIONAL STATUS OF UNDER FIVE CHILDREN IN HARAMAYA DISTRICT, OROMIA, ETHIOPIA

## ABSTRACT

*Malnutrition is a general term for a medical condition caused by an improper or insufficient diet. Under nutrition is prevalent around the world. The objective of this study was to assess the prevalence of under nutrition and factors affecting nutritional status among children aged 6-59 months in Haramaya, Eastern Ethiopia. The data were collected by using a well structured pretested questionnaire. Anthropometric measurements of the children were taken to assess the nutritional status of the children. Multivariate multiple linear regression models by taking the Z-score of the weight for age, height for age and weight for height of the children as dependent variables were used to assess the relationship between child nutritional status and the explanatory variables. The prevalence of stunting, wasting and underweight were 36.07% [95% CI (0.314, 0.408)], 14.43% [95% CI (0.110, 0.179)] and 23.63% [95% CI (0.195, 0.278)] respectively. The significant factors which were related to the three indicators jointly were food security status of the household, child sex, diarrhea infection, child age, and the employment status of mother. Wealth status, additional food frequency per day, and the residence of household were significantly related to the z score of wasting and underweight, stunting and underweight, and wasting and stunting respectively. The current study showed that the prevalence of child undernutrition is highly prevalent in Haramaya district. A child from a food insecure household, a male child, diarrhea infected child, and a child from employed mother were significantly more likely to have less z score of underweight, stunting and wasting compared to their corresponding counterparts in the study area. A child from lowest living standard household was significantly lower z score of wasting and underweight; a child who was feeding less frequently per day was significantly lower mean z score of stunting and underweight in the study area. Community based nutrition program should be established; continuous nutrition supervision based on each nutritional status indicators and special attention to severely malnourished children is necessary to attempt the problem of malnutrition.*

***Key words**: Haramaya, factors, Z score, undernutrition, and multivariate multiple linear regressions.*

# 1. INTRODUCTION

## 1.1. Background

Malnutrition is a general term for a medical condition caused by an improper or insufficient diet. The term usually refers to generally bad or faulty nutrition and is most often related to under nutrition. According to the World Health Organization (WHO), malnutrition is the cellular imbalance between supply of nutrients and energy and the body's demand for them to ensure growth, maintenance and specific functions, and was the greatest risk factor for illness and death worldwide (Nikolaos *et al.,* 2010).

Under nutrition was prevalent around the world. Despite numerous advances in medicine and clinical care, the simple correction of nutritional status of individuals appears to be overlooked or not considered as a sufficient medical priority (Lisa *et al.,* 2011).

According to FAO's most recent estimates indicated that globally 842 million people, 12 percent of the global population, are unable to meet their dietary energy requirements in 2011–2013. Above 98 percent of hungry people in the world live in developing regions. Sub-Saharan Africa had the highest prevalence of undernourishment and too little progress of decreasing the number of hunger people in both northern and sub-Saharan parts of the continent (FAO, 2013).

Also United Nations Children's Funds (UNICEF) globally estimated that about 165 million (26 per cent), 101 million (16 percent) and 52 million (8 percent) of children under 5 were stunted, underweight and wasted respectively in 2011. In sub-Saharan Africa 40 per cent of children under five were stunted, 33 per cent were underweight and the number of wasted under five children was increasing through time to time (UNICEF, 2013).

Among the victims in Ethiopia, children were the first place vulnerable groups. Poor nutritional status started before birth due to the poor transfer of nutrients from the mother to the fetus (Benson, 2005).

## 1.2. Statement of the Problem

Globally under nutrition was the cause of 33.3% of all child deaths. In 2011, 2.3 million children died because they did not get the nourishment they needed, this indicates that every minute of

every day four children die because of under nutrition. Among the children who survive, their development permanently damaged. This makes under nutrition one of the most fundamental and urgent challenges in global development (UNICEFUK, 2013).

Ethiopian Demography and Health Survey revealed that about 44% of under five children were stunted, 29% were underweight and 10% were wasted in 2011. In Oromia region prevalence of child under nutrition indicates that 26% were underweight with 7.8% severe underweight, 9.7% of the children were wasted with 2.8 % severe wasting and 41.4 % of the children were stunted with 18% severe stunting (CSA, 2012). But, Ethiopian demographic and health survey did not present the problems associated with nutritional status of children on district level and lower levels.

Among previous studies that conducted at district level in Ethiopia, a community based cross-sectional study conducted on prevalence of wasting and associated factors among preschool children in Gubo Sayo Woreda, Oromia, in 2014 showed that 12.5% of preschool children were wasted and revealed that the factors significantly associated with acute malnutrition (Habtamu *et al.,* 2014). However, this study did not concern stunting and underweight and their associated factors among under five children.

A community based study conducted on prevalence of malnutrition and associated factors among children aged 6-59 months at Hidabu Abote District, Oromia, in 2013 revealed that 47.6%, 30.9% and 16.7% of children were stunted, underweight and wasted respectively (Kebede Mengistu *et al.,* 2013). This study used binary logistic regression model without model adequacy checking to assess the factors associated to the nutritional status of children. In the current study multivariate multiple linear regression models was used.

Among the studies conducted in the eastern Ethiopia a community based study on determinants of child malnutrition in Kombolcha district in 2010 revealed that 45.8%, 28.9% and 11.2% of sample children were stunted, underweight and wasted, respectively (Tadiwos and Degnet, 2013). This study used logistic regression model to detect the factors associated to nutritional status of the children and the current study used multivariate multiple linear regression model.

There was unpublished study on magnitude and factors associated with malnutrition of under five children by Zewdu Sisay in 2011; but it did not cover urban children in the study and the current study included both the rural and urban children. The study conducted in East Hararge Zone by Gudina *et al.* (2014) on predictors of acute undernutrition among children aged 6 to 36 months conducted in Kersa Wereda, East Ethiopia and revealed the factors associated with the nutritional status of the children in the study area. But this study did not include children above three years of age; concerned only acute undernutrition and used multinomial logistic regression model while the current study covered the children aged 6 to 59 months; concerned the three indicators of malnutrition and used multivariate multiple linear regression models.

Many studies were done on the prevalence of undernutrition and it was well documented at national level, but estimating undernutrition at district level and extracting factors associated with undernutrition was very little. In view of the fact that the results of the studies in the one district could not represent another area; it needs to conduct more studies on district level in different parts of the country. In the current study the factors associated with nutritional status of children were assessed at district level by using multivariate multiple linear regression models by taking the Z-score of the three indicators of nutritional status as dependent variables. Therefore, the aim of this study was designed to estimate the prevalence of the undernutrition and identify factors affecting nutritional status among children aged 6-59 months in the study area.

## 1.3. Objectives of the Study

### 1.3.1. General Objective

To assess prevalence of under-nutrition and factors affecting nutritional status among children aged 6-59 months in Haramaya district.

### 1.3.2. Specific Objectives

The specific objectives of this study were:

1. To determine the prevalence of under-nutrition among children aged 6-59 months.
2. To identify factors associated to stunting status of children aged 6-59 months.
3. To identify factors associated to wasting status of children aged 6-59 months.
4. To identify factors associated to underweight status of children aged 6-59 months.

## 1.4. Research Questions

The research questions answered by this study were:

1. How much the magnitude of child under nutrition in the study area?
2. What were the factors associated to nutritional statuses of children aged 6-59 months in the study area?

## 1.5. Scope and Significance of the Study

This study use primary data and it was collected by using well structured questionnaire and it covered children of aged 6-59 months in Haramaya district randomly included in the study. This study identified the factors associated to under nutrition among children aged between 6 and 59 months in Haramaya district, Oromia, Eastern Ethiopia. The findings in the study would helpful for policy making, monitoring and evaluation activities of the government and different concerned agencies.

# 2. LITERATURE REVIEW

In this subtitle, the magnitude of under nutrition, factors associated to nutritional status of under five children and statistical model review for nutritional status of under five children were discussed.

## 2.1. Introduction

Nutritional status can be defined as the physiological condition of an individual that results from the balance between nutrient requirements and intake and the ability of the body to use these nutrients. Undernutrition is a condition in which the body does not have enough of the right kind of food to meet its energy, macronutrient and micronutrient needs (Pat and Hill, 2009).

Under nutrition could result from a lack of macronutrients, micronutrients or both. Macronutrient deficiencies occur when the body adapts to a reduction in macronutrient intake by a corresponding decrease in activity and an increased use of reserves of energy, or decreased growth. Micronutrient under nutrition was widespread in developing countries. It occurs when essential vitamins or minerals were not present in adequate amounts in the diet (World Food Program (WFP), 2005).

Under nutrition in children can be assessed using anthropometry, biochemical indicators and clinical signs of malnutrition. The advantage of anthropometry was that body measurements were sensitive over the full spectrum of under nutrition, whereas biochemical and clinical indicators were useful only when a child was at least moderately undernourished (Blossner and de Onis, 2005; CSA, 2012).

The factors associated with under nutrition were highly complex, multiple and interlinked, and UNICEF has developed a conceptual framework of the causes and consequences of child under nutrition include immediate causes, underlying causes and basic causes (UNICEFUK, 2013). The United Nations Children's Fund (UNICEF) conceptual framework of the factors affecting the nutritional status of children shown in the (Figure 1) below presents a generalized understanding of how undernutrition was the outcome of many interrelated factors (Dean *et al.*, 2006).

Generally, nutritional status of children directly related to dietary intake and health status of the children. Both health status and dietary intake reflect underlying factors of under nutrition at the household and community level that were connected to political, economic, and ideological structures within a society. The conceptual framework for nutrition reflects relationships among factors and their influences on children's nutritional status.

## 2.2. Magnitude of Under Nutrition

Under nutrition was found worldwide and was linked to major causes of death and disability. More than one third of all child deaths were attributable to undernutrition. Many low and middle income countries, particularly in Africa, have not achieved significant reductions in underweight, stunting or vitamin and mineral malnutrition (WHO, 2013). Stunting affected at least 165 million children worldwide in 2011; wasting affected at least 52 million children. Prevalence of stunting of linear growth of children younger than 5 years has decreased during the past two decades, but was higher in south Asia and sub-Saharan Africa than elsewhere (Black *et al.*, 2013).

In 2010 as investigated by United Nations System Standing Committee on Nutrition (UNSCN) hunger and inadequate food supply were still affecting large parts of the world's population with serious consequences for health and well-being, especially in children. Undernutrition in childhood stage interfered with physical and mental development (UNSCN, 2010). Undernutrition was a major public health problem throughout the developing world, particularly in southern Asia and sub-Saharan Africa. The risk of death was directly correlated with the degree of undernutrition (Olaf and Michael, 2005).

According to Ethiopian Demography and Health Survey about 44% of under five children in Ethiopia were stunted, 29 % were underweight and 10% were wasted in 2011. In Oromia region 26% were underweight with 7.8% severe underweight, 9.7% of the children were wasted with 2.8 % severe wasting and 41.4 % of the children were stunted with 18% severe stunting (CSA, 2011). The study conducted on malnutrition among under five children in Kombolcha district of East Hararghe Zone, estimates that 45.8%, 28.9% and 11.2% of the children were stunted, underweight and wasted (Tadiwos and Degenet, 2013).

Generally the magnitude of under nutrition among under five children was high especially in developing country. The prevalence of under nutrition in the Africa was high including Ethiopia.

In Ethiopia estimating the prevalence of under nutrition at the district level was scanty, and Ethiopian Demographic and Health Survey was conducted in five years interval this might not enough for estimating the nutritional status even in national level. In the current study the magnitude of under nutrition among children aged 6-59 months in Haramaya district was estimated.

## 2.3. Factors Associated With Under Nutrition

### 2.3.1. Basic Factors

Nationally, the Ethiopia health and demographic survey revealed that wasting was common in children whose mothers have no education and in those in the lowest wealth quintiles (CSA, 2012). The study conducted on nutritional status and associated factors among orphan children below the age of five years in Gondar city, Ethiopia, found that household income, educational status of caregiver, and household main source of income were significantly associated with nutritional status of under five Orphan child (Teklemariam *et al.,* 2014). Also the study conducted on prevalence and determinants of child malnutrition in Gimbi district, Oromia, found that maternal lack of education and low household income in rural area were important determinants of wasting (Kebede Eticha, 2007). Gudina *et al.* (2014) have studied on predictors of acute child under nutrition in eastern Ethiopia the case of Kersa Wereda and found that household poverty was one of the factors that significantly affect acute nutritional status of children.

Ethiopian demographic and health survey suggested that children born to mothers in the lowest wealth quintile were more than twice as likely to be underweight as children born to mothers in the highest wealth quintile. The proportion of underweight children was eight times higher for those born to uneducated mothers than for those whose mothers have more than secondary education and also rural children were more likely to be underweight than urban children (CSA, 2012).

### 2.3.2. Underlying Factors

Best nutritional status outcomes when children have access to affordable, various, nutrient-rich food; appropriate maternal and child-care practices; adequate health services; and a healthy

environment including safe water, sanitation and good hygiene practices (UNICEF, 2011). The study conducted on assessment of the causes of malnutrition in Ethiopia based on the Ethiopian demographic and health survey data in 2000 concluded that in addition to prevailing food shortages, maternal and child health care practices, distribution of food within households, infant and child care and feeding practices make children and women of childbearing age vulnerable to nutritional problems (Benson, 2005).

Ethiopian Health and Demographic Survey showed that children of thin mothers were commonly affected by wasting (CSA, 2012). The study conducted on prevalence and determinants of child malnutrition in Gimbi district, Oromia region revealed that lack of child immunization becomes one of significant factors of wasting in rural area (Kebede Eticha, 2007). Among underlying causes of under nutrition that affect child nutritional status poor access to health services and lack of mutual decision making on the care or treatment of their sick child between parents were amongst very important factors (Gudina Egata *et al.,* 2014).

As estimated from the study conducted in Amhara region, Ethiopia (Dube *et al.,* 2014) the most significantly associated factors with nutritional status of children were source of drinking water, education of father, hand-washing practice of caregiver, decision maker to use money, child vaccination status, and diarrhoea frequency occurrence. A community based cross sectional study conducted on children aged 6-59 months from September 8-23, 2012 at Hidabu Abote district, Oromia, Ethiopia, found that households not treat their drinking water was associated with wasting among children aged 6-59 months in district (Kebede Mengistu *et al.,* 2012).

A cross sectional study conducted on determinants of child malnutrition in 2010 in Kombolcha Wereda, East Hararghe zone, revealed that among the factors associated with child nutritional status child's age and latrine use were highly significant (Tadiwos and Degnet, 2013).

### 2.3.3. Immediate Factors

Among the immediate factors, the disease group include occurrence of any infection, diarrhea, fever or cough in the previous 2 weeks, the presence of lice and ringworm, vaccination status of BCG and measles (Mayer, 2007; UNICEF, 2013; Dube *et al.,* 2014). In addition to an absolute deficit in food intake, under nutrition can result from imbalanced diets in which sufficient

macronutrients consumed but insufficient vitamins and minerals resulting in various physiological disorders and increased susceptibility to disease (Benson, 2008).

The study conducted in Somali region, revealed that higher risk of stunting and underweight associated with breastfeeding for children over 12 month ( Mayer, 2007). Factors that were directly lead to poor growth also includes inappropriate complementary feeding, such as starting at the wrong age, poor access to or use of diverse types of food and inadequate intake of micronutrients (UNICEF, 2013). For how many months the child gets breast feed and for how many times the child gets food per day were significantly associated with child nutritional status (Habtamu *et al.,* 2014). The study conducted on prevalence and determinants of child malnutrition in Gimbi district, Oromia region, in both rural and urban setting's childhood illness which was indicated by fever significantly affects nutritional status of children (Kebede Eticha, 2007).

Presence of diarrheal disease two weeks prior to the study significantly associated with nutritional status of underfive child in Gondar city (Teklemariam *et al.,* 2014). A cross sectional study conducted on determinants of child malnutrition in 2010 in Kombolcha Wereda, East Hararghe zone, found that among immediate factors of nutritional status of children incidence of morbidity, child sex and immunization status were strongly associated with child nutritional status (Tadiwos and Degnet, 2013).

A community based cross sectional study conducted on children aged 6-59 months from September 8-23, 2012 at Hidabu Abote district, Oromia, Ethiopia founded that factors significantly associated with chronic under nutrition were child age and pre-lacteal feeding practice, and children were received butter as pre lacteal feeding was associated with underweight (Kebede Mengistu *et al.,* 2012). When the factors associated with under nutrition estimated the statistical model used was logistic regression model and the current study used multivariate multiple linear regression model.

## 2.4. Literature Review on Models for Child Nutrition

To assess the factors associated to the nutritional status of children most of the previous studies used binary logistic regression model (Habtamu *et al.,* 2014; Dube *et al.,* 2014; Kebede Mengistu *et al.,* 2013; Solomon Demisie and Amare Worku, 2013 ) and multinomial logistic regression

model (Gudina *et al.*, 2014). Logistic regression is a regression model where the dependent variable is categorical. In logistic regression no assumptions are made about the distributions of the explanatory variables and large sample sizes are required for logistic regression to provide sufficient numbers in both categories of the response variable. If the dependent variables were ordinal, categorical ordinal logistic regression can be used. However, Diagnostic statistics and goodness of fit tests have not been extended for use with ordinal models and the researcher cannot check the actual fitted model, only an approximation to it (Hosmer and Lemeshow, 2000).

The terms multivariate and multivariable or multiple were often used interchangeably in the public health literatures. However, these terms actually represent two very distinct types of analyses (Hidalgo and Goodman, 2013). Most of the previous studies used logistic regression model to assess the factors of child nutritional status; the current study used multivariate linear regression models and use the z score as dependent variables.

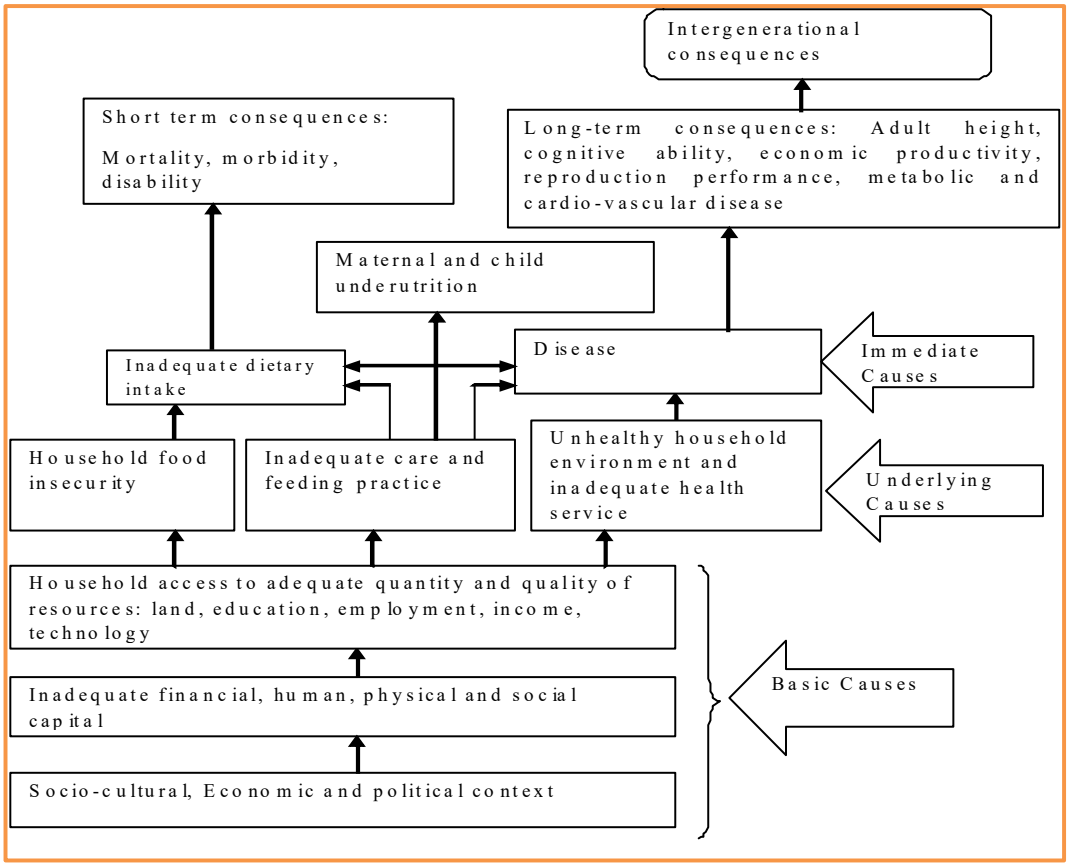



**Figure 1:** Schematic diagram of UNICEF conceptual frame work of factors associated with nutritional status of children. Source: UNICEF 2013.

# 3. METHODS AND MATERIALS

In this chapter the study area and period, population, sample size determination, data collection procedures, description of study variables and data analysis were presented.

## 3.1. Study Area, Period and Design

A community based cross-sectional study design was used in Haramaya district, East Hararghe Zone, Ethiopia from January 05 to March 25, 2015. Haramaya district was located 506 km far from East of Addis Ababa. The elevation of the area was about 2000m above sea level and geographically it located 041°59'58'' latitude and 09°24'10''longitudes.The district receives an average annual rain fall approximately 900mm and climatically there were two environmental zones of which 66.5% was midland and 33.5% was lowland. According to CSA population projection for 2014 out of the total population in Oromia region, 32,815,995, about 10 % was located in East Hararghe Zone. In the Haramaya district the projected population for 2014 was 332,985 and about 79% of the total population in the district was located in rural area (CSA, 2013). The number of under five children in the district was about 72978 and above 87 percent of the children were located in the rural area (HWHO, 2014). In the district there was one hospital, seven health centres and 34 health posts. About 78 health workers were recently working in the health posts in the district. The district was divided into 33 rural and 4 urban kebeles.

## 3.2. Sample Size Determination and Sampling Techniques

### 3.2.1. Population

The source population was all children aged between 6 to 59 months and their mothers or care givers in Haramaya district. The sample population was all randomly selected children aged 6-59 months in the selected kebeles of Haramaya district. This study included children in the district aged between 6 and 59 months capable to be measured, not hospitalized for sickness, and whose mothers or caregivers willing to be interviewed. The children who were severely injured by accidents or hospitalized and whose mother/caregivers were not physically and mentally capable to be interviewed and not willing to be interviewed were excluded from this study.

### 3.2.2. Sampling Techniques

The sampling technique used in this study was two stages stratified sampling method. The residence of the household in the district as rural and urban kebeles considered as strata. At the first stage, kebeles were selected from rural and urban residences by using simple random sampling. Four kebeles from the rural kebeles and one kebele from urban kebeles selected randomly. At the second stage, children who were aged between 6 and 59 months selected randomly in each selected kebeles. The rural kebeles included in this study were Finkille, Efa Bate, Damota and Karo Dada, and among four urban kebeles Adelle was randomly selected. The number of children randomly selected from Finkille, Efa Bate, Damota and Karo Dada, was 112, 56, 119 and 63 respectively. Among four urban Kebeles, Adelle was included in the study, and 52 children were randomly selected (Figure 2).

### 3.2.3. Sample Size Determination

The sample size determined by using proportion for stratified sampling technique formula and proportional to size allocation method (Cochran, 1977).

Firstly initial sample size was calculated as:

$$n_0 = \sum_{h=1}^{2} \frac{W_h p_h q_h}{d^2 / t^2} = \sum_{h=1}^{2} \frac{W_h p_h q_h}{V} \quad , \text{h= 1, 2.} \qquad (1)$$

Where

$n_0$ = Initial sample size.

t = the standardized normal distribution value at 95% level of significance.

$p_h$ = prevalence of stunting in urban and rural residences, $q_h = 1 - p_h$

d = margin of error = 5%, $V = \frac{d^2}{t^2} = 0.00065$

$W_h$ is the stratum weight, $W_1$= the weight of rural residence = 0.87, $W_2$= the weight of urban residence= 0.13.

In this study the value of $p_h$ was taken from Ethiopian Demographic and Health Survey in 2011 that the prevalence of stunting for rural was 46.2 % and for urban was 31.5%, the value of $W_h$

calculated by using the total number of under five children in the district and the total number of children in the residences. The initial sample size and total sample size was computed as:

$$n_0 = \sum_{h=1}^{2} \frac{W_h p_h q_h}{V} \approx 377$$

By considering non response rate 10%, the sample size calculated for this study was 415. The next step was allocating the sample size to different residences by proportional to size allocation method (Table 2).

Table 1: Sample size allocation in rural and urban areas in Haramaya district in January 2015

| Residence | $W_i$ (weight of each stratum) | Sample size (number of underfive children in the study) |
|---|---|---|
| Rural | 0.87 | 361 |
| Urban | 0.13 | 54 |
| Total | 1.00 | 415 |

After the selection of kebeles the number of children selected from each randomly selected kebeles allocated by using proportional to size allocation method in (Table 2) below.

Table 2: Allocation of sample size in selected Haramaya rural kebeles in January 2015

| Name of the Kebeles | Number of under five children | Weight ($W_i$) | Sample Size |
|---|---|---|---|
| Finqille | 1673 | 0.32 | 115 |
| Damota | 1778 | 0.34 | 123 |
| Karro Dada | 941 | 0.18 | 65 |
| Efa Bate | 836 | 0.16 | 58 |
| Total | 5228 | 1.00 | 361 |

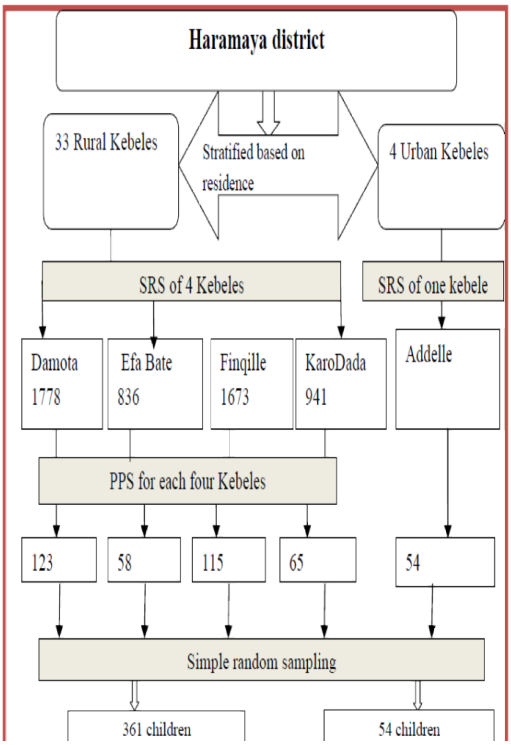



Figure 2: Schematic diagram of sampling techniques used in the study in Haramaya district in January 2015

## 3.3. Data Collection Methods

The data type in this study was primary data and obtained by using well structured questionnaires. The questionnaire was initially prepared in English and translated into the local language, ‘‘*Afan Oromo*’’, by fluent speakers of both languages.

Experienced health workers who able to communicate in “*Afan Oromo”* and employed from Haramaya district or nearby other districts sited in the study area for data collection based on their experience on data collection, and supervisors employed. Interviews were conducted with mothers/caregivers of the children to fill the questionnaire. To ensure the quality of data, training was given for the data collectors on the objective of the study and methods of data collection, anthropometric measurement and data recording methods. The supervisors and researcher closely

followed the day to day data collection process and ensure completeness and consistency of the collected questionnaires on a daily basis.

The anthropometric data were measured based on the procedure stipulated by the WHO (2006) for taking anthropometric measurements. Before taking anthropometric data for children; their age should be first determined in order to ensure the target population. The mothers were asked the age of child and if age cannot be determined accurately a height of 60-110 cm was considered as proxy indicators, the children his/her mother cannot remember the age, if the height of child was out of this range he/she should be excluded from the study.

Body length of children age up to 2 years, who could not able to stand, was measured without shoes and the height was read to the nearest 0.1cm by using a horizontal wooden length board with the infant in recumbent position. However, heights of children 2 years and above were measured using a vertical wooden height board by placing the child on the measuring board, and child standing upright in the middle of board. The child's head, shoulders, buttocks, knees and heels should be touching the board. The weight of the children was measured by electronic digital weight scale with minimum clothing and no shoes (Cogill, 2003). Adjusting the instrument was done before weighing every child by setting it to zero. The children who were less than two years and not suitable for measuring their weight alone were measured by measuring the mother and children together, and then subtracting the weight of the mother to obtain the weight of the children (Adelheid and de Onis,2008).

Oedema was checked and noted on data sheet because children with oedema were severely undernourished. In order to determine the presence of oedema, normal thumb pressure applied to the two feet for three seconds whether a shallow print or pint remained on both feet when the thumb was lifted. To identify retrospective morbidity of children, mothers were asked about any occurrence of illness during the past two weeks. Vaccination status of children was checked by observing vaccination card and if not available mothers asked to recall it. MUAC was measured on left mid upper arm and the result was recorded for both children and their mothers.

## 3.4. Study Variables

### 3.4.1. Response Variables

Child under nutrition could be identified in several ways. It was most commonly assessed through measurement of a child's weight and height, as well as through biochemical and clinical assessment. Indicators based on weight, height and age were compared to international standards and were most commonly used to assess the nutritional status of a population. Stunting captures early chronic exposure to under nutrition; wasting captures acute under nutrition; underweight was a composite indicator that includes elements of stunting and wasting (UNICEF, 2013). The advantage of anthropometry was that body measurements were sensitive over the full spectrum of malnutrition (Blossner and de Onis, 2012). Anthropometric measurement was a widely used, inexpensive and non-invasive measure of the general nutritional status of an individual (Cogill, 2003). In this study the data collected to assess the nutritional status of children by measuring the height and weight of all children aged between 6 and 59 months.

The height-for-age index provided an indicator of linear growth retardation and cumulative growth deficits in children. Children whose height-for-age Z-score was below minus two standard deviations from the median of the WHO reference population indicates stunting, or chronically malnourished. Children who were below minus three standard deviations indicate that severely stunted. Stunting reflects failure to receive adequate nutrition over a long period of time and was affected by recurrent and chronic illness.

The weight-for-height index measures body mass in relation to body height or length; it describes current nutritional status. Children with Z-scores below minus two standard deviations indicates that the child was thin (wasted) or acutely malnourished. Wasting represents the failure to receive adequate nutrition in the period immediately preceding the survey and may be the result of inadequate food intake or a recent episode of illness causing loss of weight and the beginning of undernutrition. A child with a weight-for-height index below minus three standard deviations indicates that the child was severely wasted. The weight-for-height index also provides data on overweight and obesity. Children more than two standard deviations above the median weight-for-height were overweight.

Weight-for-age was a composite index of height-for-age and weight-for-height. It takes into account both chronic and acute malnutrition. A child can be underweight for his/her age because he or she was stunted, wasted, or both. Weight-for-age was an overall indicator of a population's nutritional health. Children with weight-for-age below minus two standard deviations were classified as underweight. Children with weight-for-age below minus three standard deviations were severely underweight.

The dependent variables were the Z-score of weight for age, weight for height and height for age. The value of the Z-score was directly proportional to the nutritional status of children and by using Z-score as dependent variables the factors affecting nutritional status of under five children could be identified.

### 3.4.2. Explanatory Variables

i. **Wealth index** (1=poor, 2=medium and 3= rich). This variable was a proxy variable for many variables (Table 3). To fix the proxy variable principal component analysis was analyzed and the first component was used to determine the wealth index of household. This variable might improve the nutritional status of the children. The prevalence of children under nutrition decreases as the wealth quintile of the household increases (CSA, 2012). In this study relative living standards used to determine the wealth index in which relative poverty refers to living standards that are lower than those of other people in the specific population. One simple way of looking at relative poverty is to divide the population into equal groups based on the wealth index which was calculated by using the principal component analysis method (Rutstein and Johnson, 2004). The number of sleeping rooms and land size were continuous variables in the principal component analysis in the current study and they were standardized before entering into principal component analysis. In the current study rural principal component analysis for wealth index Roofing type, refrigerator, Bajaj, lorry, fixed telephone, and cooking material dropped because of zero variance. In urban principal component analysis electricity, roofing type, waters source, and bicycle dropped because of zero variance (Table 3).

We have get weight for each of the variables and many variables are reduced in few components and since the first component has maximum variance than all other components, the first component was took to determine the wealth index of the household and classified in to three

equal parts. The estimation of relative wealth using PCA is based on the first principal component (Rutstein and Johnson, 2004; Cordova, 2009).

Table 3: Wealth score calculation for the households of the selected kebeles of Haramaya district from January 5 to March 25, 2015

| Variables | Coding | Coefficients | |
|---|---|---|---|
| | | Rural | Urban |
| Has electricity | (yes =1, no = 0) | 0.1242 | Excluded |
| House ownership | (yes =1, no = 0) | -0.0544 | 0.1853 |
| Type of Flooring | (cement = 1, others=0) | 0.2907 | 0.2351 |
| Type of Roofing | (tin=1 , others =0) | excluded | Excluded |
| Wall material | (cement =1 , others =0) | 0.3867 | 0.2754 |
| Has Windows | (yes =1, no=0) | 0.3071 | 0.0629 |
| Water Source | (protected=1, unprotected=0) | 0.1577 | Excluded |
| Has toilet | (yes= 1, no =0 ) | 0.2888 | 0.0629 |
| Bath room | (yes=1 no=0) | -0.1584 | 0.0410 |
| Has Radio | (yes =1, no = 0) | 0.1115 | 0.2464 |
| Has Television | (yes =1, no = 0) | 0.1756 | 0.2491 |
| Has Refrigerator | (yes =1, no = 0) | excluded | 0.1830 |
| Has Watch | (yes =1, no = 0) | 0.1344 | 0.2173 |
| bicycle | (yes =1, no = 0) | 0.1092 | Excluded |
| Car | (yes =1, no = 0) | 0.2190 | 0.2787 |
| Bajaj | (yes =1, no = 0) | excluded | 0.0275 |
| Lorry(Isuzu) | (yes =1, no = 0) | excluded | 0.1175 |
| Has bed | (yes =1, no = 0) | -0.0198 | 0.2038 |
| Chair | (yes =1, no = 0) | 0.0941 | 0.2074 |
| Table | (yes =1, no = 0) | 0.1860 | 0.2258 |
| Cupboard | (yes =1, no = 0) | 0.0214 | 0.2645 |
| Shelves | (yes =1, no = 0) | 0.3277 | 0.1586 |
| sleeping room | | 0.3414 | 0.2289 |
| Land size | | 0.0572 | 0.1069 |
| Livestock | (yes =1, no = 0) | 0.0849 | 0.0744 |
| Domestic servant | (yes =1, no = 0) | -0.0808 | 0.1584 |
| Telephone (fixed) | (yes =1, no = 0) | excluded | 0.1313 |
| Mobile phone | (yes =1, no = 0) | 0.1516 | 0.2545 |
| Bank account | (yes =1, no = 0) | 0.3006 | 0.2335 |
| Cooking fuel | (use electricity=1, not use=0) | excluded | 0.2600 |

Formally, the wealth score for household of the i$^{th}$ child is the linear combination,

$$W_i = \alpha_1\left(\frac{x_1 - \bar{x}_1}{s_1}\right) + \cdots + \alpha_k\left(\frac{x_k - \bar{x}_k}{s_k}\right) \qquad (2)$$

Where, $\bar{x}_k$ and $s_k$ are the mean and standard deviation of asset $x_k$ and a represents the weight for each variable $x_k$ for the first principal component.

ii. **Residence of the household** (0 = rural, 1 = urban). Rural children were more likely to be undernourished than urban children (CSA, 2012).

iii. **Mother's education status** (0= no education and 1=educated). If the mother's education level was increase the child caring practice increase and this expected to improve the nutritional status of the children. As increase in the educational level of mothers probabilities of the child belonging to under-nourished group decreases (Rathnayake and Weerahewa, 2005).

iv. **Education status of father**: (0= no education, 1= educated). If the father has higher education level then he may has good understanding and caring of mother and child. Child nutrition is positively related to the education level of the father (Moestue and Huttly, 2008).

v. **The ways of treatment during the child was infected** (0=they use the cultural medication or 1= they go to health center). This variable measures whether his/her caregiver takes him/her to health center during infection or they treat their child by cultural medication. It was good practice if the child gets the heath center treatment during his/her infection. This variable improves the nutritional status of child (Efrem *et al.,* 2010).

vi. **Maternal employment status** (0= housewife only, 1= employed). If the mother working status was in her house, she would care her child appropriately but if she went out of home for job the child might be more exposed to undernutrition. Therefore this variable affects the nutritional status of the children negatively (Birhan, 2010).

vii. **Parent's decision making process** (0 = alone and 1= by discussion). Decision making process measures whether the father makes decision alone or the mother alone or by discussion. The nutritional status of the children improved if they decide by discussion (Gudina et al., 2014).

**v. Household food security status** (0= Insecure and 1= Secure). This variable was a proxy variable and measured by using short term nine questions of FANTA household food security measurement as listed below. These questions had four answers; never, rarely, sometimes and often, and coded as 0, 1, 2 and 3 respectively.

The nine questions shortly were:

1. Worry about food
2. Unable to eat preferred foods
3. Eat just a few kinds of foods
4. Eat foods they really do not want eat
5. Eat a smaller meal
6. Eat fewer meals in a day
7. No food of any kind in the household
8. Go to sleep hungry
9. Go a whole day and night without eating

A food secure household experiences none of the food insecurity (access) conditions, or just experiences worry, but rarely. The status of the household food security was coded as 0 for food insecure household and 1 for food secure (USDA, 2012). This variable might improve the nutritional status of children (Chaparro, 2012). Mathematically the household food security status could be computed as follows:

Let $q_{ij}$ is the value of i$^{th}$ question of household food security measurement for j$^{th}$ observation and $t_j = \sum_{i=2}^{9} q_{ij} \; for \; i > 1$ then,

$$FS_j = \begin{cases} q_{1j} & if\ t_j = 0\ and\ q_{1j} = 0 \\ (q_{1j} - 1) & if\ t_j = 0\ and\ q_{1j} \geq 1 \\ t_j & if\ t_j > 0 \end{cases} \qquad (3)$$

If $FS_j = 0$ the household for the j$^{th}$ observation was food secure otherwise insecure.

**vi. The vaccination status of the children** (0= no and 1= yes). This variable measures whether the child gets vaccination like BCG, polio and others properly. If the child vaccinated properly his/her immunity level increased. Therefore this may improve the nutritional status of the child (Tadiwos and Degenet, 2012).

**vii. Nutritional status of the mother** (0= malnourished and 1= nourished). The nutritional status of the mother will be determined by the MUAC and < 22 cm defined as malnourished (Haji Kedir *et al*., 2013). If the mother has not enough diets the child may not get enough nutrients from breast feeding and this may affect the nutritional status of the children negatively.

viii. **Age of child** (1=6-11, 2=12-17, 3=18-23, 4=24-35, 5=36-47, and 6=48-59). The age of the child was measured by months. The proportion of undernourished children was increases as the age of the children increases with highest in the age groups 24-35 months. Ethiopian Demographic and Health Survey 2011suggested that additional foods were typically introduced to children in the older age group. As the age of the child increase the complementary food requirement of the child also increase and as the food requirement of child increases the availability of food might not increase, thus increasing their exposure to infections, may contribute to decline nutritional status of children in higher age groups (Rathnayake and Weerahewa, 2005; CSA, 2012).

ix. **Child sex** (0= female, 1 = male). This variable categorize whether the child's sex was female or male. Male children were more likely affected by malnutrition relative to female children (CSA, 2012).

x. **Exclusive breast feeding status** (0=no or 1=yes). It was the dummy variable it measures whether the child feeds only breast milk for the first six months without introducing any food except some medication. If the mother breastfeeds exclusively during the first six months she reduces the baby's risk of illness, under nutrition and death. If the child feeds additional foods in the first six month the food might not easy for digestion. Therefore this variable might improve the nutritional status of the children (UNICEF, 2013).

xi. **The frequency of feeding the child per day**. This variable measures the frequency of feeding the child per day. If the child gets appropriate food more frequently, he/she can get enough diets for her body. Therefore this variable improves the nutritional status of the children (Kebede Mengistu *et al.*, 2013).

xii. **Diarrhoea infection** (0=no, 1=yes). This variable measures whether the child infected by diarrhoea two weeks before the survey. If the child infected by such disease he/she loose nutrients, and therefore it decrease the nutritional status of the child (CSA, 2012).

## 3.5. Operational Definitions

The operational definitions of some important words and phrases used in the current study were illustrated as follows:

**Exclusive breastfeeding**: Exclusive breastfeeding means that an infant receives only breast milk with no additional foods or liquids for the first six months.

**Basic factors**: the factors affecting the nutritional status of the children at society level was known as basic causes of child nutritional status and it includes political structure, cultural factors and economic contexts.

**Underlying factors**: underlying factors were the factors affecting child nutritional status at community and household level.

**Immediate factors**: the factors affecting child nutritional status at individual levels were known as proximal or underlying factors and it includes health status of the children and dietary intake.

**Diarrhoea**: Diarrhea is an illness that causes the child to pass waste from his/her body very frequently and in liquid rather than solid form.

**Undernutrition**: Children with a Z- score below minus two standard deviations were affected by malnutrition.

**Stunting**: A child was defined as stunted if the height for age index was found to be below -2 standard deviation of the mean of the standard curve. Severe stunting was diagnosed if it was below minus three standard deviations. Stunting refers to chronically undernourished.

**Underweight**: A child was defined as underweighted if the weight for age index was found to be below -2 standard deviation of the mean of the standard curve. Severe underweight was diagnosed if it was below minus three standard deviations.

**Wasting**: A child was defined as wasted if the weight for height index was found to be below -2 standard deviation of the mean of the standard curve. Severe wasting was diagnosed if it was below minus three standard deviations.

## 3.6. Data Quality Management

Well structured questionnaire was prepared in English and translated into '*Afaan Oromo'* language for field work purpose. Pre-test of the questionnaire done on 5% of sample size in study area before the actual data collection to see for the accuracy of responses and to manage field work. The scale indicators checked against zero reading after and before weighing every child. On daily basis collected information reviewed and possible errors were returned to the collectors for correction. After data collection, the investigator had checked the collected raw data for completeness and consistency before data entry. Then, coded and entered in the SPSS statistical software.

## 3.7. Data Processing and Analysis

To determine the z score of anthropometric measurements of the children based on WHO standards for each of three indicators the data imported to WHO Anthro software. The multivariate linear regression model was analysed in Stata software version 11.

The prevalence of stunting, underweight and wasting for under five children in the study area estimated based on anthropometric data obtained from the study population. The statistical model in this study was multivariate multiple linear regression models. The aim of this study was addressing the nutritional status of under five children and identifying the factors affecting nutritional status. The nutritional status of the children was categorical, but it was assessed by using anthropometric measurement like height-for-age, weight-for-height and weight-for-age. The Z-score of these measurements were continuous and used as dependent variables in the multivariate multiple linear regression models.

### 3.7.1. Multiple Linear Regression

Linear regression is an approach for modeling the relationship between dependent variable and explanatory variable when the dependent variable is continuous, and a statistical model that uses several explanatory variables to predict the outcome of a response variable is known as multiple linear regression models (Rencher and Schajle, 2008). Regression analysis is a statistical tool for the investigation of relationships between one or multiple independent variables and single or more continuous dependent variables. Multiple linear regression model is a general statistical model that is used when there are one or multiple independent variables and a single continuous dependent variable.

$$Y = X\beta + \varepsilon \tag{4}$$

Where

$$\mathrm{Y} = \begin{bmatrix} y_1 & y_2 & \cdots & y_n \end{bmatrix}', \ \beta = \begin{bmatrix} \beta_0 & \beta_1 & \cdots & \beta_p \end{bmatrix}' \ X = \begin{bmatrix} 1 & x_{11} & x_{12} & \cdots & x_{1p} \\ 1 & x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & x_{n1} & x_{n2} & \cdots & x_{np} \end{bmatrix}$$

### 3.7.2. Multivariate Multiple Linear Regression

A linear regression model that contains more than one dependent variable and more than one predictor variable is known as a multivariate multiple linear regression models (Rencher, 2002; Richard and Dean, 2007). The subject of multivariate analysis deals with the statistical analysis of the data collected on more than one response variable. Ordinarily the variables are measured simultaneously on each sampling unit. Typically, these variables are correlated (Rencher, 2002; Khattree and Naik, 2003). The multivariate approach enables us to explore the joint performance of the variables and determine the effect of each variable in the presence of the others, and multivariate statistics control type-I error by considering a set of dependent variables in multidimensional space and account for relationships among the dependent variables as well as the relationships between independent variables and dependent variables (Rencher, 2002).

The multivariate linear regression model is

$$\underset{(n\times d)}{Y} = \underset{(n\times(p+1))}{X}\ \underset{((p+1)\times d)}{\beta} + \underset{(n\times d)}{\varepsilon} \qquad (5)$$

Where
n is the number of observations
d is the number of dependent variables
p is the number of explanatory variables

$$Y=\begin{bmatrix} Y_{11} & Y_{12} & \dots & Y_{1d} \\ Y_{21} & Y_{22} & \dots & Y_{2d} \\ \dots & \dots & \dots & \dots \\ \vdots & \vdots & \ddots & \vdots \\ Y_{n1} & Y_{n2} & \dots & Y_{nd} \end{bmatrix} X=\begin{bmatrix} 1 & x_{11} & x_{12} & \cdots & x_{1p} \\ 1 & x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & x_{n1} & x_{n2} & \cdots & x_{np} \end{bmatrix} \beta=\begin{bmatrix} \beta_{01} & \beta_{02} & \cdots & \beta_{0d} \\ \beta_{11} & \beta_{12} & \cdots & \beta_{1d} \\ \vdots & \vdots & \ddots & \vdots \\ \beta_{p1} & \beta_{p2} & \cdots & \beta_{pd} \end{bmatrix} \varepsilon=\begin{bmatrix} \varepsilon_{11} & \varepsilon_{12} & \dots & \varepsilon_{1d} \\ \varepsilon_{21} & \varepsilon_{22} & \dots & \varepsilon_{2d} \\ \dots & \dots & \dots & \dots \\ \vdots & \vdots & \ddots & \vdots \\ \varepsilon_{n1} & \varepsilon_{n2} & \dots & \varepsilon_{nd} \end{bmatrix}$$

$E(\varepsilon_{(i)}) = 0$ and $Cov(\varepsilon_{(i)}, \varepsilon_{(k)}) = \sigma_{ik} I$ i, k=1,2,…,d

The model was linear because it was linear in the parameters $\beta_1, \beta_2, ..., \beta_k$

In this study the dependent variables are the z score of the three indicators of child under nutrition based on the WHO standard (Weight for age, height for age and weight for height). Independent variables are the factors associated with under nutrition. Since Z-score was directly proportional to the nutritional status of children, the z score of minus two and less indicates that a child was malnourished. Therefore the direction of the explanatory variables with the z score of children used to identify the factors affecting nutritional status of under five children.

### 3.7.3. Model Adequacy Checking

If the model was appropriately fitted with the data, the residuals should have a normal distribution with mean zero and constant variance. If any of the assumptions was violated then the forecasts, confidence intervals, and conclusions yielded by a regression model may be inefficient or seriously biased or misleading.

**Homoscedasticity of the errors**: - One of the key assumptions of regression is that the variance of the errors is constant across observations. If the errors have constant variance, the errors are called homoscedastic. Breusch-Pagan tests the null hypothesis that the error variances are all equal versus the alternative that the error variances are a multiplicative function of one or more variables (StataCorp, 2013). Define the matrix □ to be composed of the values of the variables listed in the model, such that $z_{ij}$ is the value of the $j^{th}$ variable in the model for the $i^{th}$ observation. The null hypothesis of the Breusch-Pagan test is

$$\sigma_i^2 = \sigma^2(\alpha_0 + \alpha' z_i) \qquad H_0 : \alpha = 0 \tag{6}$$

Where $\sigma_i^2$ is the error variance for the $i^{th}$ observation and $\alpha_0$ and $\alpha$ are regression coefficients. The test statistic for the Breusch-Pagan test is

$$bp = \frac{1}{v}(u - \bar{u}i)'Z(Z'Z)^{-1}Z'(u - \bar{u}i)$$

Where $u = \left(e_1^2, e_2^2, ..., e_n^2\right)$, i is a $n \times 1$ vector of ones and $v = \frac{1}{n}\sum_{i=1}^{n}\left(e_i^2 - \frac{e'e}{n}\right)^2$

A large chi-square would indicate that heteroskedasticity was present. In the current study, the chi-square value was small, indicating heteroskedasticity was not a problem (Appendix table 4).

**Normality of the error distribution**: - To check the normality of residuals a Doornik–Hansen test was used in the current study (StataCorp, 2013). Multivariate normality tests are used for checking a given set of data for similarity to the multivariate normal distribution. Multivariate normality test is a fundamental predicament in statistics. The null hypothesis is that the data set is similar to the normal distribution; therefore a sufficiently small *p*-value indicates non-normal data. Most of the multivariate normality test procedures are extensions of univariate normality tests. For the Doornik–Hansen test, the multivariate observations are transformed, then the univariate skewness and kurtosis for each transformed variable is computed, and then

these are combined into an approximate $\chi^2$ statistic. Let V be a matrix with ith diagonal element equal to $S^{-1/2}$ where $S_{ii}$ is the $i^{th}$ diagonal element of S. C=VSV is then the correlation matrix. Let H be a matrix with columns equal to the eigenvectors of C, and let $\Lambda$ be a diagonal matrix with the corresponding Eigen values. Let $\breve{X}$ be the centered version of X, i.e., $\bar{x}$ subtracted from each row. The data are then transformed using:

$$\dot{X} = \breve{X} VH\Lambda^{-1/2} H' \qquad (7)$$

The univariate skewness and kurtosis for each column of $\dot{X}$ is then computed. The general formula for univariate skewness is $\sqrt{b_1} = m_3 / m_2^{3/2}$ and kurtosis is $b_2 = m_4 / m_2^2$ where $m_p = 1/N \sum_{i=1}^{N} (x_i - \bar{x})^p$ . The univariate skewness is transformed in to an approximately normal variate

$$z_1 = \delta \log(y + \sqrt{1 + y^2}) \qquad (8)$$

Where,

$$y = \left\{ \frac{b_1(\omega^2 - 1)(N+1)(N+3)}{12(N-2)} \right\}^{1/2} \quad \delta = \left( \log \sqrt{\omega^2} \right)^{-1/2} \quad \omega^2 = -1 + \sqrt{2(\beta - 1)}$$

$$\beta = \frac{3\left(N^2 + 27N - 70\right)\left(N+1\right)\left(N+3\right)}{\left(N-2\right)\left(N+5\right)\left(N+7\right)\left(N+9\right)}$$

The univariate kurtosis $b_2$ is transformed from a gamma variate in to a $x^2$ variate and then in to a standard normal variable $z_2$

$$z_2 = \sqrt{9\alpha} \left\{ \left( \frac{x}{2\alpha} \right)^{1/3} - 1 + \frac{1}{9\alpha} \right\} \qquad (9)$$

Where,

$$x = 2f\left(b_2 - 1 - b_1\right) \text{ , } \alpha = a + b_1 c \text{ , } f = \frac{\left(N+5\right)\left(N+7\right)\left(N^3 + 37N^2 + 11N - 313\right)}{12\delta}$$

$$c = \frac{\left(N-7\right)\left(N+5\right)\left(N+7\right)\left(N^2 + 2N - 5\right)}{6\delta}, a = \frac{\left(N-2\right)\left(N+5\right)\left(N+7\right)\left(N^2 + 27N - 70\right)}{6\delta}$$

$$\delta = \left(N-3\right)\left(N+1\right)\left(N^2 + 15N - 4\right)$$

The $z_1$ and $z_2$ associated with the columns of $\dot{X}$ are collected in to vectors $Z_1$ and $Z_2$. The statistics $Z_1{}' Z_1 + Z_2{}' Z_2$ is approximately chi-square distributed with 2k degrees of freedom. In

the current model multivariate normality test statistics of chi-square with 6 degree of freedom is 8.881 with p-value of 0.18, then the hypothesis that the residual in the model normally distributed did not rejected. Therefore there is no normality problem in the data (Appendix table 3).

**Multicollinearity**:- The presence of correlations between the predictors was termed as multicollinearity. If a perfect correlation between two or more predictors exists, unique least squares solution to a regression analysis cannot be computed. More commonly, less severe multicollinearity can lead to unstable estimates of the coefficients for individual predictors. The variance inflation factor (VIF) was one popular measure of multicollinearity and used to know whether multicollinearity seriously affects the model and if the multicollinearity was serious (VIF>10) some of highly correlated predictors will be removed from the model. In the current model, the multicollinearity test of independent variables checked by variance inflation factor (VIF) and there is no any serious problem of multicollinearity among independent variables (Appendix table 1).

The residual scatter plot shows no apparent pattern (Appendix figure) and the value of Wilks' lambda test of overall model is about 0.542 with p-value of less than 0.001 (Appendix table 5), therefore this indicates that the model appropriately fitted with the data.

### 3.7.4. Parameter Estimation

The maximum likelihood (ML) and ordinary least squares (OLS) are the two most contending estimation methods used in fitting linear regression model. In the current study ordinary least square method was used. If $E(Y) = X\mathrm{B}$ and $\mathrm{cov}(Y) = \sigma^2 I$ , the least-squares estimators have minimum variance among all linear unbiased estimators and least-squares estimators $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, .... \hat{\beta}_p$ were best linear unbiased estimators (BLUE). In this expression, best means minimum variance and linear indicates that the estimators were linear functions of y (Rencher and Schajle, 2008). The ordinary least square is a method for approximately determining the unknown parameters located in a linear regression model and the OLS estimator of β is also the ML estimator, this why OLS was used in the current study.

The OLS estimator is the best estimator within the class of linear unbiased estimators (Rencher, 2002). For the parameters $\beta_0, \beta_1, \beta_2, ...\beta_p$ we seek estimators that minimize the sum of squares of error term. It can be written as:

$$\varepsilon'\varepsilon = (y - \hat{y})'(y - \hat{y}) \quad (10)$$

By differentiating equation (10) in terms of $\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2, ....\hat{\beta}_p$ the OLS estimators of $\beta_0, \beta_1, \beta_2, ...\beta_p$ can be obtained.

In multivariate linear regression the i[th] response $Y_{(i)}$ follows the univariate linear regression model (Richard and Dean, 2007)

$$Y_{(i)} = X\beta_{(i)} + \varepsilon_{(i)}, \text{ i=1,2,…,d} \quad (11)$$

Given the outcomes Y and the values of the predictor variables X with full column rank, the least squares estimate $\hat{\beta}_{(i)}$ exclusively from the observations $Y_{(i)}$ on the ith response. In the conformity with the single response solution, we take

$$\hat{\beta}_{(i)} = (X'X)^{-1} X'Y_{(i)} \quad (12)$$

Collecting these univariate least squares estimates, we obtain

$$\hat{\beta} = [\hat{\beta}_{(1)} \vdots \hat{\beta}_{(2)} \vdots \cdots \vdots \hat{\beta}_{(d)}] = (X'X)^{-1} X'[Y_{(i)} \vdots Y_{(2)} \vdots \cdots \vdots Y_{(d)}] \quad (13)$$

Or $\hat{\beta} = (X'X)^{-1} X'Y$

### 3.7.5. Hypothesis Testing

#### 3.7.5.1. Test of overall regression

The test of the overall regression was testing hypothesis that none of the X variables predict Y. That means there was no relationship between the explanatory variables and the response variable that the fit of the observed dependent variable values to those predicted by the multiple regression equation was no better than what you would expect by chance. This hypothesis can be expressed as $H_0 : \beta_1 = 0$ where $\beta_1 = (\beta_1, \beta_2, ...\beta_p)'$. To test this hypothesis regression sum of square (SSR), residual sum of square (SSE) and total sum of square needed.

$$SSR = \hat{\beta}_1 X'_c X_c \hat{\beta}_1 \quad (14)$$

$$SST = \sum_{i=1}^{n} (y_i - \bar{y})^2 \quad (15)$$

$$SSE = SST - SSR \quad (16)$$

From equation (16) and equation (18), the F statistics calculated as:

$$F = \frac{SSR / P}{SSE /(n - p - 1)} \quad (17)$$

If $H_0 : \beta_1 = 0$ was true, F was distributed as F (p, n - p - 1).

$H_0$ was rejected, if $F > F_{\alpha,p,n-p-1}$ where $F_{\alpha,p,n-p-1}$ was the upper $\alpha$ percentage point of F distribution.

For multivariate case, first consider the hypothesis that none of the *x*'s predict any of the *y*'s which can be expressed as $H_0 : \beta_1 = 0$, where $\beta_1$ contains all rows of $\beta$ except the first

$$\beta = \begin{pmatrix} \beta_0' \\ \beta_1 \end{pmatrix} = \left(\begin{array}{cccc} \beta_{01} & \beta_{02} & \cdots & \beta_{0p} \\ \hline \beta_{11} & \beta_{12} & \cdots & \beta_{1p} \\ \vdots & \vdots & & \vdots \\ \beta_{d1} & \beta_{d2} & \cdots & \beta_{dp} \end{array}\right) \quad (18)$$

The alternative hypothesis is $H_1 : \beta_1 \neq 0$ which implies that we want to know if even one $\beta_{jk} \neq 0$ , $j = 1, 2, ..., d$; $k = 1, 2, ..., p$.

The test statistics used in the current study was Wilk's lambda which is denoted by $\Lambda^*$,

$$\Lambda^* = \frac{|W|}{|B + W|} \quad (19)$$

Where,

$$W = \sum_{l=1}^{d} \sum_{j=1}^{n_l} (x_{lj} - \bar{x}_l)(x_{lj} - \bar{x}_l)' = (n_1 - 1)S_1 + (n_2 - 1)S_2 + ... + (n_d - 1)S_d$$

$$B = \sum_{l=1}^{d} n_l (\bar{x}_l - \bar{x})(\bar{x} - \bar{x})'$$

In the current model, the value of Wilks' lambda is about 0.542 with p-value of less than 0.001, therefore this indicates that the model highly fitted with the data (Appendix table 5).

#### 3.7.5.2. Test on a subset of the explanatory variables

Before preceding for multivariate multiple linear regressions, let us explain for multiple linear regression case. The test on a subset of the coefficients is testing the hypothesis that a subset of the x's is not useful in predicting the dependent variable. Let the full model consists of k predictors and the reduced model consists of k-h predictors then our hypothesis to be tested is $H_0 : \beta_{k-h+1} = \beta_{k-h+2} = ... = \beta_k = 0$, i.e., given that the effect of the other $k$ - $p$ independent variables on Y is already considered (in the reduced model).

$H_A : \beta_i \neq 0$ for some $k-h+1 \leq i \leq k$, i.e., at least one of the variables in the set being tested remains correlated to $\boldsymbol{Y}$ in the model even after conditioning on the effect of the other of $k$ - $p$ variables on the observed variation of the dependent variable.

The test statistics is

$$F = \frac{(SSE_R - SSE_F)/h}{SSE_F/[n-(k+1)]} \tag{20}$$

Where

$SSE_R$ = error sum of squares for reduced model with h predictors

$SSE_F$ = error sum of squares for full model with k predictors

We reject the null hypothesis if $F > F_{0.05,h,n-k-1}$

The hypothesis that the response variables do not depend on a subset of the predictor variables in the multivariate linear regression model becomes

$$H_0 : \beta_{(2)} = 0 \text{ where } \beta = \begin{bmatrix} \beta_{(1)} \\ \underset{((q+1)\times m)}{} \\ \beta_{(2)} \\ \underset{((r-q)\times m)}{} \end{bmatrix} \tag{21}$$

And setting $X = \underset{(n\times(q-1))}{\begin{bmatrix} \vdots \\ X_1 \\ \vdots \end{bmatrix}} \underset{(n\times(r-q))}{\begin{bmatrix} \vdots \\ X_2 \\ \vdots \end{bmatrix}}$ and

The general model can be written as

$$E(Y) = X\beta = \begin{bmatrix} X_1 \vdots X_2 \end{bmatrix} \begin{bmatrix} \beta_{(1)} \\ \beta_{(2)} \end{bmatrix} = X_1\beta_{(1)} + X_2\beta_{(2)} \tag{22}$$

Under $H_0 : \beta_{(2)} = 0$, $Y = X_1\beta_{(1)} + \varepsilon$ and the likelihood ratio test of $H_0$ is based on the quantities involved in the extra sum of squares and cross products

$$\left(Y - X_1\hat{\beta}_{(1)}\right)'\left(Y - X_1\hat{\beta}_{(1)}\right) - \left(Y - X\hat{\beta}\right)'\left(Y - X\hat{\beta}\right) = n(\hat{\Sigma}_1 - \hat{\Sigma}) \tag{23}$$

Where $\hat{\beta}_{(1)} = (X_1'X_1)^{-1}X_1'Y$ and $\hat{\Sigma}_1 = n^{-1}\left(Y - X_1\hat{\beta}_{(1)}\right)'\left(Y - X_1\hat{\beta}_{(1)}\right)$

The likelihood ratio, $\Lambda$, can be expressed in terms of generalized variances:

$$\Lambda = \frac{\max_{\beta_{(1)},\Sigma} L(\beta_{(1)},\Sigma)}{\max_{\beta,\Sigma} L(\beta,\Sigma)} = \frac{L(\hat{\beta}_{(1)},\hat{\Sigma}_1)}{L(\hat{\beta},\hat{\Sigma})} = \left(\frac{\left|\hat{\Sigma}\right|}{\left|\hat{\Sigma}_1\right|}\right)^{n/2} \tag{24}$$

Equivalently Wilk's lambda statistic $\Lambda^{2/n} = \frac{\left|\hat{\Sigma}\right|}{\left|\hat{\Sigma}_1\right|}$ can be used.

Let the multivariate multiple regression model hold with X of full rank r+1 and (r+1) +d≤n. Let the errors $\varepsilon$ be normally distributed under $H_0 : \beta_{(2)} = 0$ and $n\hat{\Sigma}$ is distributed as $W_{p,n-r-q-1}(\Sigma)$.

The likelihood ratio test of $H_0$ is equivalent to rejecting $H_0$ for large values of

$$-2\ln\Lambda = -n\ln\left(\frac{\hat{\Sigma}}{\hat{\Sigma}_1}\right) = -n\ln\frac{\left|n\hat{\Sigma}\right|}{\left|n\hat{\Sigma} + n(\hat{\Sigma}_1 - \hat{\Sigma})\right|} \tag{25}$$

## 3.8. Ethical Consideration

Office of health department in the study area was communicated through letters from Haramaya University Department of Statistics. Letters of permission obtained from Haramaya Wereda health office and Offices at lower levels in the study area communicated through letters from health office of Haramaya Wereda. Oral informed permission taken from each mother prior to the interview and anthropometric measurement of children done after the purpose of the study explained to them.

# 4. RESULT

Under this subtitle socio-demographic characteristics of the study participants, caring practice and health status of the children, and the nutritional status of the children were described. The factors associated with nutritional status of the children were assessed using multivariate multiple linear regression model.

## 4.1. Socio- Demographic Characteristics of the Study Participants

A total of 402 children aged 6-59 months within five kebeles (Finkile, Damota, Efa bate, Karo dada, and Addele) selected from Haramaya district were included in the analysis of the current study making a response rate of 96.8%. From the total 223(55.5%) were males and 179(45.5%) were females. The average age of the children in the study is 25.1 months and about 25.6 percent of the children are from 24-35 age groups, the highest number of the children found in this age group. About 3.7, 6.5, 23.4, 16.2, 14.7, and 10 percent of the children in the study were from age group of 6-8, 9-11, 12-17, 18-23, 36-47 and 48-59 months respectively; about 87.1% of the children in the study were from rural area (Table 4).

The mothers of 81.1 percent of the children in the study were housewife only, about 14.2 percent were participating in the farming and about 4.2 percent were merchants. The fathers of about 77.4 percent of the children in the study were farmers and 6.5 percent were government employee. about 54.5 percent of the children were from a family of their mother did not go to school and about 29.1% their father did not go to school, that mean they did not go to school at all. About 31.6 percent of the children were from a mother of malnourished (Table 4).

About 90.8 percent of the children in the study were from a family of male household head and 9.2 percent were from a family of female household head. Regarding with the decision style of the parents on treatment of the child during infection or sickness, about 60.4 percent of the children were from a family of practicing discussion on treatment of their child and the remaining about 39.6 percent are from a family of decide without discussion. The household food security status was determined by nine FANTA questions about their food problems in the past thirty days before the survey and about 40.8 percent of the children in the study were from a family of food insecure and about 59.2 percent are from a family of food secure (Table 4).

**Table 4:** Socio-demographic characteristics of the study participants in Haramaya district from January 05 to March 25, 2015

| Variables | Categories | Frequency(Percent) |
|---|---|---|
| Child sex | Female | 179 (44.5) |
| | Male | 223 (55.5) |
| The age of the child | 6-8 | 15 (3.7) |
| | 9-11 | 26 (6.5) |
| | 12-17 | 94 (23.4) |
| | 18-23 | 65 (16.2) |
| | 24-35 | 103 (25.6) |
| | 36-47 | 59 (14.7) |
| | 48-59 | 40 (10.0) |
| The residence of the household | Urban | 52 (12.9) |
| | Rural | 350 (87.1) |
| Occupation of the mother | House wife only | 326(81.1) |
| | Farmer | 57(14.2) |
| | Merchant | 17(4.2) |
| | Gov't employee | 2(0.5) |
| Occupation of the father | Farmer | 311(77.4) |
| | Gov't employee | 26(6.5) |
| | Merchant | 31(7.7) |
| | Daily laborer | 14(3.5) |
| | Others | 20(5.0) |
| Education status of the mother | Illiterate | 219(54.5) |
| | Literate | 183(45.5) |
| Education status of the father | Illiterate | 117(29.1) |
| | Literate | 285(70.9) |
| Nutritional status of the mother | Malnourished | 127(31.6) |
| | Nourished | 275(68.4) |
| Household head | Male | 365(90.8) |
| | Female | 37(9.2) |
| Decider on treatment of the child | Alone | 159(39.6) |
| | by discussion | 243(60.4) |
| Household food security status | Insecure | 164(40.8) |
| | Secure | 238(59.2) |

## 4.2. Caring Practice and Health Status of Children

About 97 percent of the children in the study were properly vaccinated according to their age and the mothers of about 98.5 percent of the children were reported that they treated their children in health centre. The number of the food type child feed also determined by classifying the food in

to four categories as cereal and its product, animal product, vegetables, and fruits. Only three percent of the children in the study feed all these four types of food. The respondents interviewed whether their child infected by any disease and diarrhoea two weeks before the survey. About 42.3 percent of the children infected by disease two weeks before the survey and about 18.4 percent of the children were infected by diarrhoea two weeks before the survey (Table 5).

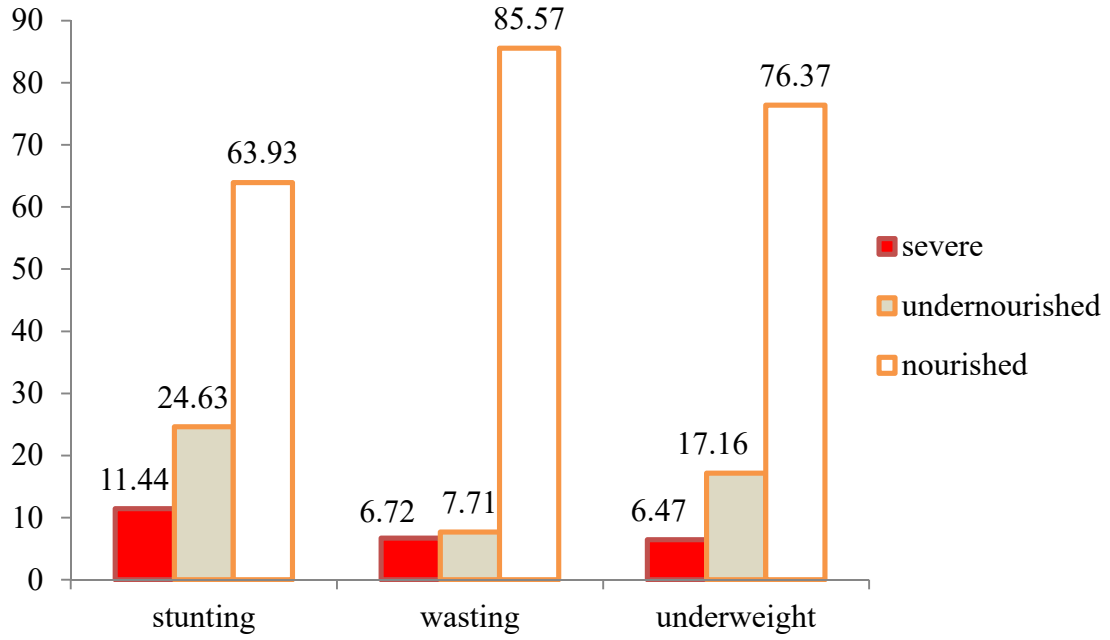
**Table 5**: Caring practice and health status of children in Haramaya district from January 05 to March 25, 2015

| Variables | Categories | Frequency(Percent) |
|---|---|---|
| Vaccination status of children | not vaccinated | 12(3.0) |
| | Vaccinated | 390(97.0) |
| Place of child treatment | No in health facilities | 6(1.5) |
| | In health facilities | 396(98.5) |
| Number food type the child feed | 1 | 110(27.4) |
| | 2 | 70(17.4) |
| | 3 | 210(52.2) |
| | 4 | 12(3.0) |
| Infection by any disease before survey | No | 232(57.7) |
| | Yes | 170(42.3) |
| Diarrhoea infection before the survey | No | 328(81.6) |
| | Yes | 74(18.4) |

## 4.3. Nutritional status of the children

According to the WHO (2006) reference standard taking two standard deviations as cutoff point, the z score of the study subject who fails below minus two standard deviation was taken as stunted, wasted and under weight. The prevalence of stunting, wasting and underweight were 36.07% [95% CI (31.4%, 40.8%)], 14.43% [95% CI (11.0%, 17.9%)] and 23.63% [95% CI (19.5%, 27.8%)] respectively. Prevalence of severe stunting, wasting and underweight was 11.44% (95% CI [8.3%, 14.6%]), 6.72% (95% CI [4.3%, 9.2%]) and 6.47% (95% CI [4.1%, 8.9%]) respectively (Figure 3).

**Figure 3:** Nutritional status of children aged 6-59 months by percent in Haramaya district from January 05 to March 25, 2015




## 4.4. Correlation Analysis

The child MUAC and the z score of the three indicators of the child malnutrition had highly significant correlation and positively correlated. (Table 6).

**Table 6**: The correlation of the child MUAC and family size to the three indicators of malnutrition of the child

| The Z-scores | Child MUAC |
|---|---|
| WHZ | 0.1772** |
| HAZ | 0.2843** |
| WAZ | 0.3115** |

## 4.5. Multivariate Linear Regression Analysis of Full Model

The relationship between the dependent variables with each factor was detected by using multivariate analysis of variance and about 9 factors are significant at 95% confidence (Table 7). Non significant variables were tested whether they are jointly zero given that all factors in the model using Wilk's Lamda test; and these seven variables out of sixteen variables were

insignificant with F value of 1.37 with 21 and 367 degrees of freedom (p-value = 0.1314). In the next model, the multivariate multiple linear regression model, all significant factors were entered.

**Table 7**: MANOVA table for the factors of child nutrition in Haramaya district from January 05 to March 25, 2015

| Source | df1 | df2 | F | Prob>F |
|---|---|---|---|---|
| Residence | 3.0 | 365.0 | 12.19 | 0.0000 |
| Child sex | 3.0 | 365.0 | 6.46 | 0.0003 |
| Diarrhea infection | 3.0 | 365.0 | 3.26 | 0.0217 |
| Food frequency | 3.0 | 365.0 | 4.80 | 0.0027 |
| HFSS | 3.0 | 365.0 | 10.29 | 0.0000 |
| Employment of mother | 3.0 | 365.0 | 9.23 | 0.0000 |
| Mother education status | 3.0 | 365.0 | 2.10 | 0.0994 |
| Child age | 15.0 | 1008.0 | 13.32 | 0.0000 |
| Mother nutritional status | 3.0 | 365.0 | 1.37 | 0.2511 |
| Decision style | 3.0 | 365.0 | 4.17 | 0.0064 |
| Vaccination | 3.0 | 365.0 | 0.79 | 0.4975 |
| Child treatment | 3.0 | 365.0 | 1.52 | 0.2084 |
| Father education status | 3.0 | 365.0 | 0.73 | 0.5370 |
| Exclusive breast | 3.0 | 365.0 | 1.76 | 0.1540 |
| Wealth status | 6.0 | 730.0 | 4.85 | 0.0001 |
| Residual | | | 368 | |
| Total | | | 388 | |

## 4.6. Univariate Linear Regression Analysis for HAZ

The number of observations used in multivariate linear regression model was 389; because the z scores of weight for age and weight for height of the children with edema could not be calculated. Out of 402 children for thirteen children edema was detected in the current study. The coefficients of multivariate linear regression is simply it was the collection of the univariate linear regression coefficients, but if the number of observations was not equal for all dependent variables some variations may be seen. The significant factors of height for age in univariate linear regression model were similar to that of multivariate linear regression. But the sex of the

child was significant in the case of multivariate linear regression model in contrast it was insignificant in univariate linear regression model and 24-35 months age group was insignificant in the case of multivariate linear regression model in contrast it was significant in the case of univariate linear regression model (Table 8).

**Table 8**: Univariate linear regression model analysis for HAZ

| Predictors | Categories | Coefficients | t | p-values | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| Child sex | Male | -.238593 | -1.79 | 0.074 | -.5008228 | .0236368 |
| Diarrhea infection | Yes | -.4197864 | -2.52 | 0.012 | -.7475436 | -.0920293 |
| Food frequency | | .1453651 | 3.84 | 0.000 | .0709485 | .2197817 |
| HFSS | Secure | .3131586 | 2.40 | 0.017 | .0562219 | .5700953 |
| Mother employ | Has work | -.5462381 | -3.31 | 0.001 | -.8710087 | -.2214676 |
| Wealth Quintiles | Medium | .1421217 | 0.90 | 0.371 | -.1696225 | .4538658 |
| | Rich | -.1301602 | -0.83 | 0.405 | -.4374146 | .1770941 |
| Age | 12-17 | -.486597 | -2.06 | 0.040 | -.951219 | -.021975 |
| | 18-23 | -.2604937 | -1.02 | 0.307 | -.7611524 | .2401649 |
| | 24-35 | -.4916388 | -2.13 | 0.034 | -.945231 | -.0380465 |
| | 36-47 | -.2620038 | -1.04 | 0.300 | -.7583883 | .2343807 |
| | 48-59 | -.3043014 | -1.10 | 0.272 | -.8479415 | .2393386 |
| Decision making | | .1486261 | 1.10 | 0.273 | -.117539 | .4147913 |
| Residence | | -.759579 | -4.02 | 0.000 | -1.13124 | -.387918 |
| Constant | | -.6368594 | -1.75 | 0.081 | -1.351642 | .0779233 |

## 4.7. Multivariate Linear Regression Analysis of Reduced Model

The regression analyses with the concept of UNICEF conceptual frame work and without the conceptual frame work were analyzed. The results of these two analyses were slightly different and the results of regression analysis with the concept of UNICEF conceptual frame work were analyzed by using three different hierarchical models.

### 4.7.1. Regression Analysis without the Concept of UNICEF Conceptual Frame Work

The predictors significantly related to the dependent variables in regression analysis without conceptual frame work, entering all variables in one model (Table 9).

**Table 9:** Regression Analysis without the Concept of UNICEF Conceptual Frame Work

| Predictors | Categories | $\hat{\beta}_{p1}$ ( WHZ) | $\hat{\beta}_{p2}$ (HAZ) | $\hat{\beta}_{p3}$ (WAZ) |
|---|---|---|---|---|
| **Residence** | Rural | .82** | -.79** | .17 |
| **Child sex** | Male | -.50** | -.31* | -.51** |
| **Diarrhea** | Yes | -.52** | -.42* | -.60** |
| **Food frequency** | | .03 | .14** | .10** |
| **HFSS** | Secure | .67** | .36** | .68** |
| **Mother employ** | Has work | -.71** | -.48** | -.80** |
| **Child Age** | 12-17 | .64** | -.49* | .40 |
| | 18-23 | .59 | -.19 | .52* |
| | 24-35 | .40* | -.43 | .19 |
| | 36-47 | .85** | -.26 | .56* |
| | 48-59 | -.01 | -.15 | -.02 |
| **Decision style** | Discussion | -.42 | .24 | -.15 |
| **Wealth status** | Medium | .54** | .01 | .37* |
| | Rich | .97** | -.25 | .55** |
| **Constant** | | -1.24 | -.60 | -1.30 |

### 4.7.2. Regression Analysis with the Concept of UNICEF Conceptual Frame Work

#### 4.7.2.1. Weight for age

The predictors significantly related to the z score of the weight for age were child sex [β=-0.73, 95% CI(-0.97, -0.48)], diarrhea infection status [β=-0.59, 95% CI(-0.91, -0.26)], additional food frequency [β=0.09, 95%CI(0.02, 0.16)], 18-23 months age group [β=0.58, 95% CI(0.08, 1.07)], wealth status (rich[β= 0.46, 95% CI(0.15, 0.78)]), household's food security status [β=0.84, 95% CI(0.59, 1.10)], and the employment status of the mother [β=-0.98, 95% CI(-1.30, -0.67)](Table 10).

The mean z scores of the weight for age of children in 18-23 months significantly about 0.58 greater when compared with the children in 6-11 months respectively given that all other factors in the model were constant. The mean z score of weight for age of the children from the rich living standard household was significantly about 0.46 greater when compared to the z score of the weight for height of the children from poor households.

The mean z score of weight for age of male children was significantly about 0.73 less relative to the mean z score of the female children given that all other factors in the model were constant. The mean z score of the children who were infected by diarrhea two weeks before the survey was

significantly about 0.59 less than the z score of the children who were not infected by diarrhea two weeks before the survey given that all other factors in the model are constant.

The mean z score of weight for age of the children increased by 0.09 as the frequency of additional food the child took per day increased by one unit given that all other factors in the model were constant. The mean z score of the children whose house hold were food secure was about 0.84 greater when compared with the z score of the children whose family is food insecure given that all other factors in the model were constant. The mean z score of the weight for age of the children whose mother had work was about 0.98 less than the mean z score of the weight for age of the children whose mother were housewife only given that all other factors in the model were constant.

#### 4.7.2.2. Height for age

The predictors significantly related to the stunting of the children in the current study were residence [β=-0.66, 95%CI(-1.07, -0.26)] , child sex [β=-0.37, 95%CI(-0.63, -0.12)], diarrhea [β=-0.59, 95%CI(-91, -0.26)], 24-35 months age group [β=-0.67, 95%CI(-1.13, -0.20)] of child age, additional food frequency the child took per day [β=0.09, 95%CI(0.02, 0.16)], household food security status [β=0.52, 95%CI(0.25, 0.78)], and employment status of the mother [β=-0.49, 95%CI(-0.81, -0.16)](Table 10).

The mean z score of height for age of the children in 24-35 months was significantly less about 0.67 when compared with the mean z score of height for age of the children in 6-11months age group given that all factors in the model were constant. The mean z score of height for age of the children increased by 0.09 as the frequency of additional food the child took per day increased by one unit. The mean z score of height for age of the children from rural area was about 0.66 less when compared with the mean z score of height for age of the children from urban area given that all other factors in the model were constant.

The mean z score of the height for age of the children whose mother had work was about 0.49 less than the mean z score of the height for age of the children whose mother were housewife only given that all other factors in the model were constant. The mean z score of height or age the children who were infected by diarrhea two weeks before the survey was about 0.52 less than

the z score of the children who were not infected by diarrhea two weeks before the survey given that all other factors in the model were constant.

The mean z score of height for age of male children was about 0.37 less when compared to the mean z score of height for age of female children given that all other factors in the model were constant. The mean z score of height for age of the children from a family of household food secure is 0.52 greater when compared to the mean z score of height for age of the children from a family of household food insecure given that all other factors in the model keeping constant.

#### 4.7.2.3. Weight for height

The predictors significantly related to the z score of the weight for height of the children in the study area were residence [β=0.97, 95% CI (0.43, 1.21)], child sex [β=-0.73, 95% CI (-1.02, -0.45)], diarrhea [β=-0.67, 95% CI (-1.04, -0.31)], 18-23 months age group [β=0.73, 95%CI(0.16, 1.3)], household food security status [β=0.77, 95%CI(0.47, 1.06)], the employment status of the mother [β=-0.99, 95%CI(-1.34, -0.64)], and wealth status (rich [β=.72, 95% CI (0.37, 1.08)]) (Table 10).

The mean z score of the weight for height of the children in 18-23 months age were significantly about 0.73 greater when compared to the mean z score of the weight for height of the children in the 6-11 months age given that all factors in the model were constant. The mean z score of weight for height of children from the rich living standard household was about 0.72 greater when compared to the mean z score of weight for height of children from poor living standard given that all other factors in the model were constant. The mean z score of the weight for height of the children whose mother had work was about 0.99 less than the mean z score of the weight for height of the children whose mother were housewife only given that all other factors in the model were constant.

The mean z score of weight for height of the children from a family of household food secure is 0.77 greater when compared to the mean z score of weight for height of the children from a family of household food insecure given that all other factors in the model keeping constant. The mean z score of the children who were infected by diarrhea two weeks before the survey was about 0.67 less than the z score of the children who were not infected by diarrhea two weeks before the survey given that all other factors in the model are constant.

The mean z score of weight for height of the children from rural area was about 0.97 greater when compared to the mean z score of weight for height of the children from urban area given that all other factors in the model were constant. The mean z score of weight for height of male children was about 0.73 less when compared to the mean z score of weight for height of female children given that all other factors in the model were constant.

**Table 10**: Factors associated with child nutritional status in Haramaya district, 2015

| Group | Predictors | Categories | $\hat{\beta}_{p1}$ ( WHZ) | $\hat{\beta}_{p2}$ (HAZ) | $\hat{\beta}_{p3}$ (WAZ) |
|---|---|---|---|---|---|
| **Basic factors** | Residence | Rural | .97** | -.66** | .32 |
| | Wealth status | Medium | -.03 | .06 | -.002 |
| | | Rich | .72** | -.07 | .46** |
| | Mother employ | Has work | -.99** | -.49** | -.98** |
| **Underlying factors** | HFSS | Secure | .77** | .52** | .84** |
| | Child Age | 12-17 | .51 | -.23 | .39 |
| | | 18-23 | .73* | -.21 | .58* |
| | | 24-35 | .18 | -.67 ** | -.05 |
| | | 36-47 | .55 | -.34 | .34 |
| | | 48-59 | -.15 | -.33 | -.15 |
| | Decision style | Discussion | -.42 | .06 | -.09 |
| **Immediate factors** | Child sex | Male | -.73** | -.37** | -.73** |
| | Diarrhea | Yes | -.67** | -.59* | -.77** |
| | Food frequency | | .04 | .09* | .07* |
| | Constant | | -1.24 | -.60 | -1.30 |

# 4. DISCUSSION

This study shown that malnutrition was a problem in Haramaya District whereby it affects children among 6-59 months age as measured by the three indicators (underweight, stunting, and wasting). The prevalence of stunting, wasting and underweight were 36.07% [95% CI (0.289, 0.382)], 14.43 % [95% CI (0.081, 0.143)] and 23.63 % [95% CI (0.169, 0.249)] respectively. Prevalence of severe stunting, wasting and underweight was 11.44 % [95% CI (0.066, 0.124)], 6.72 % [95% CI (0.017, 0.055)] and 6.47 % [95% CI (0.023, 0.064)] respectively. The current study revealed that child age, child sex, diarrhea infection, employment status of the mother, and household food security status were important factors of all three indicators of nutritional status of the children. Wealth quintiles were significantly related to the z score of underweight and wasting of the children. The frequency of child feeding per day was significant predictor to the z score of stunting and underweight of the children. The significant factor of the z score of stunting and wasting jointly was the residence of household.

In the current study the prevalence of stunting among under five children was higher than a study conducted in Gimbi district, Oromia region 32.4% stunted and the prevalence of underweight and wasting slightly equal; 15.9 percent of the children were wasted, and 23.5 percent underweight (Kebede Eticha, 2007). Although the result in this finding is less than the study conducted on the prevalence of malnutrition of children age 36-72 months in Gobu Seyo district which was 49.0% stunted (Habtamu *et al.*, 2014). This difference might be due to study period and study area, in the current study data was collected in January when most rural areas have no shortage of food relative to summer session.

EDHS 2011 indicated that the prevalence of stunting, underweight and wasted were 44%, 29% and 10% among children age 6-59 months respectively. The findings of the current study were less prevalence of stunting and underweight, however the prevalence of wasting was higher with 36.07% stunting, 23.63% under weight and 14.3 % wasting. This difference might be occurred due to the period of data collection.

The current study revealed that a child from a family of food insecure is more likely to have low z score of underweight, stunting and wasting compared to a child from a food secure household. This was consistent with recent study conducted by (Amaha Kahsay *et al.*, 2015) in Tigray,

revealed that children of the food secure households were at statistically significant better nutritional outcomes when compared to those of food insecure households. This might for the reason that the children from food secure households can get good food with all essential nutrients.

The current study revealed that the child in 6-11 months age group was more likely to have low mean z score of wasting and underweight when compared with 18-23 months age group children in the study area. Which is inconsistent to the study conducted at national level EDHS 2011 revealed that the children in higher age group were more affected by malnutrition (CSA, 2012). This might be attributed to the fact that children under one year of age were most susceptible because of their fast growth rate and increased vulnerability to diarrhea and other infectious diseases. Although the current study showed that the children from 24-35 months age groups were more likely to have less mean z score of stunting when compared to the children from 6-11 months age group which is consistent to previous study conducted in Hidabu Abote District, Oromia, Ethiopia revealed that the prevalence of stunting was positively related to the child age (Kebede Mengistu *et al.,* 2013) and also it is also consistent to the EDHS 2011 study revealed that the prevalence of stunting increases as the age of the child increases (CSA, 2012).

The current study revealed that male children were significantly have less mean z score of underweight, stunting and wasting in the study area. It was consistent to the study conducted at national level EDHS 2011 revealed that the prevalence of malnutrition was higher in male as compared to female children. It was also similar to the study conducted on magnitude and factors associated with malnutrition in children 6-59 months of age in Somali region revealed that all three forms of malnutrition were more prevalent among boys than girls (Solomon and Amare, 2013). This could be recognized to male children were more vulnerable to health inequalities than their female counterparts in the same age groups (Henry *et al.,* 2007).

The current study revealed that the children of highest living standard household significantly have higher mean z score of underweight and wasting relative to the children from poor households. This was consistence with other study done in Ethiopia at national level EDHS 2011 and in India; showed that the children from higher wealth quintile of the household were less likely to underweight (CSA, 2012; Kumar *et al*., 2014), and children from families in poor and middle socio-economic positions were more likely to be wasted than their counterparts (Gudina

Egata *et al.,* 2014). The study conducted in Mozambique revealed that wealth quintile was strongly positively correlated with wasting Z-score and stunting Z-score (Sara, 2013). This might because of the fact that wealthy family can get enough food to feed their children.

Those children who get food more times per day were less likely to be malnourished when compared with children who get food less times per day (Kebede Mengistu *et al.,* 2013). Similarly this study revealed that the frequency of feeding the child per day significantly positively associated with the z score of stunting and underweight of the children. This was for the reason that when a child feed more frequently, he/she can gain more nutrients.

The current study revealed that children who were infected by diarrhea two weeks before the survey have significantly less mean z score of underweight, stunting and wasting when compared to the children who were not infected by diarrhea two weeks before the survey. Previous studies also revealed similar results that children having diarrhea in the past two weeks prior to the data collection were more likely to develop stunted, underweight and wasted than children without diarrheal disease (Mandefro *et al.,* 2014). And also consistent to the study conducted based on EDHS 2005 data revealed that children who have diarrhea two weeks before date of survey were significantly vulnerable to malnutrition and health problem than those who have not (Birhan, 2010). This was attributed to a case in which if the child infected by such disease he/she loose nutrients and decrease food appetite, and therefore it decrease the nutritional status of the child (CSA, 2012).

Malnutrition problem was significantly less for children whose mothers were unemployed than children from employed mothers in Ethiopia (Birhan, 2010). The current study also showed that a child whose mother was unemployed has significant higher mean z score of underweight, stunting and wasting relative to a child whose mother was employed. This might for the reason that the mothers who have work have no enough time for caring the child.

The current study revealed that children from rural area have significant less mean z score of stunting than the children from urban area and it was consistent to the previous study at national level EDHS 2011(CSA, 2012). Although the current study revealed that a child from a rural area has higher mean z score of wasting than a child from urban area in the study area and it was in contrast to EDHS 2011 study. This might be attributed to urban residents have to purchase

almost all their food as well as other goods and services. High per-unit costs of food result from inefficient urban food-marketing systems (Marc and James, 2009); and also urban households in lower living standard look an inimitable set of challenges compared to their rural counterparts.

The main limitation of this study is that because of the financial and time shortage the cross-sectional design was used and it prohibits determining seasonal variations and this study was specified only in Haramaya district. However, the data were collected by using a well structured questionnaire, and the data collectors were experienced health workers and training was given before survey. Many variables considered in the multivariate linear regression model and significant factors affecting the nutritional status of the children were identified.

# 5. SUMMARY, CONCLUSIONS AND RECOMMENDATION

Summary of the study, conclusions, and recommendations were presented under this subtitle. The summary was the review of the study; the conclusions were based on the main results of the study; and the recommendations were based on the conclusions.

## 5.7. Summary

This study was aimed to assess prevalence of under-nutrition and factors affecting nutritional status of children aged 6-59 months in Haramaya district. The specific objectives of this study were determining the prevalence of under-nutrition among children aged 6-59 months and detecting the factors associated with nutritional status of children aged 6-59 months. A community based cross-sectional study was conducted on 402 randomly selected children from January 5 to March 25, 2015 to estimate the prevalence of child under nutrition and assess factors affecting stunting, underweight and wasting status of children aged 6-59 months.

To assess the nutritional status of the children anthropometric measurement was used and indicators based on weight, height and age were compared to international standards. A multivariate multiple linear regression models, a linear regression model that contains more than one dependent variable and more than one predictor variable, was used to detect the factors affecting nutritional status of children aged 6-59 months.

This study showed that malnutrition was highly prevalent in Haramaya district. The prevalence of stunting, wasting and underweight were 36.07% [95% CI (0.314, 0.408)], 14.3 % [95% CI (0.110, 0.179)] and 23.63 % [95% CI (0.195, 0.278)] respectively. Prevalence of severe stunting, wasting and underweight was 11.44 % (95% CI [0.083, 0.146]), 6.72 % (95% CI [0.043, 0.092]) and 6.47 % (95% CI [0.041, 0.089]) respectively.

The factors significantly related to the z score of underweight were child sex [β=-0.73, 95% CI(-0.97, -0.48)], diarrhea infection status [β=-0.59, 95% CI(-0.91, -0.26)], additional food frequency [β=0.09, 95%CI(0.02, 0.16)], 18-23 months age group [β=0.58, 95% CI(0.08, 1.07)], wealth status (rich[β= 0.46, 95% CI(0.15, 0.78)]), household's food security status [β=0.84, 95% CI(0.59, 1.10)], and the employment status of the mother [β=-0.98, 95% CI(-1.30, -0.67)].

The factors significantly related to the z score of stunting of the children in the current study were residence [β=-0.66, 95%CI(-1.07, -0.26)] , child sex [β=-0.37, 95%CI(-0.63, -0.12)], diarrhea [β=-0.59, 95%CI(-91, -0.26)], 24-35 months age group [β=-0.67, 95%CI(-1.13, -0.20)] of child age, additional food frequency the child took per day [β=0.09, 95%CI(0.02, 0.16)], household food security status [β=0.52, 95%CI(0.25, 0.78)], and employment status of the mother [β=-0.49, 95%CI(-0.81, -0.16)].

The factors significantly related to the z score of wasting of the children in the study area were residence [β=0.97, 95% CI (0.43, 1.21)], child sex [β=-0.73, 95% CI (-1.02, -0.45)], diarrhea [β=-0.67, 95% CI (-1.04, -0.31)], 18-23 months age group [β=0.73, 95%CI(0.16, 1.3)], household food security status [β=0.77, 95%CI(0.47, 1.06)], the employment status of the mother [β=-0.99, 95%CI(-1.34, -0.64)], and wealth status (rich [β=.72, 95% CI (0.37, 1.08)]).

## 5.8. Conclusions

The current study showed that malnutrition is highly prevalent in Haramaya District. A child from food insecure household, male children, the children who were infected by diarrhea two weeks before the survey, and the children of mothers had work out of the home were significantly more likely to be underweight, stunted and wasted compared to their corresponding counterparts in the Haramaya district. Those children in younger age group were significantly more likely affected by underweight and wasting relative to 18-23 months age group children, in contrast the children in 24-35 months age group were significantly more likely affected by stunting. The children from a family in lower living standard were significantly more likely to be underweight and wasted in the study area relative to the children from rich living standard family. The children who were feeding more frequently were significantly less likely to be stunted and wasted; and the children from rural area were significantly more likely affected by stunting and less probable to be wasted.

## 5.9. Recommendations

Based on the findings the following recommendations were reported in the current study:

Community based nutrition program should be established; continuous nutrition supervision based on each nutritional status indicators and special attention to severely malnourished children is necessary to attempt the problem of malnutrition. Nutrition education by health extension workers should be strengthen to improve the feeding practice of parents on appropriate children feeding; and on appropriate time giving to child care, especially the mothers who had work out of the home.

The governmental bodies in national level are obliged to accountability for ensuring that nutrition is sufficiently reflected in policies, strategies and legislation; at district level the implementation of policies and strategies within districts should be ensured. Efforts should be made on training of the community on participating in enterprises and giving awareness on saving habit to improve the food security situation and family living standard of the household in the community. Efforts should be made in improving environmental sanitation, safe and adequate water to prevent exposure to diarrhea. Special attention is needed to identify the most vulnerable residence for each indicators of malnutrition, not only for rural area children but also for urban area. Multivariate linear regression was more appropriate for identifying the factors associated to nutritional status of children in three indicators simultaneously using only one model.

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# 7. APPENDICES

## APPENDIX A: TEST OF ASSUMPTIONS

**Appendix Table 1**: Variance inflation factors of independent variables

| Variable | VIF | 1/VIF |
|---|---|---|
| Residence | 1.24 | 0.806518 |
| Child sex | 1.26 | 0.794646 |
| Vaccination | 1.04 | 0.958229 |
| Infection | 1.77 | 0.564339 |
| diarrhea | 1.67 | 0.599844 |
| Food frequency | 1.41 | 0.710223 |
| HFSS | 1.14 | 0.878440 |
| Mother employ | 1.34 | 0.747682 |
| Exclusive breast | 1.10 | 0.912827 |
| Decision | 1.23 | 0.815502 |
| Nutrition of mother | 1.29 | 0.774571 |
| Child treatment | 1.12 | 0.893255 |
| Mother literacy | 1.49 | 0.671256 |
| Father literacy | 1.46 | 0.683863 |
| Age 6-11 | 2.94 | 0.339773 |
| 12-23 | 2.44 | 0.409574 |
| 24-35 | 2.89 | 0.346499 |
| 36-47 | 2.25 | 0.443671 |
| 48-59 | 1.91 | 0.524817 |
| Quintiles medium | 1.64 | 0.611156 |
| Rich | 1.69 | 0.592833 |
| Mean VIF | 1.63 | |

**Normality Test**

**Appendix Table 2:** Univariate normality test of the data

| Variable | Pr(Skewness) | Pr(Kurtosis) | Adj $\chi^2(2)$ | Joint Prob>chi2 |
|---|---|---|---|---|
| RWHZ | 0.0909 | 0.7632 | 2.96 | 0.2278 |
| RHAZ | 0.1970 | 0.1852 | 3.43 | 0.1800 |
| RWAZ | 0.9803 | 0.6786 | 0.17 | 0.9175 |

**Appendix Table 3**: Doornik-Hansen test for bivariate and multivariate normality

| Pair of variables(bivariate) | | $\chi^2$ | df | Prob>chi2 |
|---|---|---|---|---|
| RWHZ | RHAZ | 6.06 | 4 | 0.1945 |
| | RWAZ | 10.86 | 4 | 0. 2082 |
| RHAZ | RWAZ | 1.99 | 4 | 0.7371 |
| Test for multivariate normality | | | | |
| Doornik-Hansen | | 8.881 | 6 | 0.1804 |

**Appendix Table 4:** Test of heteroskedasticity

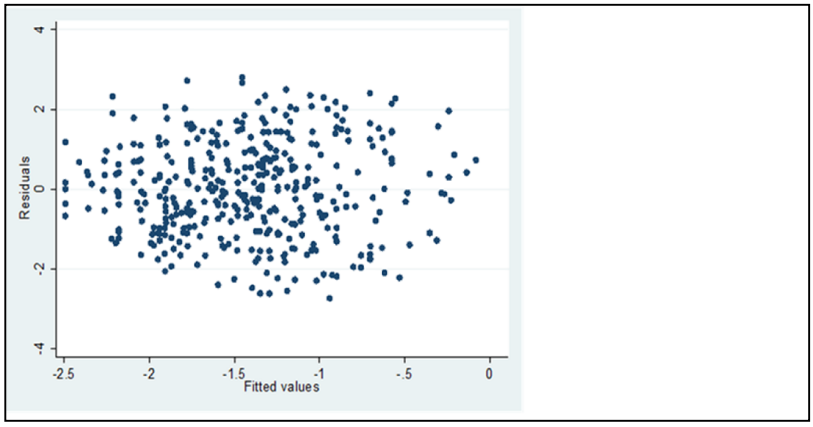
| Variables: fitted values of WAZ | Variables: fitted values of HAZ | Variables: fitted values of WHZ |
|---|---|---|
| chi2(1) = 0.40 | chi2(1) = 2.00 | chi2(1) = 0.01 |
| Prob > chi2 = 0.5255 | Prob > chi2 = 0.1570 | Prob > chi2 = 0.9325 |

**Appendix Table 5:** Test of over all multivariate linear regression model

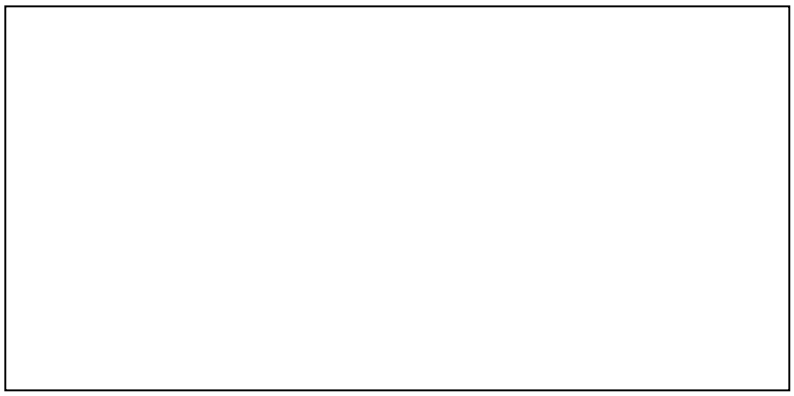
| **Type of statistics** | **Test Statistics** | **Prob>F** |
|---|---|---|
| Wilk's lambda | 0.5466 | 0.0000 |
| Pillai's trace | 0.5408 | 0.0000 |
| Lawley-Hotelling trace | 0.6785 | 0.0000 |
| Roy's largest root | 0.3337 | 0.0000 |

1. Scatter plots

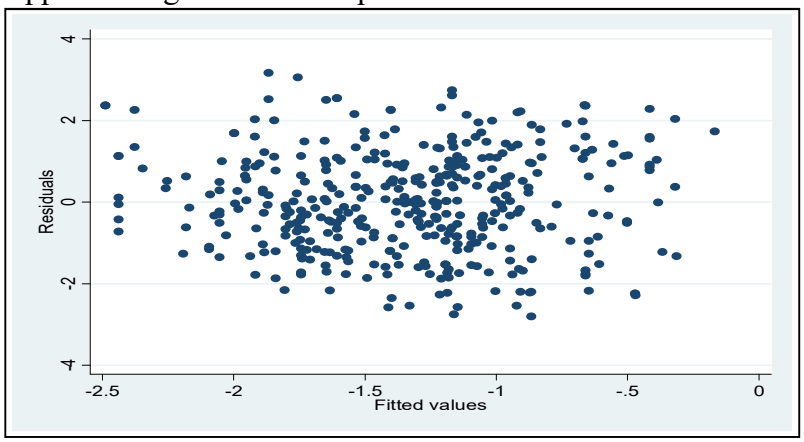
Appendix Figure 1: Scatter plot of fitted values and residuals of WHZ




Appendix Figure 2: Scatter plot of fitted values and residuals of HAZ



Appendix Figure 3: Scatter plot of fitted values and residuals WAZ



**Appendix Table 6**: The multivariate linear regression analysis model without the concept of UNICEF conceptual frame work

| DV | Predictors | Categories | Coefficient | t | P-values | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| WHZ | Residence | Rural | .8220135 | 4.11 | 0.000 | .4291849 | 1.214842 |
| | Child sex | Male | -.5041483 | -3.61 | 0.000 | -.7788768 | -.2294199 |
| | Diarrhea | Yes | -.5169037 | -2.92 | 0.004 | -.8645864 | -.1692211 |
| | Food frequency | | .0342315 | 0.87 | 0.383 | -.0427999 | .111263 |
| | HFSS | Secure | .6674101 | 4.89 | 0.000 | .3990193 | .9358009 |
| | Mother employ | Has work | -.7089749 | -4.15 | 0.000 | -1.045175 | -.3727751 |
| | Child Age | 12-17 | .6383843 | 2.63 | 0.009 | .16031 | 1.116459 |
| | | 18-23 | .5885007 | 2.22 | 0.027 | .0679595 | 1.109042 |
| | | 24-35 | .4025253 | 1.68 | 0.094 | -.0689256 | .8739762 |
| | | 36-47 | .852737 | 3.27 | 0.001 | .339727 | 1.365747 |
| | | 48-59 | -.0074317 | -0.03 | 0.980 | -.5796059 | .5647425 |
| | Decision style | Discussion | -.4210616 | -2.97 | 0.073 | -.6995556 | .1425676 |
| | Wealth | Medium | .5356626 | 3.21 | 0.001 | .2071833 | .8641419 |
| | Quintiles | Rich | .9654463 | 5.85 | 0.000 | .6408878 | 1.290005 |
| | Constant | | -1.235308 | -3.28 | 0.001 | -1.976625 | -.4939915 |
| HAZ | Residence | Rural | -.7865068 | -4.08 | 0.000 | -1.165798 | -.4072153 |
| | Child sex | Male | -.3088299 | -2.29 | 0.023 | -.574091 | -.0435688 |
| | Diarrhea | Yes | -.4174698 | -2.45 | 0.015 | -.753171 | -.0817685 |
| | Food frequency | | .1393972 | 3.69 | 0.000 | .0650203 | .2137741 |
| | HFSS | Secure | .35448 | 2.69 | 0.007 | .0953382 | .6136219 |
| | Mother employ | Has work | -.4768145 | -2.89 | 0.004 | -.8014285 | -.1522005 |
| | Age | 12-17 | -.4895173 | -2.09 | 0.038 | -.9511168 | -.0279178 |
| | | 18-23 | -.1891626 | -0.74 | 0.460 | -.6917656 | .3134403 |
| | | 24-35 | -.428322 | -1.85 | 0.065 | -.8835263 | .0268823 |
| | | 36-47 | -.2584363 | -1.03 | 0.306 | -.7537676 | .2368951 |
| | | 48-59 | -.1499934 | -0.53 | 0.594 | -.70245 | .4024633 |
| | Decision style | Discussion | .2338706 | 1.71 | 0.088 | -.0350263 | .5027674 |
| | Wealth | Medium | .0100064 | 0.06 | 0.951 | -.3071532 | .3271661 |
| | Quintiles | Rich | -.2505209 | -1.57 | 0.117 | -.5638949 | .0628531 |
| | Constant | | -.5958272 | -1.64 | 0.103 | -1.311598 | .1199432 |
| WAZ | Residence | Rural | .1697236 | 0.97 | 0.331 | -.1731178 | .512565 |
| | Child sex | Male | -.5063132 | -4.15 | 0.000 | -.7460826 | -.2665438 |
| | Diarrhea | Yes | -.5973572 | -3.87 | 0.000 | -.9007974 | -.293917 |
| | Food frequency | | .0962789 | 2.82 | 0.005 | .0290496 | .1635081 |
| | HFSS | Secure | .6768746 | 5.68 | 0.000 | .4426364 | .9111128 |

Continued…

| | Predictors | Categories | Coefficient | T | P-values | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | Mother employ | Has work | -.7950574 | -5.33 | 0.000 | -1.088476 | -.5016389 |
| | Age | 12-17 | .3956828 | 1.86 | 0.063 | -.0215567 | .8129224 |
| | | 18-23 | .5230484 | 2.26 | 0.024 | .0687459 | .977351 |
| | | 24-35 | .1879797 | 0.90 | 0.370 | -.2234793 | .5994387 |
| | | 36-47 | .5566405 | 2.44 | 0.015 | .1089108 | 1.00437 |
| | | 48-59 | -.0175316 | -0.07 | 0.945 | -.5168969 | .4818337 |
| | Decision style | Discussion | -.1543208 | -1.25 | 0.213 | -.3973766 | .0887349 |
| | Wealth | Medium | .3651118 | 2.50 | 0.013 | .0784313 | .6517922 |
| | Quintiles | Rich | .5456732 | 3.79 | 0.000 | .2624147 | .8289318 |
| | Constant | | -1.295836 | -3.94 | 0.000 | -1.942821 | -.64885 |

**Appendix Table 7**: The multivariate linear regression analysis model with the concept of UNICEF conceptual frame work.

| **Dependent variables** | | **Predictors** | **Categories** | **Coefficients** | **T** | **p-value** | **[95% Conf Interval]** | |
|---|---|---|---|---|---|---|---|---|
| **Basic factors** | **WHZ** | **Residence** | Rural | .9698828 | 4.35 | 0.000 | .5311306 | 1.408635 |
| | | **Moth emply** | Has work | -.9890846 | -5.53 | 0.000 | -1.340755 | -.6374146 |
| | | **Wealth** | Medium | -.0246274 | -0.14 | 0.888 | -.3697246 | .3204699 |
| | | **status** | Rich | .7203881 | 3.99 | 0.000 | .365679 | 1.075097 |
| | | **Intercept** | | -.4921254 | -1.72 | 0.086 | -1.054906 | .0706557 |
| | **WAZ** | **Residence** | Rural | .320275 | 1.61 | 0.108 | -.0704533 | .7110034 |
| | | **Moth emply** | Has work | -.9822558 | -6.17 | 0.000 | -1.295434 | -.6690779 |
| | | **Wealth** | Medium | -.0020419 | -0.01 | 0.990 | -.3093664 | .3052826 |
| | | **status** | Rich | .4628093 | 2.88 | 0.004 | .146925 | .7786936 |
| | | **Intercept** | | -.5014011 | -1.97 | 0.050 | -1.002583 | -.0002195 |
| | **HAZ** | **Residence** | Rural | -.6626339 | -3.23 | 0.001 | -1.066013 | -.2592551 |
| | | **Moth emply** | Has work | -.4855436 | -2.95 | 0.003 | -.8088611 | -.1622261 |
| | | **Wealth** | Medium | .0609614 | 0.38 | 0.706 | -.2563132 | .378236 |
| | | **status** | Rich | -.0702007 | -0.42 | 0.672 | -.3963122 | .2559109 |
| | | **Intercept** | | -.3173084 | -1.21 | 0.229 | -.8347166 | .2000998 |
| **Underlying factors** | **WHZ** | **HFSS** | Secure | .7673023 | 5.12 | 0.000 | .472764 | 1.061841 |
| | | **Child Age** | 12-17 | .5044717 | 1.89 | 0.059 | -.0195912 | 1.028535 |
| | | | 18-23 | .7254676 | 2.50 | 0.013 | .1557016 | 1.295234 |
| | | | 24-35 | .1799928 | 0.69 | 0.493 | -.3361549 | .6961405 |
| | | | 36-47 | .5501994 | 1.91 | 0.057 | -.0169806 | 1.117379 |
| | | | 48-59 | -.1528694 | -0.47 | 0.636 | -.7873225 | .4815837 |
| | | **Decision style** | Discuss | -.1984755 | -1.32 | 0.188 | -.4940895 | .0971386 |
| | | **Intercept** | | -.8768713 | -3.35 | 0.001 | -1.391011 | -.3627315 |
| | **WAZ** | **HFSS** | Secure | .8404723 | 6.49 | 0.000 | .5860184 | 1.094926 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Child Age** | 12-17 | .3964484 | 1.72 | 0.086 | -.0562937 | .8491904 |
| | | | 18-23 | .5765425 | 2.30 | 0.022 | .0843172 | 1.068768 |
| | | | 24-35 | -.0457459 | -0.20 | 0.840 | -.4916499 | .4001581 |
| | | | 36-47 | .342768 | 1.38 | 0.170 | -.1472232 | .8327591 |
| | | | 48-59 | -.1535527 | -0.55 | 0.582 | -.7016617 | .3945562 |
| | | **Decision style** | Discuss | -.0856528 | -0.66 | 0.510 | -.3410361 | .1697305 |
| | | **_cons** | | -1.504585 | -6.66 | 0.000 | -1.948754 | -1.060416 |
| | **HAZ** | **HFSS** | Secure | .517786 | 3.84 | 0.000 | .2529372 | .7826347 |
| | | **Child Age** | 12-17 | -.2264305 | -0.94 | 0.345 | -.6976677 | .2448067 |
| | | | 18-23 | -.2083954 | -0.80 | 0.424 | -.7207288 | .3039379 |
| | | | 24-35 | -.6661024 | -2.82 | 0.005 | -1.130222 | -.2019825 |
| | | | 36-47 | -.3385883 | -1.31 | 0.193 | -.8485964 | .1714197 |
| | | | 48-59 | -.3275465 | -1.13 | 0.260 | -.8980465 | .2429535 |
| | | **Decision** | Discussion | .0595699 | 0.44 | 0.660 | -.2062461 | .325386 |
| | | **_cons** | | -1.29548 | -5.51 | 0.000 | -1.757794 | -.8331656 |
| **Immediate factors** | **WHZ** | **Child sex** | Male | -.7298563 | -5.04 | 0.000 | -1.014816 | -.4448972 |
| | | **Diarrhea** | Yes | -.6747316 | -3.63 | 0.000 | -1.039905 | -.3095583 |
| | | **Food freq** | | .0384736 | 0.97 | 0.330 | -.0391289 | .116076 |
| | | **Constant** | | .1726222 | 0.89 | 0.374 | -.2085325 | .5537769 |
| | **WAZ** | **Child sex** | Male | -.7252073 | -5.83 | 0.000 | -.9697201 | -.4806946 |
| | | **Diarrhea** | Yes | -.7743099 | -4.86 | 0.000 | -1.087651 | -.4609684 |
| | | **Food freq** | | .0701854 | 2.07 | 0.039 | .0035976 | .1367731 |
| | | **Constant** | | -.6016173 | -3.62 | 0.000 | -.9286718 | -.2745628 |
| | **HAZ** | **Child sex** | Male | -.3731613 | -2.87 | 0.004 | -.6287191 | -.1176035 |
| | | **Diarrhea** | Yes | -.5846958 | -3.51 | 0.001 | -.9121914 | -.2572002 |
| | | **Food freq** | | .0861026 | 2.43 | 0.015 | .016507 | .1556982 |
| | | **Intercept** | | -1.343233 | -7.73 | 0.000 | -1.685061 | -1.001405 |

## APPENDIX B: QUESTIONNAIRES IN ENGLISH LANGUAGE

**Verbal Consent**

Greetings

Introduction:

My name is _____. I am working as data collector in a survey conducted by the collaboration of Haramaya University, statistics department, so as to identify factors associated to child nutritional status. Your name will not be written on this form and will never be used with any information you may tell me. You don't have to answer any questions that you don't want to answer and you may end this interview at any time you want. However, your honest answer to these questions is very important for the purpose of the study. We would

very much appreciate your participation in this survey by truly responding to the interviews. Would you be willing to participate?

It would take _____ minutes to complete the questionnaire

Signature of the interviewer certifying that informed consent has been given verbally by respondent_____.

1. Questionnaire identification number /_____/_____/
2. Interviewer Name_____
3. Date of interview_____
4. Residence: 1. Urban 2. Rural

**Part One: Socio-Demographic Variables**

| **Questions** | **Responses** |
|---|---|
| 1. Head of the HH | 1. Male 2. Female |
| 2. Total family size | _____ |
| 3. How many children <5 year live in the household? | ____ |
| 4. What is your education level? | _____ |
| 5. What is your husband's education level? | _____ |
| 6. Occupation of mother | 1. Housewife only 2. Farmer 3. Merchant/Trade 4. Private Organization employee 5. Government employee 6. Daily labourer 7. Other (specify)_____ |
| 7. Occupation of husband | 1. Farmer 2. Government employee 3. Merchant/Trade 4. Private Org. Employee 5. Daily labourer 6. Other_____ (specify |
| 8. Who decides on treatment of children when he/she sick? 1. | 1. Mainly spouse 2. Mainly husband 3. Only husband 4. Both jointly |
| 9. Do you have livestock? | 1. Yes 2. No If no, skip to 11 |
| 10. If yes for Q9, how many? | ___Milk cow ____ Oxen ___ bulls ___Goat ___Sheep ____Chicken ____ Horse ____donkey ____mule ____camel |
| 11. Size of your agricultural lands | _____ Hectare |
| 12. Ethnicity | 1. Oromo 2.Amara 3. Tigre 4. Gurage 5. Siltie 6. Others (specify)_____ |
| 13. What is your religion? | 1. Muslim 2.Orthodox 3.Protestant 4. Catholic 5.Others_____ |

**Part Two: Child Characteristics and Health Status**

| **Questions** | **Responses** |
|---|---|
| 1. Name of the child | _____ |
| 2. Child's sex | 1. Male 2. Female |

| | |
|---|---|
| 3. Child's age | _____ Months |
| 4. Does the child immunized? | 1. Yes 2. No. If no, skip to 6 |
| 5. Vaccines received (See card, if no card available ask them to recall) | 1. BCG only (See Scar) 2. DPT (No of dose____) 3. Measles |
| 6. Had the child infected by any disease before the survey? | 1. Yes 2. No |
| 7. Has the child had diarrhea in the last two weeks? | 1. Yes 2. No |
| 8. Presence of oedema on the child (Observe) | 1. Yes 2. No |

**Part Three: <u>Child Caring Practices</u>**

| **Questions** | **Responses** |
|---|---|
| **1.** Type of food that the child frequently took per day. | 1. Cereals 2. Meat 3. Milk or hojja 4. Injera 5. Vegetables 6. Atmiet/Bula/muq 7. Formula milk 8. Sugar solution 9. Other specify _____ |
| **2.** Does the child breastfeed know? | 1. Yes 2. No |
| **3.** How many times the child feed additional foods in 24 hours? | _____ times |
| **4.** How many months did you breast-feed the child? | _____ Months |
| **5.** For how many months did you exclusively breast-fed the child? | ____months |
| **6.** How did you usually treat your child when get sick) | 1. Usually home treatment 2. Taking to traditional healers 3. Taking to Health institution 4. Other_____ (Specify |
| **7.** Child weight in kilogram | _____ (by measuring) |
| **8.** Child height in centimetres | _____ |
| **9.** Child MUAC in centimetres | _____ |

**Part Four: <u>Maternal Characteristics</u>**

| | | |
|---|---|---|
| **1.** | Total number of children ever born? | In number _____ |
| **2.** | Do you lactate now? | 1. Yes 2. No |
| **3.** | Maternal MUAC in centimeters | _____ |

**Part Five: <u>Environmental Conditions and wealth index indicators</u>**

| | |
|---|---|
| **1.** What is your main source of drinking water? | 1. River 2. Pond 2. Unprotected spring. 3. Protected spring. 4. Private well 5. Public tap 6. Other (specify) |
| **2.** Do you have latrine? | 1. Yes 2. No |
| **3.** Type of latrine you use? (Observation) | 1. Private pit / wooden slab 2. Private |

| | |
|---|---|
| | uncover 3. Shared latrine/wooden slab 4. Shared cement slab latrine 5. Other (_____Specify) |
| **4.** Is your farm affected by any climate change or drought? | 1. Yes 2. No |
| **5.** Floor area of the house | ____$m^2$ |
| **6.** What type of fuel/material do you mainly use for cooking? | 1. Wood 2. Charcoal 3. Kerosene 4.Electricity 5. Animal dung 6. Other(specify)_____ |
| **7.** Income of the household. | Daily _____birr. Monthly _____ birr. Annually_____ birr |
| **8.** Have you electricity? | 1. Yes 2. No |
| **9.** Owner ship of house. | 1. Owner 2. Renter |
| **10.** Type of Flooring | 1. Earth 2. Cement 3.Wooden 4. Ceramic |
| **11.** Type of Roofing | 1. Tin 2. Grass 3. Mud 4. Cement |
| **12.** Wall material | 1. Mud 2. Cement 3. Shaklee 3. block |
| **13.** Has Windows | 1. Yes 2. No |
| **14.** Have you generator? | 1. Yes 2. No |
| **15.** Have you bed? | 1. Yes 2. No |
| **16.** Have you indoor bath room? | 1. Yes 2. No |
| **17.** Have you Radio? | 1. Yes 2. No |
| **18.** Have you Television? | 1. Yes 2. No |
| **19.** Have you Refrigerator? | 1. Yes 2. No |
| **20.** Have you Watch? | 1. Yes 2. No |
| **21.** Do you a vehicle? | 1. Yes 2. No |
| **22.** If yes, type of Vehicle and number | _____bicycle _____ car _____ Bajaj ____lorry ____other( specify) |
| **23.** Furniture type and number | ___chair ____table ___cupboard _____shelves____other(specify) |
| **24.** Number of sleeping room | _____ |
| **25.** Have you Domestic servant? | 1. Yes 2. No |
| **26.** Have you telephone (fixed)? | 1. Yes 2. No |
| **27.** Have you telephone (mobile)? | 1. Yes 2. No |
| **28.** Have you bank account? | 1. Yes 2. No |

**Part six: <u>House hold food security status</u>**

| **Questions** | **Responses** |
|---|---|
| 1. In the past four weeks, did you worry that your household would not have enough food? | 0=never 1=rarely 2=sometimes 3=often. |
| 2. In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources? | 0=never 1=rarely 2=sometimes 3=often. |

| | |
|---|---|
| 3. In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources? | 0=never 1=rarely 2=sometimes 3=often. |
| 4. In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? | 0=never 1=rarely 2=sometimes 3=often. |
| 5. In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? | 0=never 1=rarely 2=sometimes 3=often. |
| 6. In the past four weeks, did you or any household member have to eat fewer meals in a day because there was not enough food? | 0=never 1=rarely 2=sometimes 3=often. |
| 7. In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food? | 0=never 1=rarely 2=sometimes 3=often. |
| 8. In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food? | 0=never 1=rarely 2=sometimes 3=often. |
| 9. In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food? | 0=never 1=rarely 2=sometimes 3=often |

## APPENDIX C: QUESTIONAIRES IN THE LOCAL LANGUAGE: AFFAAN OROMO

Nagaa

Seensa

Maqaan kiyya _____jedhama, qorannoo Yuunivarsiitii Haramayaa kutaa staatistiksii waliin hojjetamu keessatti dalagaan kiyya raga funaanudha. Kanaaf akka rakkoolee haala soorata daaimmanii huban. Maqaan kee odeeffannoo ati natty himmuuf jirtutu kamiyyuu keessatti hin fayyadamu, hunka kana irratti hin galmaa'u. gaafii deebisuu hin barbaadne deebisuu hin qabdu. Yeroo itti deebitee xummurtu yeroo feete ta'uu danda'a. haa ta'u malee amanamummaan gaafii kana deebisuun kee qorannoo kanaaf bu'aa guddaa qaba. Gaaffilee kanatti dhugummaan deebisuun qayyabannoo kana keessatti hirmaannaa gochuu keef baay'ee sigalateeffanna. Hirmaannaa gochuuf fedhii qabdasa?

Gaafilee kana deebistee xummuruuf daqiiqaa_____ fudhata.

Mallattoo gaafataa fedhii odeeffannoo deebisaa_____n mirkaneeffamuun kennama.

1. Lakk addabaasa gaaffilee/_____/_____/
2. maqaa gaafataa_____
3. guyyaa gaafin godhamu_____
4. bakka jireenya: 1. Magaalaaa 2. Baadiyyaa

**Kutaa Tokko: Socio- Demographic**

| | **Gaffillee** | **Deebisaa** |
|---|---|---|
| 1. | Gaggeessaa manaa | 1. Dhiira 2. Dhalaa |
| 2. | Baay'ina waliigala maatii | _____ |
| 3. | Daa'imman waggaa 5 gadi meeqatu mana keessa jira? | _____ |
| 4. | Sadarkaan barnoota keetii hoo? | _____ |
| 5. | Sadarkaan barnoota abbaa manaa keetii hoo? | _____ |
| 6. | Dalagaa haadhaa | 1) haadha manaa qofa 2) qonnaan bultuu 3) daldaltuu 4) dalagduu dhaabilee dhuunfaa 5) hojjettuu mootummaa 6) dafqaan bultuu 7) kan biraa ibsi_____ |
| 7. | Dalagaa abbaa manaa | 1) qonnaan bulaa 2) hojjetaa mootummaa 3) dafqaan bulaa 4)daldalaa 5) hojjetaa dhaabilee dhuunfaa 6) kan biraa ibsi_____ |
| 8. | Yeroo inni ykn isheen dhukkubsatu/ttu eenyutu daa'ima eegus murteessa? | 1) tarre guddeessa haadha manaa 2) tarre guddeessa abbaa manaa 3) abbaa manaa qofa 4) lamaanuu waliin ta'anii |
| 9. | Horii horsiisan qabduu? | 1) eeyyee 2) lakkii. Yoo lakkii ta'e gara gaafii 11tti ce'i. |
| 10. | Yoo eeyyee ta'e, meeqa? | Sa'a aannanii_____sangaa qonnaa_____ korma_____ hoolaa_____ re'ee_____lukkuu_____farda____ harree_____gaala_____. |
| 11. | Hanga lafa qonnaa qabdan | hektaaran_____ |
| 12. | Saba: | 1) Oromo 2) Amaaraa 3) Tigree 4) Guraagee 5) Silxee 6) kan biraa_____ |
| 13. | Amantii kee maali? | 1) Musliima 2) Ortodoksii 3) Protestaantii 4) kaatolikii 5) kan biraa _____ |

**Kutaa lama: Amalaafi haala fayyummaa daaimmanii**

| **Gaaffille** | **Deebisaaa** |
|---|---|
| 1. Maqaa daa'imaa | _____ |
| 2. Saala daa'imaa | 1) dhiira 2) dhalaa |

| | |
|---|---|
| 3. Umrii daa'imaa | ____ baatii |
| 4. Daa'imtichi talaalchifameeraa? | 1) eeyyee 2) lakkii: yoo lakkii ta'e gara gaafii 6tti ce'i |
| 5. Talaallii fudhatame (kaardii ilaali, yoo hinjiru ta'e gaafadhu hangaafatami) | 1. BCG qofa (kaardii ilaali) 2. DPT (lakk. Hanga isaa____) 3. Maariyyee |
| 6. Qayyabannaa kana dura daa'imtichi dhukkuba kamiin faalameera? | 1. Eeyyee 2. Lakkii |
| 7. Turban lamaan darbe keessa daa'imticha teechiseeraa? | 1. Eeyyee 2. Lakkii |
| 8. Edema daaimmanii | 1. Eeyyee 2. Lakkii |

**Kutaa 3ffa: Shaakala Eegumsa Daa'immanii**

| | Gaffillee | Deebisaa |
|---|---|---|
| 1. | Gosaa daa'imtichii guyyaatti deeddebi'ee sooratu? | 1. Boqolo/ bishingaa/cereals 2. Aannan loonii 3. Dhadhaa 4. Bulbula sukkaaraa 5. Aannan foormulaa 6. Axmitii/ muuqa/bullaa 7. Kan biroo_____ |
| 2. | Yeroo ammaa kana daa`imni harma ni hodhaa? | 1. Eeyye 2. Lakki |
| 3. | Sa`aatii 24 keeysatti yeroo meeqa daa`imni nyaata dabalataa argata?_ | _____ |
| 4. | Baatii meeqaaf harma hoosiftaaa? | baatii_____ |
| 5. | Baati meeqaaf harma qofaa daa'imaaf kennitaaf? | Baatii_____ |
| 6. | Yeroo daa'imman dhukkubsatan akkamitti yaaltu? | 1. yeroo baayee mana tti yaalla<br>2. gara yaaltotaa adaadatti geessina<br>3. gara dhaabilee fayyaatti geessina<br>4. kan biroo _____ |
| 7. | Ulfaatina daa'immani kiloograaamii dhaan | _____ (safaruun) |
| 8. | Dheerina daa'immani | _____ seentimeetira |
| 9. | MUAC daa'immani | _____ seentimeetira |

**Kutaa 4ffa: Amala Haadhaa**

| | Gaffillee | Deebisaa |
|---|---|---|
| 1. | Lakkoofsa daa'immani dhalatanii walii galaan | _____ |
| 2. | Ammaa harma hoosisaa jirtu? | 1. Eeyyee 2. Lakki |
| 3. | MUAC haadhaa centimeetridhaan | _____ |

**Kutaa 5 ffaa haala naannoo fi agarsistoota fayyaa**

| Gaffillee | Deebisaa |
|---|---|
| 1. Irraa caalaan madda bishaan dhugaati keetti maali? | 1. Lagaa 2. Burqaa eegumsaa hin qabnee 3. Boolaa 4. Burqaa eegumsaa qabu 5. Eelaa dhunfaa 6.Kanbiraa _____ |
| 2. Falamaa fincaaani ni qaba? | 1. Eyyee 2. Lakkii |
| 3. Gosaa mana fincaani faayadamtaan | 1. Dhunfaa 2. Mukaan kan golgamee 3. Waliin 4. Simintoon kan golgamee 5. Kan biraa_____ |
| 4. Qoonni kessaan goginaan ykn haalla qilleensaan tuqaame beekaa? | 1. Eyyee 2. Lakkii |
| 5. Baalina naannoo mana | $m^2$_____ |
| 6. Nyaata bilcheeesuf humnaa annisaa kamitti faayyadamtu? | 1. Mukaa 2. Cilee 3. Bobaa'aa 4. Humnaa ibsaa boobbaa beeyladaa 5. Kan biro_____ |
| 7. Madda galii maatti? | Guyaati qarshii_____. Batitii qarshii_____. Waggatii qarshii_____ |
| 8. Ibsaa ni qabdu? | 1 eeyyee 2. Lakkii |
| 9. Abbumaa manichaa | 1. kan ofii 2. kan kiraa |
| 10. Gosa dacheesaa | 1. Lafa (biyyee) 2. Siimintoo 3. muka 4.Seeraamiksii |
| 11. Gosa fodu | 1. qorqooro 2. Marga 3.dhagaa 4. Siimintoo |
| 12. Gosa keessasaa | 1. Dhoqqee 2. Siiminto 3. Suphee 4. Xubii |
| 13. Fooddaa qaba ? | 1. Eeyyee 2. Lakkii |
| 14. Dhiheessi bishaani | 1. ni egama 2. hin egamu |
| 15. Genereetara ni qabduu? | 1. eeyyee 2. Lakkii |
| 16. Siree ni qabduu? | 1. Eeyyee 2. Lakki |
| 17. Mana keessatti kutaa bakka dhiqannna ni qabduu? | 1. Eeyyee 2. Lakkii |
| 18. Raadiyoo ni qabduu? | 1. eeyyee 2. Lakkii |
| 19. Teelivitziinii ni qabduu? | 1. eeyyee 2. Lakkii |
| 20. Qabbaneesitu ni qabduu? | 1. Eeyyee 2. Lakkii |
| 21. Sa`aatii ni qabduu? | 1. eeyyee 2. Lakkii |
| 22. Konkolaataa ni qabduu? | 1. Eeyyee 2. Lakki |
| 23. Eeyyee yoo ta`e, gosa fi lakkofsa konkolaataa. | Biskileeti_____ Konkolaataa_____ Baajaajii_____Gaarii_____ kan biroo_____ |
| 24. Gosa fi lakkofsa meeshaa manaa Teesuma____ | Xarambeezaa_____ ijaajii_____ Lookarii_____Biiffee___ kan biroo_____ |
| 25. Lakkofsa bakka hirribaa (kutaa chiisichaa) | _____ |
| 26. Hojjattuu manaa ni qabduu? | 1. Eeyyee 2. Lakkii |
| 27. Bilbila mana ni qabduu? | 1. eeyyee 2. Lakkii |

| | |
|---|---|
| 28. Bilbila mobaayilii ni qabduu? | 1. eeyyee 2. Lakkii |
| 29. Lakkofsa herregaa ni qabduu? | 1. eeyyee 2. Lakkii |

**Kutaa 6ffaa :Haala Wabii Sorata Maatii**

| **Gaaffillee** | **Deebisaa** |
|---|---|
| 1. Torban afran darban keessa Maatiin nyaata gahaa hin qaban jeette itti yaddoftee beektaa? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |
| 2. Torban afran darban Rakoo hanqina nyaataf jecha yeroon ati ykn miseensi maati nyaata ykn sorata filate nyaachu dadhabe/ dadhabdan jiraa? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |
| 3. Torban afran darban Rakoo hanqina nyaataaf jecha yeroon ati ykn miseensi maati nyaata gosa murtaa'ee qofa nyaatte/ nyaatan qabdu? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |
| 4. Torban afran darban keessa Rakoo hanqina nyaataaf jecha yeroon ati ykn miseensi maati gosa nyaata nyaachaa hin turre kan nyaatan qabda/ qabdu? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |
| 5. Torban afran darban keessa Rakoo hanqina nyaataaf jecha yeroon ati ykn miseensi maati hanga beeloftanii nyaachu qabdanii gadii nyaattan ni jiraa? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |
| 6. Torban afran darban keessa Rakoo hanqina nyaataaf jecha yeroon ati ykn miseensi maati hanga guyyaati nyaachu qabdanii gadii nyaattan ni jiraa? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |
| 7. Torban afran darban keessa Rakoo dhabiinsa midhaanin kan ka'ee wantii nyaatamu tokkolle dhabame beekaa? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |
| 8. Torban afran darban keessa Rakoo hanqina nyaataaf jecha yeroon ati ykn miseensi maati osoo beela'uu garaa hiribasaa kan deeme ni jiraa? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |
| 9. Torban afran darban keessa Rakoo dhabiinsa nyaata jecha miseensi maati keessaa guyyaa fi halkan guutu nyaata malee olanii /altani beektu? | 0. matuma 1. Darbee darbee 2. Gaafa gaafa 3. Yeroo hundaa |

# APPENDIX D: LISTS OF KEBELES IN HARAMAYA WEREDA

| Rural Kebeles | | Urban Kebeles |
|---|---|---|
| 1. Aradda Bate | 18. Efa Bate | 1. Addelle 01 |
| 2. Aradda Woltaha | 19. Efa Oromiya | 2. Haramaya 01 |
| 3. Amuma | 20. Qorke | 3. Haramaya 02 |
| 4. Awumara | 21. Karo Tarkanfi | 4. Haramaya 03(Bate) |
| 5. Biftu Gada | 22. Kuro | |
| 6. Bachaqe bacaqqe | 23. Maya Balina | |
| 7. Dirre Qabso | 24. Medda Gamachu | |
| 8. Damota | 25. Nagaya | |
| 9. Fandisha | 26. Qabri Daraba | |
| 10. Haqa Fila | 27. Qabri Gatata | |
| 11. Gobbe Cala | 28. Qabri Qajima | |
| 12. Gobbe Qirite | 29. Karo Dada | |
| 13. Gobbe Salama | 30. Sherif Kalid | |
| 14. Haqa Adi | 31. Tuji Gabisa | |
| 15. Finqille | 32. Tiniqe | |
| 16. Haqa | 33. Ugaz | |
| 17. Efa Balina | | |