Anthropometric Approach to child Poverty: Assessing Nutritional Status and Vulnerability to Child Malnutrition; Evidence from Assela, Adama and Modjo towns

By

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ABSTRACT

This study will explore the extent of nutritional poverty in Adama, Assela and Modjo towns using micro analytical anthropometrics indices like wasting, stunting, underweight and vulnerability to malnutrition models. In the contemporary world income poverty level of individual is too shallow to explain the overall welfare. These measures are different from traditional income/consumption measures of poverty because they capture wider dimension of poverty and living standard. Growth status of children can clearly implicate the degree of short term exposure to risk and disturbances and long term malnutrition. Moreover, the study will explore pushing factors behind nutritional poverty. Development of the country can only be taken to the peak as long as we settle nutritional system to international standard level development of family that can ensure futuristic, thoughtful and innovative future generation. Econometrics models like logistic and weighted feasible linear regression models have been used to estimate parameters and its correlates in the three towns. Result of the model proves that about 55% of children in the three towns are vulnerable to malnutrition regardless of living standard of their family. Children and family related assets, length of breast feed, food intake level, growth environment and education level are negatively affecting vulnerability to malnutrition, wasting, stunting and underweight of children while fosterage, income inequality, birth order, family size are positively influencing child poverty. It has been widely and deeply observed that children from these towns are highly vulnerable to nutritional poverty. Therefore, food price inflation should be kept minimum to guarantee easy food access by all individuals living in the country to have mentally and physically developed children.

***Key Words**: Nutritional Poverty, anthropometry, wasting, stunting, underweight, vulnerability to malnutrition, inequality, Assela, Modjo, Adama.*

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INTORODUCTION

1.1 Background

Nutrition[2] is an important factor in physical and mental growth of children. The nutrition diet is marked by selective consumption of mixed varieties of foods rich in important contents for body and mental growth of human being. Food consumption requires body health composition formula and we should not haphazardly consume what is available around. According to Amare et al (2012) about 79% of all deaths worldwide that are attributable to chronic diseases are already occurring in developing countries due to nutritional problems.

Epidemiological studies show that nutritional inadequacy can influence the incidence and the severity of infectious diseases. In Ethiopia, nutritional problems and infectious diseases are amongst the major health problems. Chronic health disorders such as obesity, diabetes and cardiovascular diseases (CVDs) have been increasing in the country since the last few decades. According to the Ethiopian nationwide study on income, expenditure and consumption of 2014, fruits accounted for the lowest proportion (0.2%) of the per capita expenditure as compared to cereals (20.4%), pulses (3.9%), oils and fats (2%), khat (1.4%), or alcohol and tobacco (1.1%). A strong association between nutritional impairment and the development of chronic diseases such as cardiovascular diseases, cancer, and diabetes has been reported. Population-based data on cause of death from a few isolated studies, in predominantly rural populations, in Ethiopia demonstrate that a considerable proportion of the disease burden in these populations is due to CVD and other chronic diseases caused by nutritional poverty.

The prevalence of malnutrition[3], or more specifically undernutrition, has reached crisis levels in the great country of Ethiopia. The World Bank *(prevalence of undernourishment index 2008-2012)* estimates that as of last year 40 percent of the Ethiopian population is still undernourished. The malnutrition rate in Ethiopia is comparable to that of India, the home of one of the highest rates in the world.[i] Nearly fifty percent of the under-five mortality rate in Ethiopia is related to malnutrition. This number has decreased over the past decade, but is still high enough to cause alarm. Two growth-related nutrition issues are also of great concern to the plight of Ethiopian children: stunting and wasting. An important contributing factor to malnutrition is micronutrient deficiencies. Vitamin A "is extremely important to the proper functioning of the immune system and to a child's growth."[iii] Although supplement rates are at 52 percent, half of Ethiopia's children are still not receiving the proper amount of vitamin A.[iv] Iodine is also an important micronutrient, since insufficient intake may result in low cognitive abilities and **(**IDD) iodine deficiency disorder

Recent studies show that 26% of the population has goiter and 62% are at risk of IDD *(Ethiopian Nutrition Institute Survey).*Stunting is indicative of chronic, long-term malnutrition and is essentially a "failure to reach one's biological potential for growth."[ii] This affects 44 percent of children under age five, an alarming rate *(UNICEF 2012)*[4]. Wasting, or "significant recent or current weight loss," affects 10.1 percent of children under age five *(World Bank 2012)*[5]. It is therefore quite clear that children are greatly, and detrimentally, impacted by this undernutrition crisis.

Poverty has most commonly been assessed against income or consumption criteria. In this interpretation, a person is poor only if his/her income level is below the defined poverty line, or if consumption falls below a stipulated minimum. Dealing with non income measures of poverty give rise to basic needs perspectives, which go far beyond income, and include the need for nutrition, basic health and education, clean water and other services, which are required to obtain better standard of living. More recently, poverty has been defined in terms of the absence of basic capabilities to meet these physical needs, but also to achieve goals of meeting minimum level of income that meet daily caloric requirements. It is known that an insufficient intake of calories (or undernourishment[i]) is one of the primary causes of poor nutritional status and, often, of premature death. According to FAO (2015) [6]the proportion of undernourished people in Ethiopia is 32% and she is categorized in the country not achieving world food summit target by 2015.

[2] **Nutrition** is the science that interprets the interaction of nutrients and other substances in food (e.g. phytonutrients, anthocyanins, tannins, etc.) in relation to maintenance, growth, reproduction, health and disease of an organism (*https://en.wikipedia.org/wiki/**Nutrition)***

[3] lack of proper nutrition, caused by not having enough to eat, not eating enough of the right things, or being unable to use the food that one does eat.

[4] http://www.unicef.org/media/media_68734.html

[5] http://www.unicef.org/media/media_68734.html

[6] http://www.fao.org/hunger/en/

According to world health organization report (2015) malnutrition, particularly protein-energy and micronutrient deficiency, is a concerning public health issue in Ethiopia. Concerned bodies are highly inclining to find additional efforts that are required to achieve the objectives set out in the national Health Sector Development Programme (HSDP) and National Nutritoin Programme (NNP), as well as the Millennium Development Goals (MDGs) and the 2025 WHO Global Nutrition Targets.

1.2 Statement of the Problem

The standard food energy intake of children [ii]is very important in creating innovative and thoughtful future generation who has concern in the development of the nation (UNICEF, 2012). However, evidences from world health organization (2015), [7]UNICEF (2015)[8], IFPRI (2014)[9] and Ethiopia mini Demographic and Health Survey (2014) [10]shows that the average national prevalence of stunting and wasting are as high as 58% and 40% respectively. Knowing the prevalence level of nutritional poverty of children is important cornerstone in the overall welfare development of the society.

Assessment of the nutritional status of the child by the use of nutritional anthropometric indicators of growth has been used not only to provide information on the nutritional and health status of children but also as an indirect measure of the quality of life of the entire community or population, and thereby as an indicator of the nutritional status and adequacy of all members of that community (FAO, 1996).

Successful poverty alleviation strategies cannot be designed, without an appropriate understanding of poverty itself. In the 1970's poverty was defined in financial terms only. Accordingly, weak purchasing power or low per capita income was conventionally and widely accepted as the main indicator for poverty. As a result of experience and world-wide discussion, the (World Bank, 1990) included social aspects in their definition of poverty, defining it as the inability to achieve a minimum standard of living. In spite of this, world-wide poverty lines were still defined as monetary poverty lines, leading to a discrepancy between definition of poverty and related indicators for monitoring purposes. The question arises whether poverty can be understood as a deficiency in the standard of living, when only monetary indicators are used to measure its deficit. As one possible solution to this dilemma, the concept of "*basic needs*" was suggested. Basic needs include food, health, primary education, favorable environmental conditions, and a social and cultural life, which all are required in sufficient quality and quantity (Gross, 1997). A broader definition of" human poverty" has been proposed wherein poverty is seen primarily as relating to peoples capabilities and opportunities (UNDP, 1997).

According to UNDP (2010) [11]multidimensional Poverty Index (MPI) is a composite measure of the percentage of deprivations that the average person would experience if the deprivations of poor households were shared equally across the population. The Global Multidimensional Poverty Index (MPI) is a new measure designed to capture the severe deprivations that people face at the same time. The Global MPI reflects both the incidence of multidimensional deprivation, and its intensity – how many deprivations people experience at the same time. It offers a valuable complement to traditional income-based poverty measures.

Nowadays special attention has been adapted to measure child poverty. Child poverty [12]is a multidimensional phenomenon and can be measured in many ways. It is imperative that governments make a commitment to child poverty reduction, recognizing and responding to child poverty is the first priority, alongside building expertise and improved approaches to child poverty measurement. Understanding child poverty to the fullest possible extent is vital. While an adult may fall into poverty temporarily, falling into poverty in childhood can last a lifetime – rarely does a child get a second chance at an education or a healthy start in life. As such, child poverty threatens not only the individual child, but is likely to be passed on to future generations, entrenching and even exacerbating inequality in society. According to UNICEF (2015) child poverty becomes very problematic in Ethiopia.

Attempts have been made to examine the *extent* of poverty in Ethiopia, (MoFED, 2006, Getachew, 2010, Menasbo et al, 2010, Dercon, 2006, 2008).The government's 2004/05 Household Income and Consumption Expenditure Survey is the most extensive survey available on the *extent* of poverty. It indicates that the incidence of poverty is higher in rural compared to urban areas with the poverty head count ratio of 39.3% and 35.1% respectively. The survey

[7] http://www.who.int/childgrowth/en/
[8]https://books.google.com.et/books?id=1O2wCgAAQBAJ&pg=PA30&lpg=PA30&dq=UNICEF+2015+global+hunger
[9] https://www.ifpri.org/publication/2014-global-hunger-index
[10] http://www.docdatabase.net/more-ethiopia-mini-demographic-and-health-survey-2014-1291989.html
[11] http://hdr.undp.org/en/content/multidimensional-poverty-index-mpi
[12] http://www.unicef.org/socialpolicy/index_childpoverty.html

also revealed that national poverty incidence has declined by 12% as compared to the 1999/2000 level (MoFED, 2006). These estimates of poverty mainly depend on the income measures of poverty. In general, most of these studies are based on income and consumption measures of poverty that captures only one dimension of poverty. These measures of poverty cannot adequately capture differences of household in standard of living. Measures that best capture this are the anthropometric measures of poverty. However, very little researches have been made on nutritional poverty of children[iii] in Ethiopia. Nutritional poverty research is therefore very important to reduce retardation in the child development. Therefore this research could add significant value to the current literature in this regards.

1.3 Objectives of the Study

The general objective of this study is to assess anthropometric approach to child poverty in Adama, Assela and Modjo towns

The specific objectives are:-

1. To measure the extent of nutritional poverty in the study area
2. To analyze child vulnerability to malnutrition
3. To identify factors that affect children stunting, wasting, under weight and child vulnerability to malnutrition

1.4 Significance of the Study

This particular study will have the role of improving the current way of conducting research in the area by shifting from the traditional measures of poverty to more refined and widely accepted measures. This not only improves the quality of the output but also has power to build policy decisions on reliable estimates of poverty. In general the completion of this study will have the following importance:-

1. It creates awareness on the importance of anthropometric measures of poverty
2. It shades light on the socio economic and institutional factors that determine poverty
3. It alerts the government officials and other decision makers to consider the wider measures of poverty for policy decision making.

2 REVIEW OF THE LITERATURE

2.1 Theoretical Literature

2.1.1. Measures of Poverty

The most commonly used indicator that distinguishes the poor and non-poor households is the poverty line. Hence the person is considered as poor if the per capita income or consumption level falls below pre-determined minimum level necessary to meet daily basic needs. There are three commonly used indices to measure poverty. These are headcount index, the poverty gap index, and the severity index or Foster- Greer Thorbeke Index. The head count index is defined as the proportion of the population whose measured standard of living is less than the poverty line. However, the index does not capture the difference among the poor. The poverty gap index shows the intensity of poverty, which is the difference between the poverty line and the mean income of the poor expressed as the percentage of the poverty line. The severity index measures the mean of the individual poverty gaps raised to the power of a (poverty aversion parameter) reflecting society's valuation of different degrees of poverty.

2.1.1.1. Anthropometric Measures of Poverty

Anthropometry can be used to assess nutritional status at individual and population level. It requires weight and height measurements over time so that the growth velocity can be measured. A decline in an individual's anthropometric index from one point in time to another could indicate illness and/or nutritional deficiency that may result in serious health outcome. Anthropometry is the most frequently used method to assess the nutritional status of individuals or population groups. Measurements of nutritional anthropometry are based on growth in children and body weight changes in adults (Shetty, 2005). Nutritional anthropometry has been defined as measurements of the variations of the physical dimensions and the gross composition of the human body at different age levels and degrees of nutrition" (Jelliffe, 1966), sited in Shetty, 2005). Anthropometric measurements are of two types, *growth and body composition*, and have been very widely used for the assessment of the nutritional status of both children and adults (*ibid* P.5).

In infants and children under 5 years of age, an assessment of growth has been the single most important measurement that best defines their nutritional status. Disturbances innutrition because of inadequacy of food intake, severe and repeated infections or acombination of both, operating very often as a vicious spiral invariably affects the growth of a child. These adverse conditions are closely linked to the general standard of living and the population's ability to

meet its basic needs for nutritious food, safe water, good housing, acceptable levels of environmental sanitations and ready and easy access to health care. Assessment of the nutritional status of the child by the use of nutritional anthropometric indicators of growth has thus, been used not only to provide information on the nutritional and health status of children but also as an indirect measure of the quality of life of the entire community or population, and thereby as an indicator of the nutritional status and adequacy of all members of that community (FAO, 1994).

The use of nutritional anthropometry also permits the stratification of survey results according to age, sex, region, rural/urban and other socio demographic characteristic of the population, thus, providing more information for detecting vulnerable groups and for better understanding the population situation.

Stunting, wasting and body mass index (BMI) are anthropometric indicators that are used to show long and short run malnutrition. Wasting and stunting are mostly used as measures of malnutrition for children up to the age of 5 years. Body mass index (BMI) is more appropriate for adults. Low weight to age ratio is an indicator of stunting (shortness). It is associated with poor overall economic conditions and or repeated exposure to adverse condition. A person is stunted when he is shorter than he would be at his current age. Specifically a person is stunted when the height /age ratio is less than the mean of height/age ratio minus twice times the standard deviation of the standardized distribution. When the height /age ratio of an individual is less than the mean of the ratio minus three times the standard deviation of the standardized distribution, it is called severely stunted. Stunting is interpreted as a measure of long-term malnutrition because malnutrition causes slow growth. This measure is relevant especially for children up to five or six years old.

Low weight to height ratio is an indicator of wasting (thinness). It is associated with a failure to gain a weight or a loose of weight. Wasting refers to the magnitude of the weight (kg) to height (m) ratio of a person. A person is wasted when the weight height ratio is less than the mean of the ratio minus two times the standard deviation of the standardized distribution. If the ratio is less than the mean ratio minus three times the standard deviation, it is called severely wasted. Wasting indicates short-term malnutrition.

Height and weight are the most commonly used indicators of the nutritional status of a child. According to WHO working group (1986), appropriate height-for-age of a child reflects linear growth and can measure long-term growth faltering or stunting, while appropriate weight-for- height reflects proper body proportion or the harmony of growth. Weight- for –height is particularly sensitive to acute growth disturbances and is useful to detect the presence of wasting. Weight-for-age represents a convenient synthesis of both linear growth and body proportion, and thus can be used for diagnosis of underweight children. The presence of under nutrition in children is assessed by using these three anthropometric parameters (weight-for-age, height-for-age and weight-for-height) and by comparing them with an internationally accepted reference standards, i.e. National Center for Health Statistics (NCHS)/WHO international reference population (WHO, 1983). If a child has a low weight for age, i.e., a Z-score below two standard deviation of the reference population mean (-2 Z score), such a child is categorized as "*stunted*".
Similarly, a low weight-for-age is a diagnostic of an "*underweight*" child, while a low weight-for-height is an indicative of "*wasting*". In a population, the growth retardation prevalence of under five-years- old preschool children is estimated by the proportion of weight-for-age, height-for-age, and weight-for- height below -2 Z score, the accepted cutoff for the diagnosis of under nutrition and an indicative of an increase in risk of morbidity and mortality (WHO 1995). An additional use is the estimate of overweight children owing to over nutrition, as measured by the proportion of children with weight for-height above + Z score. Another common classification is the deviation from the median. Commonly children below 70% of the median are classified as malnourished, below 60% as severely malnourished.

The Body-Mass-Index (BMI) is a measure for fatness/thinness in adults.BMI = Weight in kilogram divided by square of height in meters. Normally body weight is proportional to body height and the BMI of well nourished adult ranges from 18.5 to25. A BMI higher than 25 indicates obesity and a BMI lower than 18.5 is considered to be an indicator of energy deficiency. Women are considered severely malnourished if the BMI is lower than 17.

2.1.2 Income Vs Non Income Measures of Poverty

Today it has become a standard in the comparative analysis of poverty to analyze relative income or, less frequently, consumption poverty rather than assuming an absolute minimum level. Income and its distribution is an important indicator of a particular social condition yet it seems for various reasons not exhaustive. Townsend (1979) was among the first to address this problem. He did, however, not attempt to abandon low income as a measure of poverty; rather he tried to identify an income threshold which corresponds to a meaningful deprivation level. In a

sense Townsend projected extreme inequalities in the functioning space into the income space. The latter is generally understood at least as less complex, if not uni dimensional. Further the use of an income measure suggests some similarity to the level of minimum social transfers. The availability of harmonized data sources for household incomes (e.g. Luxembourg Income Study; European Community Household Panel) seems to have facilitated comparative analysis of income poverty. Notwithstanding the convenience of using income to measure poverty it seems still debatable whether it can be regarded as theoretically exhaustive. Sen (1992) defines poverty as limited basic capabilities. Generally the capability approach identifies a hypothetical space of functioning which may be achieved by an individual. Sen admits that this space is difficult to assess empirically and most of his own work refers to functioning, as proxy of the full range of possible opportunities.

Two fundamental arguments may be brought to caution against income as the sole determinant of poverty. First, income is a flow of resources; it is related but not identical to the corresponding stock of monetary and non-monetary capital which in itself determines capabilities. The latter holds particularly in the case of negative capital (debts) which drastically reduces the achievable range of functioning. Longitudinal observation of income flows may help to improve this shortcoming of present social reporting, however it still ignores quantities of the stock which were accumulated (or inherited) outside the reference period. Thus a consistent definition of the economically disadvantaged would require the inclusion of broader measures of wealth. Second, income can represent only the demand side, a whole range of assumptions need to be made on how a given amount of income can be converted into comparable functioning, particularly in international comparison. Present reporting on income inequalities and poverty usually refers to household income adjusted for household size. Though resources within households are usually shared among its members the degree of this haring is not known. Also the extent of intra household transfers may be subject to cultural differences. Findings on subjective elasticities clearly show also that the convertibility of household income into household welfare is not the same in different countries of the world. (Strengmann and Kuhn, 2000, Tentschert et al, 2000), Klasen, 2000) highlights the conceptual and theoretical problems associated with the sole use of monetary poverty measures in three fields: the problem of appropriateness and interpretation of utility as welfare measure as well as the question of translating income into utilities; the problem of inter-personal comparisons of utility under the restrictive assumptions about cardinal utility functions; and the (unrealistic) underlying assumption of complete markets.

2.1.3. Determinants of malnutrition

2.1.3.1. Women's nutrition

Some evidence in developing countries indicate that malnourished individuals, that is, women with a body mass index (BMI) below 18.5, show a progressive increase in mortality rates as well as increased risk of illness (Rotimi, 1999). For social and biological reasons, women of the reproductive age are amongst the most vulnerable to malnutrition. Increased prenatal and neonatal mortality, a higher risk of low birth weight babies, stillbirths, and miscarriage are some of the consequences of malnutrition in women (Krasovec and Anderson, 1991). Some of the socioeconomic and demographic factors explaining women's nutrition according to studies done in different places are reviewed below.

2.1.3.2. Household economic status

The economic status of a household is an indicator of access to adequate food supplies, use of health services, availability of improved water sources, and sanitation facilities, which are prime determinants of child and maternal nutritional status (UNICEF, 1990). A study of most of the DHS surveys conducted in developing countries (Loaiza, 1997) and a study in the Southern Nations, Nationalities and Peoples Region (SNNPR) of Ethiopia (Teller and Yimar, 2000) showed that women from low economic status households were the most affected by malnutrition.

2.1.3.3. Education status of women

Women who receive even a minimal education are generally more aware than those who have no education of how to utilize available resources for the improvement of their own nutritional status and that of their families. Education may enable women to make independent decisions, to be accepted by other household members, and to have greater access to household resources that are important to nutritional status. A comparative study on maternal malnutrition in ten sub-Saharan African countries (Loaiza, 1997) and a study in the SNNPR of Ethiopia (Teller and Yimar, 2000) showed that the higher the level of education, the lower the proportion of undernourished women. 2.1.3 Place of residence A comparative study on maternal nutritional status in 16 of the 18 DHS conducted countries (Loaiza, 1997) and a study in the SNNPR of Ethiopia (Teller and Yimar, 2000) showed that rural women

are more likely to suffer from chronic energy deficiency than women in urban areas. These higher rates of rural malnutrition were also reported by local studies in Ethiopia (Zerihun et al., 1997; Ferro-Luzzi et al., 1990). Similarly, studies on child nutrition (Sommerfelt et al., 1994; Yimer, 2000) also showed significantly higher levels of stunting among rural than urban children.

2.1.3.4 Women's employment and control over income

Women's employment increases household income, with consequent benefit to household nutrition in general and the woman's nutritional status in particular. Employment may increase women's status and power, and may bolster a woman's preference to spend her earnings on health and nutrition. Though employed, women without control over their income and decision making authority within the household are deprived of economic and social power and the ability to take actions that will benefit their own well-being. Studies in Africa have indicated that, at similar levels of income, households in which women have a greater control over their income are more likely to be food secure (Kennedy and Haddad, 1991).

2.1.3.5. Age of women

Women's age and parity are important factors that affect maternal depletion, especially in high fertility countries (Zerihun, 1997) DHS surveys conducted in Burkina Faso, Ghana, Malawi, Namibia, Niger, Senegal, and Zambia show a greater proportion of mothers age 15-19 and 40-49 that exhibit chronic energy deficiencies (CED). Local studies in Ethiopia also showed that women in the youngest age group (15-19) and women in the oldest age group surveyed (45-49) are the most affected by undernutrition (Teller and Yimar, 2000).

2.1.3.6. Marital status of women

Marital status of the women is associated with household headship and other social & economic status of the women that affects their nutritional status. Nutritional and social securities could be endangered by a negative change in marital status. A study on the SNNPR Region of Ethiopia showed that women's malnutrition is significantly associated with marital status indicating that compared to married women malnutrition is higher among unmarried rural and divorced/separated urban women compared to married ones (Teller and Yimar, 2000).

2.1.4. Child nutrition and malnutrition

Approximately 10 percent of children born in Ethiopia will die before their first birthday and 17 percent will die before their fifth birthday (CSA and ORC Macro, 2001). According to formulas developed by Pelletier et al. (1994), 57 percent of under-five mortality in Ethiopia is related to severe and mild to moderate malnutrition (ORC Macro, 2001). The consequences of malnutrition in children also include poor physical development and limited intellectual abilities that diminish their working capacity during adulthood. Some of the socioeconomic and demographic factors explaining child nutrition according to studies done in different places are reviewed below.

2.1.4.1. Household economic status

As in the case of women, the economic status of a household is also one of the most important determinants of child nutritional status (UNICEF, 1990). Comparative studies on child nutrition for more than 15 countries (Sommerfelt et al., 1994) and some local studies in Ethiopia (Getaneh et al., 1998; Genebo et al., 1999; Yimer, 2000) showed that the higher the level of economic status of the household, the lower the level of child stunting.

2.1.4.2. Education of mother

Education is one of the most important resources that enable women to provide appropriate care for their children, which is an important determinant of children's growth and development. Studies in the Philippines (Aguillion et al, 1982), Libya (Popkin and Bisgrove, 1988), Uganda (Statistics Department and Macro International Inc., 1996), and Ethiopia (Yimer, 2000; Genebo et al., 1999) show a decreased incidence of malnutrition among young children with an increase in the level of mothers' education.

2.1.4.3 Employment status of mothers

Although women's employment enhances the household's accessibility to income, it may also have negative effects on the nutritional status of children, as it reduces a mother's time for childcare. Some studies have revealed that mothers of the most malnourished children work outside their home (Popkin, 1980). Another study argued that there is no association between maternal employment and children's nutritional status (Leslie, 1988).

2.1.4.4. Source of water and availability of toilet facility

Unfavourable health environment caused by inadequate water and sanitation can increase the probability of infectious diseases and indirectly cause certain types of malnutrition (UNICEF, 1990; Engle, 1992). A comparative study in some developing countries (Sommerfelt et al., 1994) and in Jimma, Ethiopia (Getaneh et al., 1998) showed that unprotected water source and non-availability of latrine were associated with low child stature.

2.1.4.5 Child morbidity

Diarrhea and other infectious diseases manifested in the form of fever affect both dietary intake and utilization, which may have a negative effect on improved child nutritional status. A comparative study on children's nutritional status (Sommerfelt et al., 1994) indicated that stunting was highest among children with recent diarrhea.

2.2.6 Age of child

Children's nutritional status is also more sensitive to factors such as feeding/weaning practices, care, and exposure to infection at specific ages. A cumulative indicator of growth retardation (height-for-age) in children is positively associated with age (Anderson, 1995). Local and regional studies in Ethiopia have also shown an increase in malnutrition with increase in age of the child (Yimer, 2000; Genebo et al., 1999; Samson and Lakech, 2000).

2.1.4.6 Birth order

It is expected that parents give less attention to older children when they give birth to a new child who needs much attention and care. One study showed that stunting is rare in birth order 2-3 (Sommerfelt et al., 1994), and higher birth order (5+) is positively associated with child malnutrition.

2.1.4.7 Birth interval of the child

Closely spaced pregnancies are often associated with the mother having little time to regain lost fat and nutrient stores (ACC/SCN, 1990). Higher birth spacing is also likely to improve child nutrition, since the mother gets enough time for proper childcare and feeding. Studies in developing countries showed that children born after a short birth interval (less than 24 months) have higher levels of stunting in most countries where DHS surveys have been conducted (Sommerfelt et al., 1994)

2.1.5. Interrelationship between maternal and child nutrition

Birth weight, child growth, and adolescent growth determine nutritional status before and during pregnancy (maternal nutrition). Maternal nutrition also influences fetal growth and birth weight (ACC/SCN, 1992). The presence of an intergenerational link between maternal and child nutrition means a small mother will have small babies who in turn grow to become small mothers. Some findings on the relationship between maternal and child nutrition (Loaiza, 1997; Teller et al., 2000; Genebo et al., 1999) showed that a high proportion of low-birth-weight and stunted children were observed among malnourished mothers.

2.1.6. Anthropometric Deprivation and Poverty

Literature denotes poverty as a multidimensional phenomenon. For this reason, it is necessary to determine all possible forms of poverty which societies may measure from. Although the present work will not be a specific multidimensional approximation work two-dimensional instead, it will seek to add an anthropometric dimension to the study of poverty with the aim of re-directing the perception of what is considered poverty among the most selected strata in direct correlation with the most randomly rooted, persistent structural poverty within a group of people.

2.1.7. ANTHROPOMETRIC POVERTY MEASUREMENTS: THE ARGENTINE CASE

He suggests expanding the concept of poverty so that it also comprises all those people who are not able to develop basic capabilities and functioning to attain a level of initial welfare. Hence the question: How can a person develop all their capabilities without a biological support to make it possible? In that search, anthropometry comes up as one of the simplest and most secular ways used to measure such basic support in people's development.

In terms of equal opportunities, and leaving genetic deference's aside, ensuring each individual's full mental and physical capabilities should be the obligation of any nation towards their citizens. Therefore, to guarantee equal opportunities in terms of nutrition should also be a priority of any social science that advocates to the human welfare analysis. In this work, tools are proposed and developed to fully appreciate the magnitude and depth of the anthropometric deprivation on individuals within a certain group of people. Anthropometry is extensively accepted as the most practically used tool to evaluate the nutrition status of human beings in general, and in particular, of children and adolescents in their stages of development. The individuals size as their anthropometric status, is also used as a measurement of life quality given the fact that they oer welfare measurement in relation to the natural development of individuals physical prop.

Among the wide range of literature that comprises dierent aspects of anthropometry, it is very necessary to mention Robert Fogel's (1986, 1987, 2004, 2004b; are, among other contributions, related the prevalence of chronic diseases, disabilities and infant mortality to anthropometric variables such as height and body mass index.

For this reason, even though the present work emphasizes the study of multidimensional poverty, it does have, from the very beginning, a Fogel spirit due to its inheritance. Other important contributions can be appreciated in Steckel

(1995) who looks for links between incomes and the anthropometric measurement height as an alternative way of measuring life standards. Steckel himself widely revised the economics-anthropometric literature and found a positive correlation between height and levels of income per capita among individuals; he also found a high sensitivity in height variable among the lowest-income groups taking into consideration 16 countries with low and high average incomes in 1990 and 1991. By addressing welfare multidimensionality, Sen (1985, 1992, 1999); suggested that besides observing income as a measurement of welfare and poverty, the individual's functioning's and capabilities should also be observed; hence, a person's welfare should be denied as the presence of essential functioning's to develop tasks, and the capabilities as the extent of a person's indispensable means to develop them.

In this way, poverty indexes should be used to notice individuals' inability to attain a minimum level of basic capabilities in order to function and develop; it would also be possible to perceive individuals' inabilities to, for example, be healthy, well-nourished, educated, protected, etc. To measure them, Bourguignon and sen (1999) proposed a quantitative theory that makes it possible to expand poverty indexes into multiple dimensions, so as to reect people's (functionings shortage in a more comprehensive way, and individuals' lack of material wealth, in a more representative way.

At local level, one of the few existent works that pretends to reect the evolution of such lacks from a multidimensional measurement of poverty, Conconi and Ham (2007) prepared an analysis of relative multidimensional poverty for Argentina using the Ongoing Household Survey (Encuesta Permanente de Hogares EPH) between the 1998-2002 periods on dierent economy dimensions: labor condition, housing, education and income. They found an increasing tendency in social levels of exclusion as a result of the multidimensional measurement. In this way the results shown here oer information about the current, as well as the long-term poverty study of the general welfare of the population represented.

2.1.8. Anthropometric Deprivation and its Measurement

Anthropometry, especially weight and size, constitutes the most direct, low cost, non-invasive, trustworthy, reproducible and objective way of measuring nutritional status due to its capacity to sum up the nutritional history of individuals, as well as of populations. According to the World Health Organization (WHO 1986) anthropometric variables are used to create indicators of nutritional statuses. Among many evaluation methods, the use of the pediatric `z-score' is preferred; it homogenizes the presentation, the analysis and the interpretation of anthropometric data for the nutritional evaluation of a population. Three basic anthropometric variables: size, weight and age are combined to create the two fundamental anthropometric indexes weight-for-height (W/H) and height-for-age (H/A), which are widely used in the nutritional evaluation of a developing individual. They consider the standard individual deviation of every child with respect to the median of the population of reference as a means to qualify the growth of an individual into normal or malnourished.

2.1.8.1 ANTHROPOMETRIC POVERTY MEASUREMENTS: THE ARGENTINE CASE

Due to the necessity of a reference population which exceeds the regional genetic dierences, and in the search of standardization to measure malnutrition among 0-5 year old children including Argentina, the values used are those of the W/H and H/A average population made by Sociedad Argentina de Pedriatía (Argentine Pediatric Society) for the whole country. (Lejarraga, 1987). According to the WHO International Standards (1986), both evaluation indexes of nutritional development are obtained as follows:

$$Z_{ij} = \frac{x_{ij} - med_{ij}}{sdij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

The number of individuals *i* will be the number of toddlers N in the sample considered, so that $I = (1, \ldots, N)$ between the age range from 0 to 5 years, recommended by the WHO for the nutritional appreciation. The Z score of the *I* developing individual, according to the anthropometric variable $j = (1, 2)$ will then be the result of the deference between its anthropometric value *x* and *med*, the average of the population of reference corresponding to sex and age, in standard deviation units. As *j* may be $j = 1, 2$ whether the W/H or H/A variables are considered, there are averages of reference according to age and sex, which nally conform the two key variables for the characterization of the nutritional state upon which this work is based.

2.1.9. Anthropometric Deprivation: Nutritional Significance and Classification.

Anthropometric deprivation or child malnutrition can initially be classified into two basic categories: wasting and stunting. The rst mentioned, also called acute malnutrition or emaciation, can be attributed to a child's tissue or body mass decit in comparison with other children of the same height, and are identied with the reported variable values

weight-for height which are lower than two standard deviations with respect to the average of reference. One of the characteristics of wasting is that it can appear and disappear quickly according to the environment. That is why seasonal phenomena such as diet variation, illnesses or food provision may condition it. The second category, stunting or chronic malnutrition, is synonymous with a decrease of the speed of skeletal growth and it is identified with the reported values of the variable height-for-age which are lower than two standard deviations. On the other hand, this nutritional status has been associated with conditions of general poverty in multiple dimensions of welfare (housing, education, income, etc.) for a long time. This type of anthropometric deprivation is undoubtedly the most worrisome due to the fact that the irreversible damage it causes to toddlers today will bring about after-eects for the rest of their lives.

2.1.9.1. Classification of Malnutrition According to its Severity.

Additionally, Waterlow's classification et. al. (1977) is taken into consideration; it orders what has been stated above according to its severity, and it also takes into account those cases in which both phenomena appear together (stunting) and (wasting), differentiating the shortened individual's malnutrition between mild and severe. In this classification, the mild-chronic malnutrition is also called compensated because it presents a normal speed of growth; by contrast, the severe-chronic malnutrition is called decompensate because it is related to an abnormal speed of growth.

To graphically summarize the above mentioned information and incorporating threshold values according to the Standards of the World Health Organization Bulletin (WHO 1976) the following chart represents the toddler's classification in accordance with the standard `Z score' compiled for the W/H and H/A values - from now onwards referred to as z_{i1} and/or z_{i2} respectively – between 6-month to 5-year-old children who suer from some kind of nutritional lack as can be appreciated below.

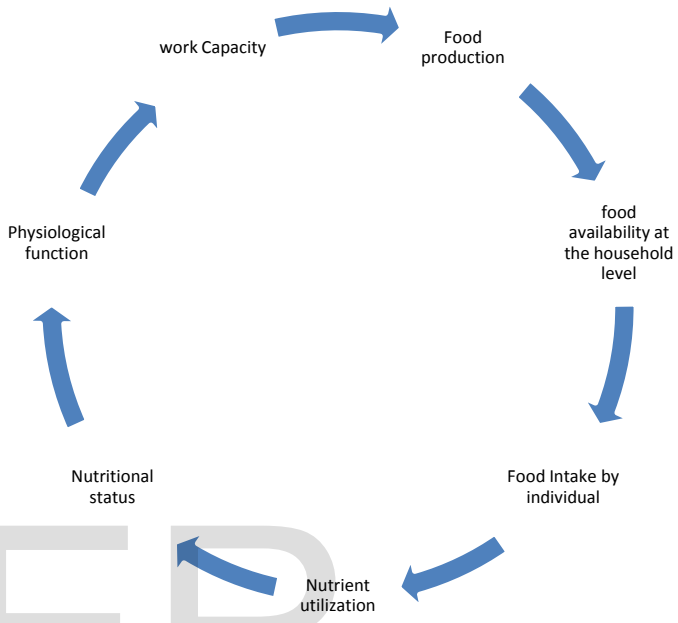
Table 1 Z Score distribution for Nutritional Deficiency

T/E - P/T	**Z_{i1} > -2sd**	**Z_{i1} < -2sd**
Z_{i2} > -2sd	Normal	Wasted Acute malnutrition
Z_{i2} < -2sd	Stunted Chronic malnutrition (mild)	Stunted and wasted chronic malnutrition (sever)

On the basis of this anthropometric classification, given the nutritional welfare, the making up of a nutritional status variable will be backed up in the subsequent measurement of poverty severity, indigence and anthropometric deprivation.

Nutritional cycle

Graph 1 Nutritional Cycle



In Figure 1 a simplified model of the 'Nutrition Cycle' is shown. It emphasizes the complex nature of factors that affect nutritional status. Members of a household can only exist if they continue to eat, either by growing or earning money for food. Debilitating adult infections such as schistosomiasis, on chocerciasis, trypanosomiasis and malaria can prevent economically active household members from working and so providing food. The whole household may suffer as a result and marginally deficient members are especially vulnerable. It has recently been suggested that the spread of the AIDS virus throughout substantial areas of Africa could disrupt food production to the extent that widespread famine results. Furthermore it is important to recognize that food may not be equitably distributed nationally or between different family members and that individuals do not have identical rates of nutrient utilization. The factors in Table 1 are all potentially important determinants of nutrition. It is not surprising therefore those studies of nutrition and infection performed in different social and economic environments sometimes give conflicting results.

2.1.9.1 FACTORS AFFECTING THE NUTRITION CYCLE

The factors in Table 1 are all potentially important determinants of nutrition. It is not surprising therefore those studies of nutrition and infection performed in different social and economic environments sometimes give conflicting results.

Table 2 Factors Affecting Nutritional Cycle

Physical Fitness and Health	*− Injury, illness, disability.*
Employment Opportunities	− Economic/social status, market forces.
Agricultural Patterns	− Land, climate, availability of seeds, fertilizers, markets and transport, food prices.
Households	− Family size, number of dependents per food producer or wage earner, age distribution of the family.
Social	− Differential in food distribution within a family belief about appropriate foods.

2.2. Empirical Literature

According to Sommerfelt (1994), the association between family poverty and children's health, achievement, and behavior, few measure the effects of the timing, depth, and duration of poverty on children, and many fail to adjust for other family characteristics (for example, female headship, mother's age, and schooling) that may account for much of the observed correlation between poverty and child outcomes. This study explores the relationship between poverty and child outcomes in depth. By and large, this research supports the conclusion that family income has selective but, in some instances, quite substantial effects on child and adolescent well-being. Family income appears to be more strongly related to children's ability and achievement than to their emotional outcomes. Children who live in extreme poverty or who live below the poverty line for multiple years appear, all other things being equal, to suffer the worst outcomes. The timing of poverty also seems to be important for certain child outcomes. Children who experience poverty during their preschool and early school years have lower rates of school completion than children and adolescents who experience poverty only in later years. Although more research is needed on the significance of the timing of poverty on child outcomes, findings to date suggest that interventions during early childhood may be most important in reducing poverty's impact on children.

Study by Dereje Danbe Debeko et al. (2015) shows that almost, half of the under five children in Ethiopia are malnourished. The objective of this study was to estimate and identify determinants of nutritional status among under-five children in Hawassa Zuria District Southern Ethiopia. This survey was conducted by house to house visit through two-stage sampling using community based cross-sectional study design in 6 randomly selected kebeles during April 15-30, 2011. 721 children in total, aged 6-59 months old were studied to assess nutritional status in terms of stunting, wasting, and underweight. Socio-economic, health related and demographic measures were obtained from structured questionnaire. Also, anthropometric measurements were taken from each child in the study. Binary and multinomial logistic regressions were used to relate underlying factors to the adjusted odds of malnutrition indices. The results indicated that the overall prevalence of stunting, underweight, and wasting were 45.8 %, 31.9 %, and 23.6%, respectively. Female children were more stunted, under weight and wasted relative to males (OR = 1.67, 0.600 and 1.47), respectively. Children who had uneducated mothers were significantly more likely to be moderately underweight as compared to those of whose mothers had secondary and above educational level (OR= 0.35, CI: 0.16–0.79). Nutritional status in the study area among study population was categorized in low levels. However, planning the public preventive strategies in the district can help to control under-nutrition based on underlying factors of in the study population including, maternal education, maternal pre-natal health care services, toilet facility, child health care services and safe water supply.

According to Syed E Mahmood (2011) one of the greatest problems for India is undernutrition among children. The country is still struggling with this problem. Malnutrition, the condition resulting from faulty nutrition, weakens the immune system and causes significant growth and cognitive delay. Growth assessment is the measurement that best defines the health and nutritional status of children, while also providing an indirect measurement of well-being for the entire population. A cross-sectional study, in which we explored nutritional status in school-age slum children and analyze factors associated with malnutrition with the help of a pre-designed and pre-tested questionnaire, anthropometric measurements and clinical

examination from December 2010 to April 2011 in urban slums of Bareilly, Uttar-Pradesh (UP), India. The mean height and weight of boys and girls in the study group was lower than the CDC 2000 (Centers for Disease Control and Prevention) standards in all age groups. Regarding nutritional status, prevalence of stunting and underweight was highest in age group 11 yrs to 13 yrs whereas prevalence of wasting was highest in age group 5 yrs to 7 yrs. Except refractive errors all illnesses are more common among girls, but this gender difference is statistically significant only for anemia and rickets. The risk of malnutrition was significantly higher among children living in joint families, children whose mother's education was [less than or equal to] 6th standard and children with working mothers. Most of the school-age slum children in our study had a poor nutritional status. Interventions such as skills-based nutrition education, fortification of food items, effective infection control, training of public healthcare workers and delivery of integrated programs are recommended.

Roberto (1999) shows Hurricanes and other natural disasters can produce crop destruction, population displacement, infrastructure damage, and long-term public health consequences that include increased malnutrition among the affected populations. This paper presents the results of anthropometric measurements taken of 295 children under 5 years of age from three regions of Honduras that were affected by Hurricane Mitch, a major storm that struck Central America in the fall of 1998. The children in our study were sampled in three shelters in the capital city of Tegucigalpa; in the resettlement zone of Nueva Choluteca, Choluteca; and in the small urban area of Catacamas, Olancho. Our data indicated that, in comparison to the period before the hurricane, there was an elevated prevalence of wasting in all three of the study areas, and that there were also high levels of underweight in the Tegucigalpa and Nueva Choluteca study areas. There were statistically significant differences between the mean values of malnutrition indicators for Catacamas and those for the Tegucigalpa and Nueva Choluteca settlements. These differences suggest that resettled families were confronting a nutritional crisis in July and August of 1999, some 9 months after the hurricane struck.

Rodrigo Lopez-Pablos (2009) studies multidimensional perspective on the analysis of poverty, an anthropometric dimension has been added as an integral reference of welfare, reinterpreting the physiological significance of the existence of different types of malnutrition among 0.5 to 6 year old children, as well as those children who will uses a global deficiency in their essential capabilities and functioning's in the future. Two-dimensional FGT, Sen and Gini anthropometric indexes have shown that malnourished families not only do have the most unequal income but also that the future poor people generation in the NEA and NOA regions will be the worst in terms of cultural and cognitive capacities.

This paper examines the relationship between measures of income poverty, undernourishment, childhood under nutrition, and child mortality in developing countries. While there is, as expected, a close aggregate correlation between these measures of deprivation, the measures generate some inter-regional paradoxes. Income poverty and child mortality is highest in Africa, but childhood under nutrition is by far the highest in South Asia, while the share of people with insufficient calories (undernourishment) is highest in the Caribbean. The paper finds that standard explanations cannot account for these interregional paradoxes, particularly the ones related to undernourishment and childhood under nutrition. The paper suggests that measurement issues related to the way undernourishment and childhood under nutrition is measured might play a significant role in affecting these inter-regional puzzles and points to implications for research and policy.

Alemu Mekonnen (2002) shows one of the poorest countries in the world, Ethiopia's rate of child malnutrition is one of the highest, even within sub-Saharan Africa. The causes and relative importance of various determinants of malnutrition in Ethiopia are not well understood. This paper specifically explores some of the less obvious factors affecting children's nutritional status in Ethiopia. It is based on information collected in 2002 from 1001 households with eight-year-old children mainly from food insecure communities in Tigray, Amhara, Oromia, SNNP and Addis Ababa Regional States. As part of the Young Lives Project, this study is particularly important because the determinants of the nutritional status of eight-year-old children is much less researched than that of younger children, not only in Ethiopia but in other developing countries. The results from simple correlation analysis indicated that a number of variables were significantly related to weight-for-height z-score (WHZ) (as an indicator of wasting). In addition to analysing WHZ for the whole sample, we have also separately analysed WHZ for urban and rural households, and found that the determinants differed. The results show that weight-for-height z-scores depend on the sex of the child and suggest that short term malnutrition is higher for male children than for female children. We conclude that variables such as physical and natural capital (wealth index, ownership of radio, television

and land), human capital (education of members of the household), social capital (strength of a caregiver's ties to social organizations and networks), age-sex composition of households (the number of girls, the number of female adults) and location of residence (rural or urban) are important in influencing WHZ in eight-year-olds. We conclude that addressing child malnutrition, especially WHZ, requires a multi-dimensional approach that takes into account food security, public health and gendered intra-household dynamics if it is to be effective. Moreover, a cross-sectoral nutrition policy is needed to improve policy synergies.

CHAPTER THREE: DATA AND METHODOLOGY OF THE STUDY

3.1. Data Collection Tools

The work has employed both quantitative and qualitative tools of assessment which are based on primary field level data. Enumeration questionnaire has been developed for broader level of assessment of the households for understanding the nutritional, demographic, socio economic and anthropometric indices such as age, width of skull, length of skull, arm size, weight and height of children and adults in the study area. Primary data are collected from households selected from the study site at random from income based stratum of each towns for the year April-June 2015/16.

3.2. Sample Design and sample size

For this study sample is drawn using multi- stage stratified sampling method. In the first stage 5 kebeles, 4 kebeles and 1 kebele have been selected randomly from Adama, Assela and Modjo towns respectively. In the second step dwellers are classified according to their income level as low income, middle income and high income earners. This classification is made in collaboration with kebele administrative workers. In the third step sample size from each kebeles are allocated according to proportional sample allocations procedure. The households' lists at respective kebele administration sample of households are selected using systematic random sampling method. The investigation used Yemane (1967) of sample size determining formula for finite population. The total number of households investigated is 400. The sampled households are interviewed with structured enumerator questionnaire for gathering data and information on various aspects of household level data including demographics, household assets, consumption, employment and income, credit, household total incomes, anthropometrics indices, children related expenditures, family characteristics, poverty perception level, nutrition and food intake level.

According to Yemane (1967) sample size can be calculated with formula

-

$$n = \frac{N}{(N-1)e^2} \quad \text{.....} 1$$

Where e measures degree of precision and N stands for total population size

With the help of Yemane (1967) formula, total sample taken from the three towns are 400. Using proportional sample allocation procedure, sample size selected from each town is shown in the following table.

Table 7 sample size allocation

Towns name	*Total population size* [13]	*Sample size*
Adama	299,621	261
Assela	110,088	98
Modjo	39,316	41
Total	449025	400

Source: own Calculation

The specific target household has been selected in proportion to population size of sampled stratum of each kebeles. In order to consider the impact of gender difference, the study chose 30% of sample to be female and the remaining 70% to be male.

3.3. Data Analysis

After the field level data is collected and edited appropriate statistical tools such as means, proportion, percentage, ANOVA[14], and econometrics models have been employed in the analysis of the data. Econometric model such as probit and logit are useful for the analysis of variables which are dichotomous in nature such as poor and non poor, wasted or not wasted, stunted or non stunted, under weighted not underweighted etc. in this study the logit model is used(the model is specified blow). Moreover, weighted feasible general least square method has been employed to estimate vulnerability to malnutrition model.

[13] Total population size referred in the table reflects the size of towns by 2012

[14] is used to determine whether there are any significant differences between the means of three or more independent (unrelated) groups

3.4. Analytical Framework and Model

There are many settings in which the economic outcome we seek to model is a discrete choice among a set of alternatives, rather than a continuous measure of some activity. In this case the models have in common a dependent variable as an indicator of discrete choice such as yes or no decision. In this study the dependent variable is a binary choice, either a child is stunted (wasted) (Y=1) or not(Y=0). It is believed that a set of factors such as family size, education of family, household income, birth order, frequency of illness etc. gathered in a vector **X** affects the probability of being in either of the group.

$$prob(Y = 1/ X) = F(X,\beta)$$
$$prob(Y = 0 / X) = 1 - F(X,\beta) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The variables of interest are categorized under dependent and independent variables. The dependent variables are anthropometrics among children which are used as summary indices of nutritional status. Anthropometric indicators are constructed using data on the children's age, height, arm size, and weight. According to WHO (2015), the three most commonly used anthropometric indices to measure the health and nutritional status of children are weight-for-height (WHZ) height-for-age (HAZ) and weight-for-age (WAZ). For this study, the indices of nutritional status are expressed in standard deviation units (z-score) from the median for the international reference population given by the following equation.

$$Z - score(orSD - score) = \frac{X - \breve{X}}{\sigma} \quad \ldots\ldots\ldots (4)$$

Where X is the observed value and $\breve{X}$ and σ are the median and the standard deviation values of the total sample, respectively. The nutritional status variables (weight-for-age, height-for-age and weight-for-height) which are continuous variables were treated as dichotomous, with two values 'well-nourished' and 'under-nourished'. To this end, cut-off points need to be used to estimate the prevalence of anthropometric abnormality. The conventional cut-off point, which is applied in the present study, is -2 standard deviation units (z-score) from the median reference population. Children whose z-score falls below -2 standard deviation units are classified as under-nourished (coded 1) and those above -2 standard deviation as well nourished (coded 0). The calculation of the indices of child malnutrition involves comparison with an international reference population as recommended by the World Health Organization (Dibley et al., 1987a and 1987b). The justification for use of a reference population is the empirical finding that well-nourished children in all populations follow very similar growth patterns (Habicht et al., 1974; Green 2003).

The explanatory variables are composed of a set of socioeconomic characteristics of children, their parents and the community. The selection of control variables is guided by theoretical reasons, availability of data and previous empirical experience. The following variables are included: sex and age of the child, economic status of the household, birth order (categorize as first, second, third, fourth and or higher birth order) age of mother (grouped as below 19, 20-29, and 30 years and higher) and educational status of the mother and father, mother's current work status, religion, access to different amenities (access to pit latrine and tap water), access to information and media (watching television/radio every week or not), community characteristics (distance to the nearest health facility), child care, inequality, environment in which child is grown, nutritional intake level, urbanity, etc.

Given the dichotomous nature of the dependent variable (0, 1), estimation is based on using binary regression models. For the analysis of the nutritional status of children, the dependent variable is equal to 1 if the child's z-score is below -2 standard deviation units (under-nourished child) and equal to 0 if a z-score is above -2 standard deviation (well nourished child).

For the standard formulation of the health demand model, we refer to Behrman and Deolalikar (1988), in which a household maximizes a utility function. In this case, a household may be assumed to choose health and nutrition Hi, of all household members, leisure Li, consumption of goods and services Ci and tastes and preferences of the household, φ.

$$U = U(Ci, Li, Hi, \varphi) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The household maximizes this utility function subject to two constraints; a health production function for nutritional status and a budget constraint. The budget constraint takes the form:

$$I = PcC + WL + PY\,Y \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where Pc and W, PY are the price vectors of consumption goods, leisure and health inputs respectively, and I is the full income including the value of the time endowment of

the household and non-labor income. In this framework, the reduced form function for child health is:

$$HI, HC = \psi(Hinp, Cchar, Mchar, Fchar, HHchar, COMchar, \mu) \quad \ldots \quad (7)$$

Where

Hinp - health inputs such as vaccination, medical care, etc.

Cchar -Child characteristics such as age, sex, etc.

Mchar - Mother's characteristics such as education, health status, age, genetics, etc

Fchar – Father's characteristics (the same as mothers)

HHchr -Household characteristics such as economic status, number of house hold members,etc

COMchar - Community features like access to health services, safe water, sanitation, etc.

μ are unobservable individual health endowments.

Where the particular functional form of the function ψ( ) depends on the underlying functions characterizing household preferences and the health production function.

Modeling nutrition outcomes in terms of flows rather than stocks results in the derived reduced forms for the stock variables that include lagged exogenous variables as argument. The anthropometrics can be estimated as a short run and long-run health production functions respectively using equation (7). Different production functions (linear, Cob-Douglas, CES, trans-log, etc.) will be estimated to know the functional form that fit the data well. Fixed effect specifications and random effects models will be estimated to analyze the different determinants of child nutritional status.

The set of parameters β reflects the impact of changes in **X** on the probability. In this case what interests us is the marginal effect of explanatory variables on the probability of being stunted, wasted and under weight. Both probit and logit analysis are well established approaches in the literature focusing on binary choices (Burton *et al*., 1990) and whether to use logit or probit is a matter of computational convenience. The logit model has been widely used in many fields, including economics (Greene, 2003). A binary logit model is chosen for this study. The model enable us the determination of the factors influencing poverty in the case of individual specific data including household attributes, nature of their agricultural practice, and their asset holdings. In this method, individuals or children are classified as stunted, wasted or underweight according to their anthropometric indices.

Following Greene, 2003 the logit model, for binary choice problem can be specified. By differentiating the log likelihood function with respect to the parameters β the maximum likelihood estimates can be generated through an appropriate mathematical iterative procedure.

Unlike the standard regression analysis, the parameter value (β) is not directly interpretable as the effect of a change in the explanatory variable on the mean or expected value of the dependent variable. The coefficients need to be adjusted to be marginal effects in the case of logit model. In other words, the marginal effect which gives the partial derivatives indicating the change in the probability of the dependent variable relative to a unit change in one of the independent variables, need to be computed. As the relationship between the repressors and the absolute probabilities in non linear, marginal effects vary according to the choice of X and, consequently, they will vary among individuals according to the point of evaluation.

For continuous variables, the marginal effect is the probability change in response to an increase in the value of the independent variable by one evaluated at the mean value. For dummy variables, the marginal effect is computed as the difference in probabilities of their dependent variable between the group with designated value 1 and the reference group.

Assessment of determinants of poverty is a difficult and tricky task. Because it requires both tracing out of all relevant variables, and linking them with poverty in a way that could be used in decision making. This can also be complicated with the problem of using appropriate measure of poverty. There is a general agreement that poverty cannot be defined and measured with a single indicator. Repeated observations of household have shown that it is difficult to clearly determine who the poor are: some household move in and out of poverty and some are excluded when using one indicator and included when using another indicator (Alderman and Garcia, 1993).

There is a need, therefore, to use a range of indicators that corresponds to the different dimensions of poverty to identify all with different characteristics. It is only in this way that it is possible to assess the extent and nature of poverty determinants that have significant impacts. Now days Economists came to conclude that a person is poor not only because of its standard of living but also because of bad diet and poor food intake system. A given household could be exposed to obesity, stunting, wasting and underweight regardless of income level. According to (FAO, 2012) a rich person whose diet system is bad could

be considered as poor because of its low awareness level on nutritional intake science.

Household poverty can be attributed due to difference in income, education, asset ownership, etc. however, having better income, education, etc cannot always considered as guarantee for better welfare. According to WHO (2010) a person who cannot implement acquired knowledge for better nutritional intake, is taken to be poor. Sometimes people know what type of food to eat but when it comes to intake system most people fail to implement according to the science of nutrition. The argument is that if you don't use the knowledge you acquired, you will be poor. Finding out about the livelihood systems of poor people is an essential first step in identifying the options they have for improving their lot. The profiling of vulnerable groups is a useful way to formulate appropriate policy which is very helpful in reducing poverty. This research try to use methodology developed by Iyengar and Sudarshan (1982) to work-out a composite vulnerability[15] index from multivariate data and it was used to rank the households in terms of their economic performance. This methodology is statistically sound and well suited to study household vulnerability level to different economic indicators.

It is assumed that there are M towns, K indicators of vulnerability to malnutrition and Xij, I = 1,2,…K are normalized scores. The level or stage of development of ith town, $\hat{Y}$ vulnerability, is assumed to be a linear sum of X_{ij} as

$$\hat{Y} = \sum_{j=1}^{K} wjXij \quad \text{…… (8)}$$

Where w's (0<w<1 and $\sum_{j=1}^{K} wj$ =1) are the weights. In lynegar and Sudarshin's method the weights are assumed to vary inversely as the variance over the towns in the respective indicators of vulnerability to malnutrition. That is, the weight Wj is determined by

$$wj = \frac{c}{\sqrt{\mathrm{var}(Xij)}} \quad \text{…… (9)}$$

Where c is normalizing constant such that

$$c = \left[\frac{\sum_{j=1}^{j=k} 1}{\sqrt{\mathrm{var}(xij)}}\right]^{-1} \quad \text{……(10)}$$

The choice of weight in this manner would ensure that large variation in any one of the indicators would not unduly dominate the contribution of the rest of the indicators and distort inter regional comparisons. The vulnerability index so computed lies between 0 and 1, with 1 indicating maximum vulnerability and 0 indicating no vulnerability at all. For classificatory purposes, a simple ranking of the towns based on indices viz $\hat{Y}$ would be enough. However, for meaningful characterization of the different stages of vulnerability, suitable fractal classification from assumed probability distribution is needed. A probability distribution which is suitable for this purpose is the beta distribution which is generally skewed and takes values in the interval (0,1) as followed by lyengar and sudarshin (1982) has been applied. The distribution has the probability density given by

$$\beta(a,b) = \int_0^1 x^{\alpha-1}(1-x)^{b-1}dx \ , \qquad 0 < Z < 1 \text{ and } a,b > 0$$

where $\beta(a,b)$ is the beta function defined by

The two parameters a and b of the distribution can be estimated either by using the method described in lyegar and sudarshan (1982) or by using software package. The beta distribution is skewed with linear interval such that each interval has the same probability weight of 20%. These ranges of intervals can be used to characterize the various stages of vulnerability.

1. Less vulnerable if ($0 < \hat{Y} < Z_1$)
2. Moderately vulnerable if ($Z_1 < \hat{Y} < Z_2$)
3. Vulnerable if ($Z_2 < \hat{Y} < Z_3$)
4. Highly vulnerable if ($Z_3 < \hat{Y} < Z_4$)
5. Very highly vulnerable if ($Z_4 < \hat{Y} < 1$)

The vulnerability index calculated with the help of lyegar and Sudarshin (1982) method is used in the modeling of weighted feasible generalized least square method.

The short form of FGLSM used is written as follows

Child vulnerability to malnutrition = F(child characteristics, family characteristics, birth order, health education, frequency of sickness, number of vaccination, income inequality, child care, energy intake level, length of breast feed, urbanity, child care, growth environment,…)…….. 11

Functional form of equation 11 can be written as follows

$$\hat{v}\beta = \sum_{i}^{n} x_{ij} \int_{i}^{n} \Phi_{ij} \quad \text{……12}$$

The coefficient of the FGLS method can be estimated with the following function

$$\hat{\beta}_{FGLS} = (X'\hat{\Omega}^{-1}X)^{-1}X'\hat{\Omega}^{-1}y \quad \text{……13}$$

Variance of FGLS method can be estimated with the help of the following function

[15] is the state of being open to malnutrition. Vulnerability to malnutrition measures probability of an entity exposed to nutritional deficiency.

$$\mathrm{var}(u \mid X) = u^2 = \sigma^2 \exp(\delta_0 + \delta_1 x_1 + \delta_2 x_2 + \ldots + \delta_k x_k) \quad \ldots\ldots\ldots\ldots..14$$

By taking log of the both sides logalizm of squared error can be written as

$$\log(\hat{u}^2) = \alpha_0 + \delta_1 x_1 + \delta_2 x_2 + \ldots + \delta_k x_k + e. \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots.15$$

By taking exponential of equation 15 it is possible to get the result of FGLS result of vulnerability to malnutrition. This model is used in order to calculate the average vulnerability to malnutrition from education, family characteristics, child care, length of breast feed, income level, health, birth order, number of vaccination, and energy in take level. The coefficients of the stunting, wasting, underweight and vulnerability models have been used for the analysis after hetroscedastisity[16], normality[17], multicollinarity[18] problems have been removed.

Chapter four: Data Analysis

4.1. Descriptive section

The discussion in this chapter is broadly categorized in to the analysis of descriptive and inferential. Analysis has been made by collecting data from dwellers living in the Adama, Assela and Modjo towns of Oromia regional state. To clearly reveal the behavior of parent population, we must take representative sample on the bases of non-biasedness, consistent and efficient parameters. Having looked at the proposition of Yemane (1986), the researcher selected 400 samples from the three towns. The following table shows children growth attributes on the bases of household characteristics.

Following the analysis of Charles Zaiontz (2014) 0.5 is used as cutoff point for wasting, stunting, under weight and vulnerability to malnutrition parameters. The table shows that child born from elder father is more likely to be wasted, stunted and under weighted than child born from younger father. Child born from younger mother (mother whose age is below 20) is more likely to be wasted, stunted and underweighted than child born from mother whose age is above 20. Many literatures have been showing as education level of mother is more important in the growth level of child. The data collected from these three towns also shows us that education level of mother is very important in reducing the problems child growth. Child born from educated mother is more likely to be cared and feed balanced diet than less educated mothers' child. From the data analysis we have also observed that regardless of income of mother, education is weighing in favor of children balanced growth.

The dependency ratio of family is hypothesized to contribute positively to children malnutrition. Different researchers have come up with different findings. Large family size is preferable in high income group society as children born from rich family are believed to augment family's job. But the researcher has observed that regardless of income of family, child born in large family size are more likely to be wasted, stunted and underweighted. For detailed analysis of the relationship between income and anthropometrics indices, try to look at graph 4.3. On one hand, According to the table, younger child is more likely to be exposed to short term malnutrition (wasted) and underweighted than their elders' counterpart. On the other hand, elder child is more likely to be exposed to long term malnutrition than their younger counterpart. This analysis has been in line with different reports of world health organization.

Table 3 Summary of household characteristics by anthropometrics indices

	wasted		underweight		stunting	
Household characteristics	**wasted**	**not wasted**	**under weighted**	**not under weighted**	**stunted**	**not stunted**
Age of father	31.34	29.39216	31.52381	29.52542	31.45902	28.675
Experience of household head	7.11204	4.91489	7.208684	5.09434	7.42463	3.864865
mother's age at birth	25.94	24.5882	25.85714	24.83051	26.2459	23.75
Education of household head	8.18	9.53061	8.491228	9.333333	8.02564	9.38333
Family size	4.81632	4.44	4.362069	2.767619	4.81666	4.333333
Age of child	2.7228	2.55294	5	2.544068	2.5775	2.676066
Length of breast feed	1.45313	2.02687	1.567119	1.9735	1.216053	2.063167
Arm size of child	14.45	14.70192	14.545	14.635	14.51803	14.67949

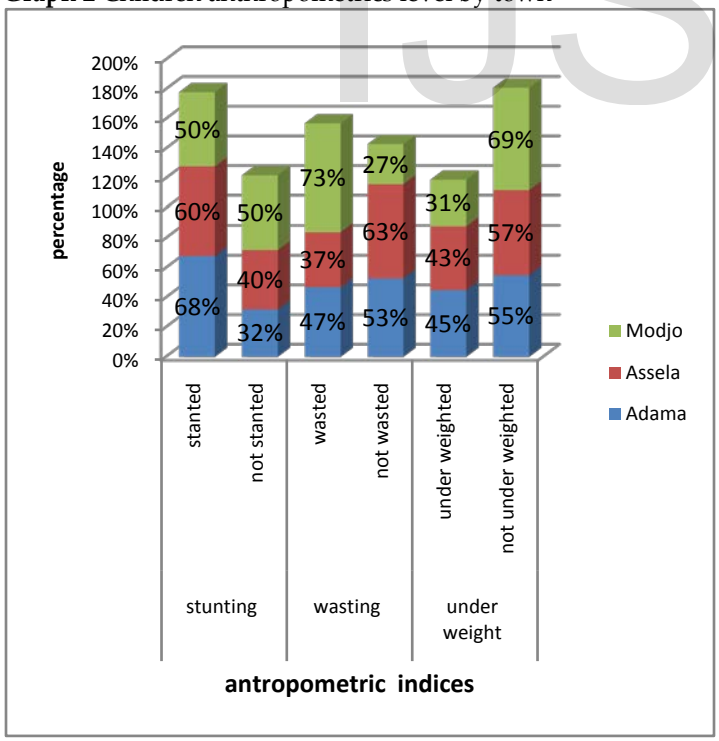
Source (own survey, 2015)

[16] refers to the circumstance in which the variability of a variable is unequal across the range of values of a second variable that predicts it.
[17] is a statistical process used to determine if a sample or any group of data fits a standard normal distribution
[18] is a phenomenon in which two or more predictor variables in a multiple regression model are highly correlated, meaning that one can be linearly predicted from the others with a substantial degree of accuracy

According to table 4.1 the length of breast feed is observed to reduce the problems of wasting, stunting and malnutrition. Child who has had longer breast feed is less likely to be exposed to growth retardation than those children who has had shorter breast feed. To sum up children growth retardation is being observed in all the three towns regardless of household characteristics. In fact child born from parents with better education, income, breast feed, family planning is less likely to be exposed to nutritional and growth retardation problems.

Graph 4.1 shows distribution of children's nutritional related growth retardation problem in Adama, Assela and Modjo towns. The graph shows us that stunting and under weight is largely observed in Adama and shallowly seen in Modjo towns while wasting (short term malnutrition) is deeply and shallowly observed Modjo and Assela towns respectively. Relatively speaking children of Assela town are less exposed to nutritional growth retardation problems than both Adama and Modjo town. These may be attributed to household accessibility to agriculture (farming and livestock rearing) which are very critical ingredients of children growth. The researcher tried to study the impact of livestock ownership on growth status of children and has come up with supportive argument.

Graph 2 Children anthropometrics level by town



Source: Own survey (2015)

Following lyenger and Sudarshin's (1982) approach to vulnerability score estimation procedure, the researcher tried to estimate children vulnerability to malnutrition and factors determining children vulnerability to malnutrition in the three towns. The approach divided vulnerability score in to five same interval ranges by the weight of 20%. If probability of vulnerable is between (0-0.2) less vulnerable, moderately vulnerable (0.2-0.4), vulnerable (0.4-0.6), highly vulnerable (0.6-0.8)and very highly vulnerable (0.8-1).

According to graph 2 there is no child with less vulnerability score in the three towns. Children have 0.4 vulnerability score and above. Similarly the table 4.2 shows that, on average, about 55% of children in the three towns are vulnerable to malnutrition. Various researches are showing that vulnerability score above 0.5 needs significant policy intervention to reduce children and growth related problems like child mortality rate, obesity, non communicable diseases, slow thinking and growth retardation. This means that unless careful follow up is made, children are more likely to be exposed to malnutrition which is thought to be the cause of aforementioned problems. The average vulnerability score of children is somehow related to the degree of urbanity. Children from highly urbanized town are less likely to be exposed to nutritional problem the like. According to table 4 children from Assela town are the most likely to be exposed to malnutrition than Adama and Modjo towns.

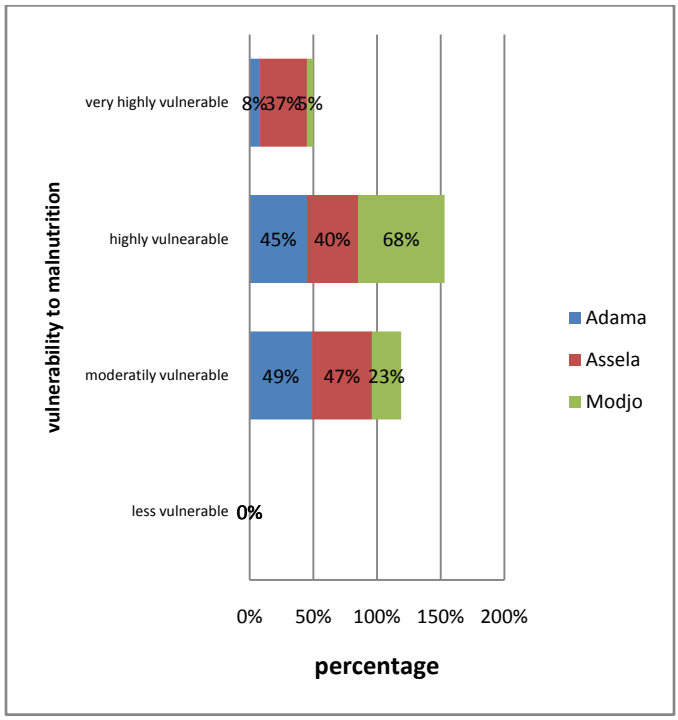
Table 4 Average vulnerability to malnutrition score in the three towns

Towns	Average Vulnerability
Adama	0.53
Assela	0.57
Modjo	0.56
Overall Average	0.55

Source: own survey (2015)

Figures in the table 4 shows that children are vulnerable to malnutrition regardless of degree of urbanity. Although vulnerability score is relatively lower in Adama town than Modjo and assela, still strong interventions is required to nullify its possible outcomes in the future.

Graph 3 children vulnerability to malnutrition by towns



Source: Own survey (2015)

Graph 3 shows the correlation between children vulnerability to malnutrition and poverty in the three towns. There are different approaches to define poverty. Someone is not only poor due to its income level. High income categories could be poor if they don't know the nutritional science that made the family members healthy and comfortable. Similarly low income categories could be called rich if they consume balanced diet according to the nutritional science. Therefore to study how nutritional effect matters on growth status of children I used approach stated NHS (2011) which is stated as follows

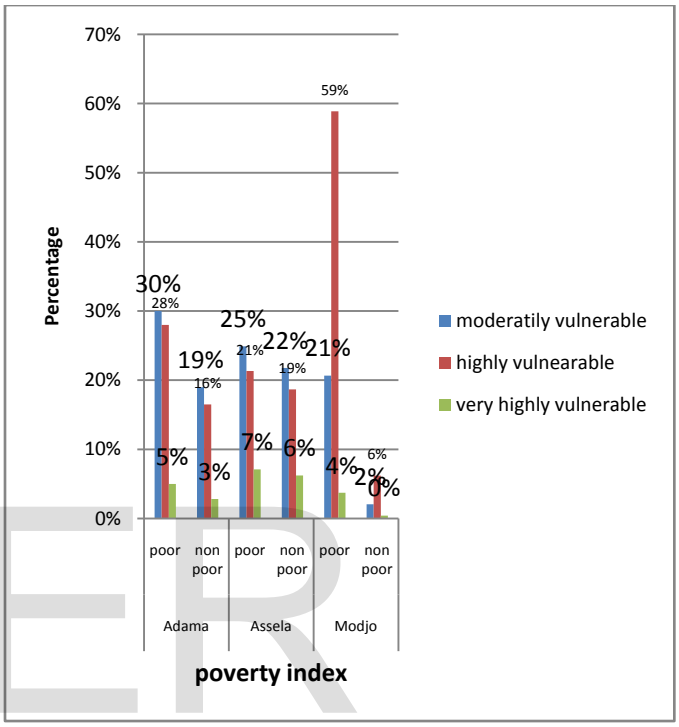
Table 5 Average energy requirements for children between 1 to 10 years old

Age (years)	Boys	Girls
1 to7	1200kcal	1000kcal
7	1649kcal	1530kcal
8	1745kcal	1625kcal
9	1840kcal	1721kcal
10	2032kcal	1936kcal

Source: NHS (2011)

Following table 5 standard energy intake requirements for normal and balanced growth of child, I categorized nutritional energy intake of children (proxied for poverty of children) in to nutritionally poor if intake is below standard and nutritionally non poor if intake is above standard level.

Graph 4 Children vulnerability to malnutrition by poverty status



Source: own survey (2015)

Graph 4 shows us that nutritionally poor children in all the three towns are moderately and highly vulnerable to malnutrition. I tried to relate income poverty to vulnerability to malnutrition in order to see how income matters in explaining vulnerability to malnutrition of children. I have observed that nutritional poverty and income poverty has strong correlation and same implication. Meaning children from low income family are more likely to be exposed to malnutrition than children from low income family.

Children from poor family of Modjo town is the most likely to be exposed to malnutrition than the other two towns while children from high income family are less likely to be exposed to malnutrition in Modjo. The Graph 4 also showing us children from high income family are also exposed to malnutrition due to the unawareness of family in following the standard nutritional intake science. Non

poor exposition to malnutrition is to its highest level in Assela.

Table 6 ANOVA test on household perception of food price inflation in affecting diet food energy intake of child

Sources	*SS*	*df*	*MS*	*F*	*P value*	*F crit*	*RMSSE*	*Omega Sq*
Between Groups	1318 5	1	1318 5	180.7 3	0.0000*** [19]	3.888 3	1.3376	0.47083
Within Groups	1459 1	20 0	72.95 5					
	2777	20	138.1					
Total	6	1	9					

Source: own survey (2015)

Households have been asked to rate the degree to which food price inflation is making them not to purchase all necessary food items required for child growth (Balanced Diet). The null hypothesis states that change in food price is not making educated families not to purchase all varieties of food required for child growth and alternative hypothesis says that food price inflation is making educated families not to purchase all food items required for child growth. The result from table 6 shows that food price inflation is constraining educated families not to purchase all contents required for child growth. The null hypothesis has been rejected at even 1% significance level. Even though educated people know what type of food to feed their children, the existing food price inflation is influencing them not to purchase balanced diet.

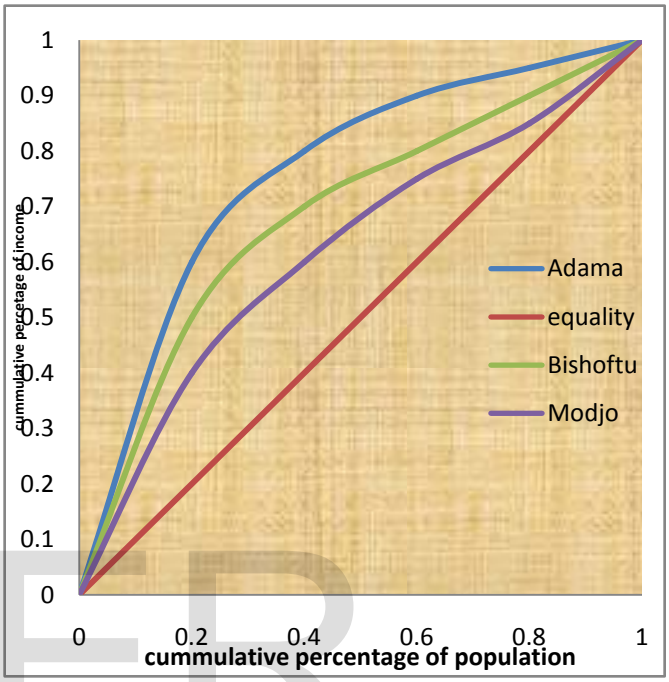
Table 7 Gini Coefficient[20] level

Towns	Gini coefficient
Adama	0.76
Assela	0.56
Modjo	0.54

Source: own survey (2015)

The Gini coefficient shown in the table 7 reveals that income inequality is proportionally related with degree of urbanity.

Graph 5 Income distribution of Adama, Assela and Modjo towns using Lorenz Curve [21]



Source: own survey (2015)

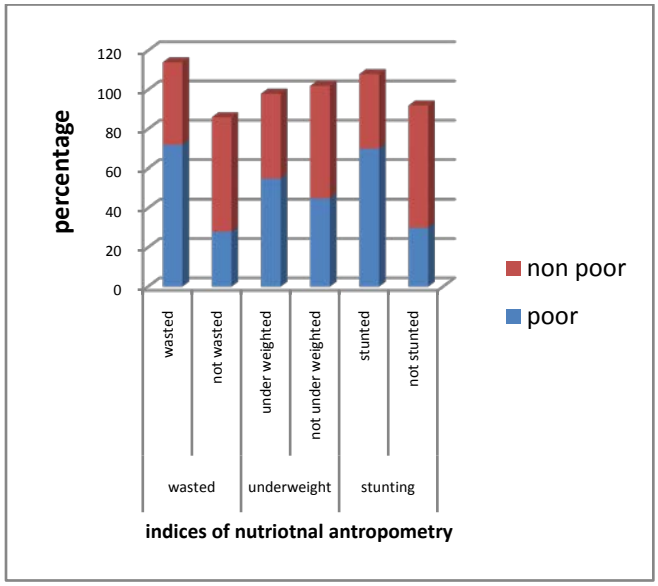
Graph 5 show extent of income inequality using Lorenz curve and Gini coefficient. Theoretically income inequality is thought to cause food price inflation. Cost of living makes individuals not to purchase all necessary varieties of food that is considered as guarantee to reduce malnutrition. Income inequality is highest in Adama and lowest in Modjo. This means that poor income earners of Adama and Assela towns cannot easily purchase balanced diet good for healthy functioning of human body. In high income inequality area, we have high probability of child being stunted, wasted and under weighted. In high income inequality area there is high probability of child from low income family to be exposed to malnutrition (for detailed analyses have a look at econometrics section)

[19] Significant even at one %

[20] The **Gini coefficient** is a measure of inequality of a distribution. It is defined as a ratio with values between 0 and 1: the numerator is the area between the Lorenz curve of the distribution and the uniform distribution line; the denominator is the area under the uniform distribution line.

[21] In economics, the **Lorenz curve** is a graphical representation of the distribution of income or of wealth. It was developed by Max O. **Lorenz** in 1905 for representing inequality of the wealth distribution

Graph 6 Relationship between poverty and nutritional anthropometry



Source (own survey, 2015)

Graph 6 also proves that poverty positively contributes to wasting, stunting and underweight of children. Children from poor income family are more tended to be exposed to nutritional deficiencies like wasting, underweight and stunting. The graph also shows that income is not as such sufficient condition for solving nutritional deficiency of children.

Part II: Econometrics Analysis

We have four models; vulnerability to malnutrition model, stunting model, wasting model and underweight model. Coefficients of vulnerability to malnutrition model has been estimated with the help of Weighted feasible least square method while coefficients of the other three models have been estimated with the help of logistic regression model.

Table 8 Econometrics results

variable name	Vulnerability to malnutrition	Stunting	Wasting	Underweight
Urbanity	- 3.606 (0.775)***	-41.97 (0.960)***	1.15 (0.63)**[22]	-0.439 (0.535)
Family size	6.2678 (0.6997)***	5.358 (0.427)***	0.0527 (0.2002)	0.1152 (0.1951)
Age of household head	-2.1390 (0.1625)***	0.1832 (0.855)	0.1327 (0.138)	0.0032 (0.67)
Mothers Age at Birth	1.8590 (0.3152)***	-6.459 (0.233)***	-0.416 (0.218)	0.038 (0.95)
Education of Mother	-1.8590 (0.1728)***	-2.7126 (0.254)***	0.1207 (0.129)	-0.1575 (0.1012)
Religion of parents[23]	-8.9686 (3.4133)**	-1.373 (3.17)	0.167 (0.054)**	0.4408 (0.1108)***
House ownership	-2.6225 (1.5560)	-9.621 (0.901)***	-6.89 (2.73)***	1.34 (3.451)
Size of house	-0.4326 (0.0288)***	1.373 (3.177)	0.0109 (0.0085)	-2.784 (5.696)
Availability of separate rooms for children	-10.1898 (0.90518)***	-1.66 (0.122)***	-1.2208 (1.008)*	-2.22 (1.11)*[24]
Age of child	11.8258 (0.4224)***	94.69 (1.80)***	-1.575 (0.474)**	0.03 (2.12)
Arm size	-1.7086 (0.7892)***	-17.31 (0.986)***	0.012 (0.134)	0.340 (0.997)
Birth order	2.7275(0.2432)***	1.66 (1.22)***	-0.137 (0.102)	-0.1398 (0.026***)
Proportional body growth	-0.0387 (0.0219)*	-4.28 (0.498)***	-0.472 (0.339)	-1.63 (1.73)
Frequency of illness	2.9401 (0.3889)***	0.0066 (0.0078)*	0.347 (0.184)*	0.1321 (0.160)
Poverty perception	-1.6693 (0.6547)**	2.76 (2.668)	1.615 (1.466)	0.039 (0.037)
Expenditure on children	-2.5572 (0.2315)***	-5.0288 (0.4058)***	0.704 (0.28)**	0.988 (0.997)

[22] Significant at 5% level of significance

[23] Range from extremist to liberal

[24] Significant at 10% significance level

Number of vaccination	-0.0034 (0.0002)***	-2.745 (0.8761)***	-0.081 (0.003)**	-0.243 (0.2338)
Dietary level	-0.387(0.0219)***	-1.278(0.437)*	-5.77 (3.001)*	-0.764 (0.235)***
Length of breast feed	-9.595 (2.45)***	-30.78(1.212)***	0.515 (0.4883)	0.0077 (0.006)
Gender	0.113 (0.124)	-6.57 (1.34)***	1.354 (1.14)	0.464 (0.311)*
Fosterage	4.44 (2.002)**	3.88 (2.24)	8.504 (4.54)*	2.254 (0.9914)**
Income inequality	15.798 (5.365)***	13.523 (2.452)***	11.324 (2.33)***	2.221 (1.11)

Source: own survey (2015)

***** Significant at 1%**

**** Significant at 5%**

***Significant at 10%**

Table 9 shows econometrics results for vulnerability, stunting, wasting and underweight models. Urbanity, age of household head, education of mother, religion of parent, size of house, availability of separate room for child, arm size, proportional body growth, poverty perception, expenditure on children, number of vaccination, dietary level and number of breast feed reduces degree of child vulnerability to malnutrition. However, income inequality, fosterage, frequency of illness, birth order, age of child and family size increases degree of child exposure to malnutrition.

Statistical result from table 9 shows us that degree of urbanity reduces probability of child being stunted, under weighted and exposure to malnutrition. Child from relatively urbanized area is less likely to be stunted, underweighted and vulnerable than less urbanized area. However, urbanity is increasing short term malnutrition (wasting). Child from relatively urbanized area is more likely to be wasted.

Family size is positively affect children vulnerability to malnutrition and long term malnutrition (stunting) but it is less relevant to explain short term malnutrition and underweight. Child born in large family size is more exposed to long term problem and more likely to be vulnerable to problems. Age of household head is reducing child exposure to malnutrition. This is due to the fact that income and experience of household head increases with the level of age of household head. However, it lacks power to explain wasting and underweight of child. Child born from younger mother is less likely to be exposed to long term malnutrition while more vulnerable to nutritional related problems. In fact age of mother at first birth cannot be blamed for wasting and underweight.

Child born from educated mother is less vulnerable to nutritional related problems. Child of educated mother is less likely to be stunted and under weighted but less important in explaining wasting of child. The table also shows us that child born from conservative and extremist parent are more likely to be wasted and underweighted. However, it does not influence long term malnutrition of child. Child born from family owning their own house is less likely to be stunted and wasted than those who does not own house.

Children who have separate rooms are less likely to be wasted, stunted and underweighted than who does not own separate rooms. Younger children are more likely to be stunted and less likely to be wasted than their elder children. Similarly, birth orders of children positively affect stunting and negatively affect underweight. Child born last is more likely to be stunted and less likely to be underweighted than child born first. In other word, child born at first round less exposed to long term malnutrition but more likely to be underweighted. Proportional body growth reduces the problem stunting. This implies that proportional growth of hand, legs, skull and arm size with age, height and weight reduces the problem of stunting.

Number of child vaccination reduces the problem of stunting and wasting. Children exposed to frequent illness are more likely to be stunted and wasted. Number of vaccination and frequency of illness are less important to explain underweight.

Daily food energy intake of child is very crucial in reducing child exposure to malnutrition significantly. Children whose food intake level is to standard are less likely to be wasted, stunted and underweighted. Child who suck breast for longer time is less exposed to long term malnutrition than the one who doesn't. However, length of breast feed is not sufficient to explain wasting and stunting of child clearly. In addition, the data also shows that male children are more likely to be underweighted and less likely to be wasted than female children.

Children growing at foster parents are more likely to be wasted and underweighted than those of children growing

in the hand of their real parents. However, growing in the hand of foster parents is as such important to explain stunting (long term malnutrition). The degree of income inequality raises possibility of child exposure to malnutrition. Children born in the areas of high income inequality are more stunted and wasted than children born in the areas of income equality.

Chapter five: Conclusion and recommendation

5.1 conclusions

This research tried to analyze anthropometrics approach to child poverty. The research gave focus to assessing nutritional status and Vulnerability to malnutrition of child in Adama, Assela and Modjo towns. Poverty has multi-dimensional definitions. Income poverty is not always explaining the welfare status of households. Now days many health organizations are focusing on how nutritional intake is important in explaining child mortality, malnutrition, slow physical and metal growth. In order to have good citizen we need to take care of children growth most importantly as nutritional intake level of children are most important in creating reliable, thoughtful and innovative future youth in the country's development. Knowing factors contributing to children exposure to malnutrition and extent and distribution of stunting, wasting and underweight are very significant to the reduction of children related nutritional problems.

For the purpose of this study about 400 sample dwellers from Adama, Assela and Modjo have been selected. In order to reduce the problem of biasedness[25], inconsistency[26] and inefficiency[27] of statistic the researcher used multi stage stratified sampling. Total target population has been stratified in to low income, middle income and high income earners. The parameters of vulnerability to malnutrition model have estimated with the help of weighted feasible least square method and binary choice model was selected to run the models of wasting, stunting and underweight.

The analysis shows us child born from elder father is more likely to be wasted, stunted and under weighted than child born from younger father. Child born from younger mother (mother whose age is below 20) is more likely to be wasted, stunted and underweighted than child born from mother whose age is above 20. Education level of mother is observed very important in reducing the problems child growth and vulnerability to malnutrition.

Child born in large family size is more likely to be wasted, stunted and underweighted. Moreover, younger child is more likely to be exposed to short term malnutrition (wasted) and underweighted than their elders' counterpart while elder child is more likely to be exposed to long term malnutrition than their younger counterpart. The length of breast feed is observed to reduce the problems of wasting, stunting and malnutrition.

Stunting and under weight is deeply and shallowly observed in Adama and Modjo towns respectively. On the other hand wasting is deeply and shallowly observed Modjo and Assela towns. Relatively speaking children of Assela town are less exposed to nutritional growth retardation problems than both Adama and Modjo town. These may be attributed to household accessibility to agriculture (farming and livestock rearing) which are very critical ingredients of children growth. The researcher tried to study the impact of livestock ownership on growth status of children and has come up with supportive argument. However, if strong intervention is not made children from Assela town are the most likely to be exposed to malnutrition than Adama And Modjo towns.

Nutritionally poor children in all the three towns are moderately and highly vulnerable to malnutrition. I tried to relate income poverty to vulnerability to malnutrition in order to see how income matters in explaining vulnerability to malnutrition of children. Children from low income family are more likely to be exposed to malnutrition than children from high income family. Children from poor family of Modjo town is the most likely to be exposed to malnutrition than the other two towns while children from high income family are less likely to be exposed to malnutrition in Modjo. Children from high income family are also exposed to malnutrition due to the education of family towards the science of nutrition. Non poor exposition to malnutrition is to its highest level in Assela.

[25] The *bias* (or *bias* function) of an estimator is the difference between this estimator's expected value and the true value of the parameter being estimated. An estimator or decision rule with zero *bias* is called unbiased. Otherwise the estimator is said to be *biased*.

[26] In statistics, a **consistent estimator** or asymptotically **consistent estimator** is an **estimator**—a rule for computing estimates of a parameter θ_0—having the property that as the number of data points used increases indefinitely, the resulting sequence of estimates converges in probability to θ_0.

[27] In the comparison of various statistical procedures, **efficiency** is a measure of the optimality of an **estimator**, of an experimental design, or of a hypothesis testing procedure. Essentially, a more **efficient estimator**, experiment, or test needs fewer observations than a less **efficient** one to achieve a given performance.

Income inequality is highest in Adama and lowest in Modjo. This means that poor income earners of Adama and Assela towns cannot easily purchase balanced diet good for health and overall growth of children. The result also proves that income distribution positively contributes to wasting, stunting and underweight of children. In high income inequality area, we have high probability of child being stunted, wasted and under weighted. In high income inequality area there is high probability of child from low income family to be exposed to malnutrition.

Urbanity, age of household head, education of mother, religion of parent, size of house, availability of separate room for child, arm size, proportional body growth, poverty perception, expenditure on children, number of vaccination, dietary level and number of breast feed reduces degree of child vulnerability to malnutrition. However, income inequality, fosterage, frequency of illness, birth order, age of child and family size increases degree of child exposure to malnutrition.

Child from relatively urbanized area is less likely to be stunted, underweighted and vulnerable than less urbanized area. However, urbanity is increasing short term malnutrition (wasting). Child from relatively urbanized area is more likely to be wasted. Children who have separate rooms are less likely to be wasted, stunted and underweighted than who does not own separate rooms. Younger children are more likely to be stunted and less likely to be wasted than elder children. Similarly, birth orders of children positively affect stunting and negatively affect underweight.

Number of child vaccination reduces the problem of stunting and wasting. Children exposed to frequent illness are more likely to be stunted and wasted. Number of vaccination and frequency of illness are less important to explain underweight. Daily food energy intake of child is very crucial in reducing child exposure to malnutrition significantly. Child who suck breast for longer time is less exposed to long term malnutrition than the one who doesn't. However, length of breast feed is not sufficient to explain wasting and stunting of child clearly. In addition, the data also shows that male children are more likely to be underweighted and less likely to be wasted than female children.

Children growing at foster parents are more likely to be wasted and underweighted than those of children growing in the hand of their real parents. However, growing in the hand of foster parents is as such important to explain stunting (long term malnutrition). The degree of income inequality raises possibility of child exposure to malnutrition. Children born in the areas of high income inequality are more stunted and wasted than children born in the areas of income equality.

5.2. Recommendations

Based on the finding results of this research, the researcher want to recommend important areas needs to be considered by woredas and city's policy executors of Assela, Adama and Modjo towns.

- Health sector offices should provide explanations about the side effects of women giving birth below 20 years while men should be encouraged to born required number of child at their youth age
- Women above 20 years old should be given unique all inclusive health, child care and nutrition related education and trainings apart from formal education
- Parent with good Family planning should be encouraged
- Women should be encouraged to give longer breast feed
- Parents should feed children animal products at the very childish age
- **The science of nutrition should be formally provided for all parents regardless of their living standards from nutritional experts**
- Income inequality should be reduced
- Poor targeted projects must be launched
- Town dwellers should get their own homes
- Parents should prepare separate rooms for their children
- All children must be vaccinated at the standard regular intervals
- Government should give special emphasizes to social development in addition to economic growth
- Government should closely observe child growth scheme to develop reliable future generation
- Children blow 10 years old must be closely monitored as they are highly vulnerable to malnutrition
- As children from less urbanized areas are more vulnerable to nutritional problem they should not abandon urban farming
- Children from more urbanized areas should get basic facilities required in child growth
- long term focus must be given to relatively less urbanized towns as the intensity of the problem high there
- **Above all, food price inflation should be as minimum as possible than any other living costs which is fundamental to all rounded development of future generation**

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7. Appendixes

Appendix 1 Definition of key Terms and Concepts

Absolute poverty level: The income level below which a minimum nutritionally diet plus essential non-food requirements is not affordable.

Underweight: *Moderate and severe* -- below minus two standard deviations from median weight for age of reference population; *severe* -- below minus three standard deviations from median weight for age of reference population.

Wasting: *Moderate and severe* -- below minus two standard deviations from median weight for height of reference population.

Stunting: *Moderate and severe* -- below minus two standard deviations from median height for age of reference population.

Living standard: A level of material comfort as measured by the goods, services, and luxuries available to an individual, group, or nation.

Anthropometry: the measure of people's growth indicators such as weights and heights (related to their age and sex). It is used for growth assessment and is a single measurement that best defines the health/nutritional status of children.

Appendix 2 Description of variable used in the model

Variable name	*Description*	*Unit of measurement*
Urbanity	Represent degree of urban	Categorical variable, 1 coded for highly urbanized, 2 averagely urbanized, lowly urbanized
Age of household head	Age of household head	In years
Education of mother	Represent education level of mother	Continuous variable, in years
Relationship	Relationship of child with household head	Categorical variable; 1 own family, 2 grandfather/mother, 3 aunt/uncle, 4 foster father/mother, 5 non relative
Availability of separate rooms	Availability of separate rooms for children	Coded yes/no
House ownership	Type of house owned by family	Coded as 1 rented home, 2 owned home
Height	Height of child	In meter
Weight	Weight of child	In meter
Age of child	Age of child	In years
Arm size	Arm size of child	In centimeter
Length of skull	Length of skull	In centimeter
Width of skull	Width of skull	In centimeter
Religion	Religion of family	Categorical variable Coded as 1 highly extremist, 2 conservative, 3 on and off, 4 liberal
Number of vaccination	Number of times a child is vaccinated	Continuous variable given in number
Frequency of illness	Frequency of a child exposed to sickness in a year	Continuous number given in number of times
Income inequality	Income variation of parents fostering the child under consideration	Continuous variable Given in birr
Child related asset	Amount of expenditure made by family to child related assets	Continuous variable
Experience	Experience of household head	Given in number of years
Food price Perception	Educated Household head perception on food price in affecting balanced diet purchasing decision	Categorical variable coded as 1 very highly affecting, 2 highly affecting, 3 averagely affecting, 4 somehow affecting , 5 very lowly affecting, 6 not affecting

Household expenditure	Yearly total household expenditure	Continuous variable given in years
Length of breast feed	Number of years mother is giving breast milk as the only diet before starting additional food	Continuous variable given in years
Dietary level	Amount of food energy intake per day	Continuous variable given per day
Years in which child is given additional food	Number of years after which child is given additional food	Continuous variable given in years
Birth order	Birth order of child born	Categorized as 1 first born, 2 second born, 3 third born, 4th born,…
Gender	Sex of child born	Coded 1 for male , 2 for female
Poverty perception	Poverty perception level of family	Coded as 1 prosperous, 2 rich, 3 average, 4 poor, 5 desperate
Proportional body growth	Proportional body growth of child	Continuous variable
Size of house	Total size of house	Total size of house in care meter

[i] This report card primarily uses the term undernutrition, defined as the outcome of insufficient food intake (hunger) and repeated infectious diseases. Undernutrition includes being underweight for one's age, too short for one's age (stunted), dangerously thin (wasted), and deficient in vitamins and minerals (micronutrient malnutrition). The term malnutrition refers to both undernutrition and overnutrition.

[ii] *Energy requirements are related to age, gender, body size and level of activity. Therefore it is difficult to give recommendations for a general calorie intake. Energy requirements tend to increase up to the age of 15 -18 years, because children and youths are active and growing rapidly. On average, boys have slightly higher requirements than girls and this persists throughout adulthood. After the age 18 years energy requirements tend to be lower, but this also depends on the individual's level of activity. By the age of 50 years, energy requirements are even lower, partly due to a reduction in the basal metabolic rate and to a reduced level of activity. The recommendations given for a daily calorie intake refer to an adult person with moderate activity. For women it should be around 2000 and for men 2500-2800 calories (kcal) each day. Toddlers need about 1300 calories each day. For children aged 7 to 10, the estimated average requirement of energy is 1970 kilocalories a day for boys and 1740 kcal for girls. But this is only a guide; many children will need more than these estimates and some will need less, depending on a number of things, including how physically active they are (Based on: Food Standards Agency*

[iii] *Energy requirements are related to age, gender, body size and level of activity. Therefore it is Children experience poverty as an environment that is damaging to their mental, physical, emotional and spiritual development. Therefore, expanding the definition of child poverty beyond traditional conceptualizations, such as low household income or low levels of consumption, is particularly important. And yet, child poverty is rarely differentiated from poverty in general and its special dimensions are seldom recognized. Children experience poverty with their hands, minds and hearts. Material poverty – for example, starting the day without a nutritious meal or engaging in hazardous labour – hinders emotional capacity as well as bodily growth. Living in an environment that provides little stimulation or emotional support to children, on the other hand, can remove many of the positive effects of growing up in a materially rich household. By discriminating against their participation in society and inhibiting their potential, poverty is a measure not only of children's suffering but also of their disempowerment.*