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ASSESSMENT ON THE ADEQUACY OF ENERGY AND MICRONUTRIENTS IN THE FOOD SUPPLIED AND THE NUTRITIONAL STATUS OF CHILDREN FROM SELECTED ORPHANAGES IN ADDIS ABABA, ETHIOPIA

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Declaration

I, the undersigned declare that this thesis is my original work and has not been presented for a degree in this or any other university and that all sources of materials used for this thesis have been duly acknowledged.

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This thesis work has been submitted for examination with our approval as University advisors.

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Abbreviations and acronyms

AAS	Atomic Absorption Spectrophotometer
AIDS	Acquired Immune Deficiency Syndrome
AOAC	Association of Analytical Chemists
BAZ	Body mass index for age
DNA	Deoxyribonucleic Acid
EDHS	Ethiopia Demographic and Health Survey
FANTA	Food and Nutrition Technical Assistance Project
FAO	Food and Agriculture Organization of the United Nations
FMOH	Federal Ministry of Health
HAZ	Height for age
HDDS	Household Dietary Diversity Score
HIV	Human Immune Virus
IDDS	Individual Dietary Diversity Score
PEM	Protein Energy malnutrition
PPM	Parts per million
RNA	Ribonucleic Acid
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
UNAIDS	United Nations on HIV/AIDS
UNICEF	United Nations International Children Education Fund
UNU	United Nations University
WAZ	Weight for age
WFP	World Food Program
WHO	World Health Organization

Abstract

It is well known that the increasing number of orphans and vulnerable children in Ethiopia have resulted in the expansion of orphanages in which children are provided with basic necessities of life including food, clothing, shelter, schooling and health care facilities. However, children in these institutions become undernourished due to lack of adequate resources and limitations of knowledge and understanding on their nutritional needs. In Ethiopia, although different researches have been conducted on the nutritional status of children, only few studies are done that assessed the adequacy of nutrients given and the nutritional status of children in orphanages. The main objective of this study was therefore to assess the energy adequacy of the food given and the nutritional status of children from selected four orphanages in Addis Ababa. An institution based cross sectional study with multistage random sampling was applied between January to February 2016. Structured questionnaires were used to collect data from the children and caretakers in the orphanages. Food samples that were given in the selected orphanages throughout the week were collected and tested in the laboratory for their nutrient composition and were analyzed using independent sample t-test to determine differences between government and non government orphanages. One sample t-test was also applied to compare the energy difference between the meal given in the orphanages with the RDA. The children's nutritional status was assessed anthropometrically using a Height-for-Age, Weight-for-Age and Weight-for-Height indices. WHO Anthro plus software for Assessing Growth of the World's Children and Adolescents was used. t-test for proportions was used to compare the differences in proportions of children who were malnourished among government and non government orphanages. The daily mean energy intake of the children was 1320 ± 304 Kcal. The prevalence of stunting, underweight and wasting among the children was 20.96 %, 17.34 % and 9.27 %. The total mean energy intake among the children in non government orphanages was significantly higher ($p<0.05$) than government orphanages. The children in government orphanages had significantly higher rate of stunting and underweight ($p< 0.05$) than children in non government orphanages. However, there was no significant difference in wasting among the two groups ($p> 0.05$). In conclusion, this study found that malnutrition is prevalent among children in selected orphanages of Addis Ababa. To improve the nutritional status of the children, stakeholders should formulate and strengthen nutrition programs and policies oriented towards this segment of the population.

Key words : Malnutrition, Children, Orphanages, Addis Ababa.

1. Introduction

1.1. Background

Better nutritional status of children reflects a healthy and a productive generation in the future. In particular for school children, it is a critical factor for optimum growth and it should be neither inadequate nor excessive. It is widely believed and scientifically proved that improved nutrition and health enhance the learning ability of the children. In the long run, it leads to an increase in the strength of the labor force and thereby it contributes positively for the economic growth (Tadiwos et al., 2013).

Malnutrition is one of the leading causes of morbidity and mortality of children in Ethiopia. The country has the second highest rate of malnutrition in Sub-Saharan Africa (FMOH, 2008). Malnutrition in children is one of the most serious public health problems in Ethiopia and the highest in the world (Solomon et al., 2008).

The major cause for child under nutrition is lack of enough calories or nutrients. If it occurs in early life, it has major negative consequences on educational achievement and productivity during adulthood. For example: stunting, which is a form of chronic energy under nutrition, is associated with poor school achievement and poor school performance (Mekides et al., 2015).

Although different researches have been done on the nutritional status of under-five children in different parts of Ethiopia [Melkie (2007), Kontakt (2014), Yisak et al., (2015), Danbe (2015)] little is known about the nutritional status of orphan children. To date only few studies have been conducted, which assessed the nutritional status of this segment of population. This study explored the adequacy of nutrients in the food supplied to children in selected orphanage centers of Addis Ababa and the nutritional status of these children.

1.2. Statement of the problem

The increasing number of orphans and vulnerable children in Ethiopia will inevitably have a profound impact on societies in which they live. The impact of HIV/AIDS, malaria, climatic changes and other socioeconomic changes compounded with high level of poverty has subjected these children to deplorable conditions, denying them adequate access to basic needs of life necessary for their proper growth and development.

Every 15 seconds, another child becomes an AIDS orphan in Africa. Every day 5,760 more children become orphans. Every year 2,102,400 more children become orphans (in Africa alone). 143,000,000 orphans in the world today spend an average of 10 years in an orphanage or foster home (Bimal, 2014). Though estimates vary, recent approximations claim that there are over 5 million orphans including 1.5 million AIDS orphans in Ethiopia. The definition used to classify orphans is children under 18 years of age who have lost one or both parents (Gross et al., 2007).

After AIDS orphans, "The remaining 70% of orphans are often classified as 'famine orphans,' 'war orphans,' 'malaria orphans,' and 'social orphans,' i.e. children who have been abandoned mainly due to poverty" (Abebe et al., 2007). According to Bimal (2014), these large number of orphans and vulnerable children have resulted in the expansion of orphanages that aimed to provide basic necessities including food, shelter, clothing, schooling, health care facilities and the likes in order to grow and take care of the children in the proper manner.

Previous studies conducted in orphanages of different countries state that the prevalence of malnutrition among children living in orphanages is high. The one possible cause of this situation may be due to lack of adequate resources to cover the nutritional needs of the children. There may also be limited awareness and lack of knowledge and understanding on the proper nutritional care of the children, the consequences of childhood malnutrition, appropriate childcare and poor hygiene practice among the administrators and caretakers in the orphanages.

Most of the studies conducted in Ethiopia focused on the nutritional status and associated factors among children under five years of age. There is very limited data concerning the adequacy of nutrients in the food supplied and the nutritional status of children living in orphanages. Therefore, the statistical results generated from this study will help to fill the existing knowledge gap on the amount of energy and micronutrients in the food supplied to children in the selected orphanages in accordance with the recommended dietary allowances. It also provides data on the nutritional status of the children in relation to the standard growth chart.

1.3. Significance of the study

- The results of this study will help to generate current information on the adequacy of energy in the food supplied to children in relation to RDA in selected orphanages of Addis Ababa.
- It will provide information on the micronutrient intakes of the children in relation to RDA.
- It provides information on the nutritional status of the children growing in these institutions so that, the children status in relation to the standard growth chart will be verified, so that it raises awareness on the nutritional status of the children.
- It will provide information whether there exists a difference in the energy adequacy of the food given and the nutritional status of the children living in selected government and non government orphanages of Addis Ababa.
- It may help to increase the knowledge and understanding of the caregivers and the responsible bodies on the type of malnutrition that exists in these children. i.e. the prevalence of stunting, wasting or underweight and hence it will help the orphanages and the caregivers to improve their nutritional care practices.
- It can be used as a guide for the caretakers of the children, the government, policy-making bodies, non-governmental organizations and donors to formulate strategies that help to address the nutritional needs of the children
- It can also be used as a reference for further studies in related field.

2. Objectives

2.1. General objective

To assess the nutritional status, energy and micronutrient adequacy of foods consumed by children from selected orphanages in Addis Ababa, Ethiopia.

2.2. Specific objectives

- To assess the mean meal energy intake of children living in selected orphanages in Addis Ababa.
- To compare the mean meal energy intake of the children living in selected government and non government orphanages with respect to the recommended dietary allowances.
- To compare the micronutrient intakes of the children with regard to the recommended dietary allowances.
- To access the nutritional status of the children living in selected orphanages of Addis Ababa.
- To compare the nutritional status of children from selected government and non government orphanages.
- To suggest possible recommendations to improve the energy intake and the nutritional status of the children.

3. Literature review

3.1. Nutrition and children health

There is a growing consensus that poor nutritional status during childhood can have long-lasting scarring consequences into adulthood, both in terms of health and mortality, and in terms of other measures of human capital such as schooling and productivity, which in turn may diminish their working capacity during adulthood and have negative effects on national economic growth (Glewwe et al., 2007).

Malnutrition in children is a major public health problem in most of the developing countries and Protein Energy Malnutrition (PEM) is more common among the children. Every year, 7.6 million children die of preventable malnutrition and its related causes (Collins et al., 2006).

Child malnutrition may also lead to higher levels of chronic illness and disability in adult life which may have intergenerational effects as malnourished females are more likely to give birth to low-weight babies which is the next prevalent cause of infant and child mortality(Silva, 2005).

Socio-cultural practices such as less consideration for supplementary child feedings, late weaning and poverty are major causal factors of malnutrition in children. Child health nutritional indicators are used to assess the quality of available health services as well as the general health condition of the entire population (Nazni et al., 2010).

3.2.The state of child malnutrition on the world

Malnutrition is an underlying cause of the death of 2.6 million children each year, and one-third of the global total of children's (7.6 million children) deaths each year before their fifth birthday through weakening the body's resistance to illness. Malnutrition is a silent killer that are under reported, under addressed and, as a result, under prioritized.

Every hour and minute of every day, 300 and 5 children die because of malnutrition respectively. In the world today, one child in four is stunted due to malnutrition, and in developing countries this figure is as high as one in three and specifically in Africa two out of five children's will suffered with malnutrition (Save the children, 2012).

Under nutrition contributes to nearly half of all deaths in children under 5 and is widespread in Africa and Asia according to UNICEF, WHO, World Bank 2016 report.

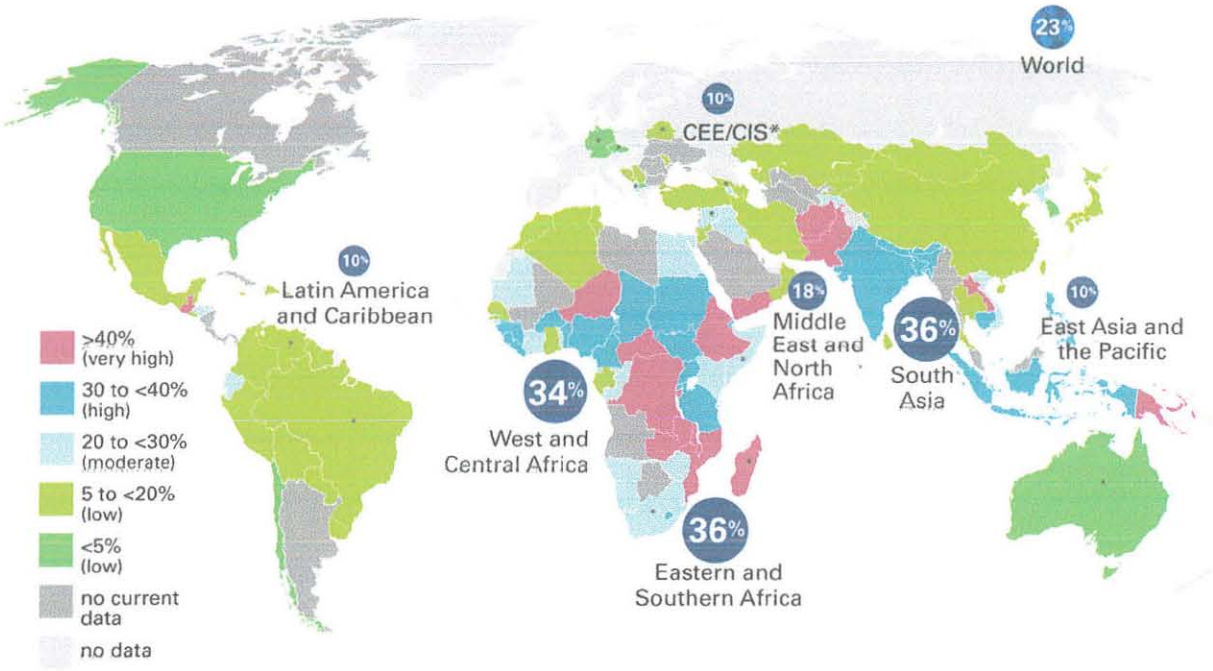

Fig.3.1. Percentage of children under 5 who are stunted, 2010-2016

Source: UNICEF, WHO, World Bank Joint Malnutrition dataset, September 2016 update

3.3.Types of malnutrition

3.3.1. Stunting

A child is too short for his/her age. This is caused by poor diet and frequent infections. Stunting generally occurs before age 2, and the effects are largely irreversible. These include delayed motor development, impaired cognitive function and poor school performance. In total, 171 million children , 27 percent of all children globally are stunted (UNICEF, 2012).

3.3.2. Wasting

A child's weight is too low for his/her height. This is caused by acute malnutrition. Wasting is a strong predictor of mortality among children under five. It is usually caused by severe food shortage or disease. In total, over 60 million children, 10 percent of all children globally are wasted (De Onis et al., 2011).

3.3.3. Underweight

A child's weight is too low for his/her age. A child can be underweight because she/he is stunted, wasted or both. Weight is a sensitive indicator of short-term (i.e., acute) under nutrition. Whereas a deficit in height (stunting) is difficult to correct, a deficit in weight (underweight) can be recouped if nutrition and health improve later in childhood. Worldwide, more than 100 million children are underweight. Being underweight is associated with 19 percent of child deaths (Black et al., 2008).

3.3.4. Micronutrient deficiency

The micronutrients are a group of dietary constituents characterized by the low amounts in which they are found in the diet, but which nevertheless are the key to optimal macronutrient metabolism, and by the interdependent role of many of them in metabolism and functions. Micronutrients are essential for growth and development, utilization of macronutrients, maintenance of adequate defenses against infectious diseases and for many other metabolic and physiological functions (WHO, 1996).

Micronutrient deficiency is a condition when a child lacks essential vitamins or minerals. These include vitamin A, iodine deficiency, iron, zinc, calcium, magnesium and other micronutrients. Micronutrient deficiencies are caused by a long-term lack of nutritious food or by infections such as worms. Micronutrient deficiencies are associated with 10 percent of all children's deaths, or about one-third of all children's deaths, due to malnutrition (Save the Children, 2012).

3.3.4.1. Iron deficiency

Iron is an essential cofactor for a wide variety of important cellular processes, such as oxygen transport, respiration, the tricarboxylic acid cycle, lipid metabolism, gene regulation and DNA synthesis (Hentze et al., 2004).

Iron deficiency is probably the most prevalent and common micronutrient deficiency in the developing world (Hashizume et al., 2003). The detrimental health effects of iron deficiency include anemia, impaired physical growth, mental and motor development and learning capacity in children and adolescents and may impair body temperature regulation, lower resistance to infection and possibly affect attention, decreased intellectual and work performance as well as functional alterations of the small bowel. Besides other vulnerable age groups, such as infancy and early childhood, adolescence is placed at a high risk level for developing iron deficiency, due to a combination of menstrual iron losses in girls and a rapid physical growth, especially in boys (Fomon et al., 2003).

Poor diet quality and low dietary iron bioavailability are the principal factors that contribute to the increased incidence of iron deficiency. The bioavailability of haem iron, present in animal products, is high with absorption rates of 20–30%, whereas the bioavailability of non haem iron is determined by the presence of enhancing or inhibiting factors. The main enhancers of non haem iron absorption are meat (haem iron) and vitamin C. Inhibitors include phytate (nuts, bran and oat products, whole-wheat and brown flour), polyphenols (tea, coffee, cocoa, some spices and vegetables) and calcium (milk products) (Reddy et al., 2000).

In developing countries, low standards of living, low socio- economic conditions, restricted access to food and lack of knowledge for good dietary practices and personal hygiene contribute even more to a high occurrence of iron deficiency and hence anemia (Hall et al., 2001). Intestinal parasitic infection, due to poor hygienic conditions, interferes with iron absorption by reducing it, thus expanding the prevalence of iron deficiency anemia in the developing world (Musaiger, 2002).

3.3.4.2. Zinc deficiency

Zinc is an essential micronutrient for human health, growth and development (WHO, 1996). Zinc is a trace mineral that plays a central role in cellular growth, specifically in the production of enzymes necessary for the synthesis of RNA and DNA. Zinc is prevalent in the brain, where it binds with proteins, thus contributing to both the structure and function of the brain. Severe zinc deficiency can cause abnormal cerebellar function and impair behavioral and emotional responses. Severe zinc deficiency is easy to recognize through dwarfism, hypogonadism and severe developmental delays. However, many consequences of zinc deficiency, including stunting and increased rates of infectious diseases such as diarrhea and pneumonia, are also shared by other nutritional and environmental factors and are thus more difficult to recognize (Caulfield et al., 2004).

3.3.4.3. Calcium deficiency

Calcium and vitamin D are necessary for many cellular processes. In fact, the primary role of calcium is to serve as a second messenger in virtually all cells. Ionized calcium is the most common signal transduction element in cells due to its ability to reversibly bind to proteins. vitamin D receptors have been identified in most body cells, including the small intestine, colon, brain, heart, skin, prostate, gonads, breast, lymphocytes, osteoblasts, *B*-islet cells and mononuclear cells (Holick, 2004).

There is mounting evidence that adolescents are at risk for poor calcium and vitamin D nutritional status. since calcium and vitamin D are critical for optimal bone mineral accrual in the developing skeleton, poor nutritional status in adolescence is a matter for concern.

The human skeleton has an abundant supply of calcium and finely tuned mechanisms for release of calcium as needed. when either calcium intake or vitamin D status is low, calcium homeostasis is maintained, through the regulation of the parathyroid gland and kidneys, at the expense of bone. In a growing child or adolescent, lack of calcium accumulation in the skeleton can have negative consequences for achievement of peak bone mass (Bachrak, 2001).

3.3.4.4. Magnesium deficiency

Magnesium is the second most abundant intracellular and the fourth most abundant cat ion in the body (Altura, 1991). Magnesium is one of the most essential minerals in human body. It is an intracellular ion and works as a cofactor for more than 300 enzymatic reactions (Manuel, et.al, 2009).

Magnesium helps to produce and then transport energy in human body. It activates ATP (adenosine triphosphate) which is a vital energy storage molecule in the body. It also helps to transmit nerve signals and assist the muscles to relax. Magnesium helps to activate enzymes as thus, helping in digestion and absorption. Magnesium also helps in utilization of proteins, carbohydrate and fats. Since magnesium is one of the most needed minerals in human body, its deficiency dangerously affects every function of the body (Dean, 2007).

Magnesium is essential in regulating the central nervous system excitability. It calms the brain and people do not need to become severely deficient in magnesium for the brain to become hyperactive (Sircus, 2007).

Magnesium deficiency is a serious condition in which there is an insufficient amount of magnesium in the body to help the proper function of various organs in the body. People with magnesium deficiency are always tired, irritable, nervous, stiffness in the muscles and difficult to concentrate. Research further claims that magnesium deficiency is actually linked to various pathological conditions (Manuel, et.al, 2009).

3.4. The state of child malnutrition in Ethiopia

In Ethiopia, child malnutrition is an enormous challenge. It constitutes a particularly daunting challenge as the country had a 10.4 % under-five mortality rate in 2009, of which the majority was linked to severe and mild to moderate malnutrition. The figure is among the highest in the world and is severe even by sub-Saharan African standards (UNICEF, 2010).

The most important forms of malnutrition in Ethiopia are protein energy malnutrition (PEM), vitamin A deficiency, Iodine deficiency disorders, and Iron deficiency anemia (Edris, 2004).

Absolute poverty, poor health and sanitary conditions, limited knowledge of nutritional matters among certain households, and fluctuations in incomes are some of the principal reasons for the high prevalence of malnutrition . Improved nutrition is assumed to be directly linked to expanded food production while increased income is a good proxy for improved nutrition (EDHS, 2014).

Nationally, 38 percent of children under age five are stunted(-3 to -2 SD), and 18 percent of children are severely stunted(< -3 SD). In general, the prevalence of stunting increases as the age of a child increases, with the highest prevalence of chronic malnutrition. The percentage of children stunted is higher in rural areas (40 percent) than in urban areas (25 percent). Overall, 10 percent of Ethiopian children are wasted(-3 to -2 SD), and 3 percent are severely wasted(< -3 SD). 24 percent of children under age five are underweight (have low weight-for-age), and 7 percent are severely underweight (EDHS, 2016).

3.5. Child malnutrition impacts on the economy

Malnutrition can have a big impact on earnings when children reach adulthood. The effects of malnutrition on physical stature, the ability to do physical work, and on cognitive development, can lock children into poverty and entrench inequalities. Children who are malnourished go onto earn 20% less as adults than the children who are well nourished (Grantham, 2007). But, there is some evidence that the difference could be even larger. One study has estimated this earning deficit for malnourished children at 66% (Hoddinott et al., 2011).

This in turn means that malnutrition can act as a big barrier to economic growth. Estimates suggest that in low- and middle-income countries, the impact of malnutrition could decrease GDP by between 2% and 11%. This is partly a result of its impacts on educational development as well as on physical productivity and health (WFP et al., 2007).

Part of the impact of malnutrition on earnings may be because of the effect on children's physical development. Several studies have confirmed the correlation between adult height and wages ,for example, a large cross-sectional study in Brazil found that a 1% increase in adults' height was associated with a 2.4% increase in earnings (Thomas et al., 1997).

It is likely that physical size itself (and therefore its nutrition determinants) is a direct predictor of earnings in contexts where physical strength is necessary, such as agriculture or other manual labor. Similarly, malnutrition can affect earnings simply by reducing people's physical ability to spend time at work, e.g., due to illness (Haddad et al., 1991).

But in a world where jobs increasingly require cognitive skills and educational qualifications, the impacts of cognitive development and educational outcomes is another important pathway by which malnutrition can reduce wages. Poor cognitive and educational development is linked to lower wage rates, as evidence from many countries including Kenya, Tanzania, Ghana and Pakistan shows (Demment et al., 2002).

Nutrition is not only important for increasing individuals' economic outcomes; it is essential for whole societies' economic development. This occurs partly as a result of the link between malnutrition and lower productivity with reduced earnings at the individual level leading to knock-on effects on national-level economic growth. Malnutrition also affects national economies by increasing healthcare costs, as people who were malnourished as children are more likely to fall ill to diseases (Currie et al., 2012).

3.6. Nutritional status

The nutritional status refers to the health of an individual as it is affected by the intake of food and its utilization. It is the condition of health of an individual influenced by the utilization of the nutrients. It can be determined only by the correlation of information obtained through a careful medical and dietary history and appropriate laboratory investigations (Christakis, 1975).

Nutritional status should show the relationship between food and nutrients, their use in the body and general health. It may be good, fair or poor, depending on the body ability to utilize these nutrients. Nutritional status is affected when a person is deprived of adequate amount of essential nutrients over extended period of time (Overt, 1980).

Nutritional assessment is the process whereby the state of nutritional health of an individual or group of individuals is determined. Nutritional status is commonly assessed by anthropometrics measurement, clinical examinations for ascertaining nutritional deficiencies & also biochemical assessment (Overt Jc.,1980).

The assessment of growth not only serves as a means of evaluating the health and nutritional status of children but also provides an excellent measurement of the inequalities in human development faced by populations. Children who suffer from growth retardation as a result of poor diets and/or recurrent infections tend to have increased numbers of severe diarrhea episodes and a heightened susceptibility to certain infectious diseases, e.g. malaria, meningitis and pneumonia (Man et al., 1998).

There is an association between increasing severity of anthropometric deficits and mortality, and a substantial contribution is made by all degrees of malnutrition to child mortality
(Pelletier et al., 1995).

3.6.1. Anthropometric measurements

Anthropometry is now a widely accepted, simple field technique for evaluating physical growth and the nutritional status of individuals and population groups.

The anthropometrical indicators are generally considered as nutrition status indicators based on the internationally defined (standard) cut-off points. Theoretically, the body of a child responds to malnutrition in two ways that can be measured by anthropometrics survey. First, a reduction in growth over the long-term results in low height-for-age or stunting. Second, a short-term response to inadequate food intakes is assessed by weight relative to height (wasting). The combination of short-term and long-term food shortage and growth disturbances produces low weight-for-age (underweight) (Onis, 2000).

3.6.1.1. Height-for-age

The height-for-age index provides an indicator of linear growth retardation and cumulative growth deficits in children. Children whose height-for-age Z-score is below minus two standard deviations (−2 SD) from the median of the WHO reference population are considered short for their age (stunted), or chronically malnourished.

Children who are below minus three standard deviations (−3 SD) are considered severely stunted. Stunting reflects failure to receive adequate nutrition over a long period of time and is affected by recurrent and chronic illness. Height-for-age, therefore, represents the long-term effects of malnutrition in a population and is not sensitive to recent, short- term changes in dietary intake.

3.6.1.2. Weight-for-height

The weight-for-height index measures body mass in relation to body height or length; it describes current nutritional status. Children with Z-scores below minus two standard deviations (−2 SD) are considered thin (wasted) or acutely malnourished. Wasting represents the failure to receive adequate nutrition in the period immediately preceding the survey and may be the result of inadequate food intake or a recent episode of illness causing loss of weight and the onset of malnutrition. Children with a weight-for-height index below minus three standard deviations (−3 SD) are considered severely wasted.

The weight-for-height index also provides data on overweight and obesity. Children more than two standard deviations (+2 SD) above the median weight-for-height are considered overweight, or obese.

3.6.1.3. Weight-for-age

Weight-for-age is a composite index of height-for-age and weight-for-height. It takes into account both chronic and acute malnutrition. A child can be underweight for his/her age because he or she is stunted, wasted, or both. Weight-for-age is an overall indicator of a population's nutritional health. Children with weight-for-age below minus two standard deviations (−2 SD) are classified as underweight. Children with weight-for-age below minus three standard deviations (−3 SD) are considered severely underweight.

3.7. 24-hour dietary recall/ Dietary diversity score

Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods, and is also a proxy for nutrient adequacy of the diet of individuals. The dietary diversity questionnaire represents a rapid, user-friendly and easily administered low-cost assessment tool (FAO, 2010).

The household dietary diversity score (HDDS) is meant to reflect, in a snapshot form, the economic ability of a household to access a variety of foods. Studies have shown that an increase in dietary diversity is associated with socio-economic status and household food security (household energy availability) (Hoddinot et al., 2002).

Individual dietary diversity scores (IDDS) aim to reflect nutrient adequacy. Studies in different age groups have shown that an increase in individual dietary diversity score is related to increased nutrient adequacy of the diet (Kennedy et al., 2010). It is also associated with individual caloric availability (Hoddinot et al., 2002).

IDDS indicates diet quality, and has proven to be a good indicator of nutrient adequacy in women, young children, and adolescents (Kennedy et al., 2010).

Dietary diversity scores have been validated for several age/sex groups as proxy measures for macro and/ or micronutrient adequacy of the diet. Scores have been positively correlated with macronutrient and micronutrient adequacy of the diet for children, adolescents and adults (Arimond et al., 2010).

3.8. Nutrition and Orphan hood

An orphan is a child whose parents are dead, who has been deprived of parental care, one that lacks support, supervision or care and who lost his/her home or address. An orphan can also be defined as a child that lives 12 months away from his/her parents (The American Heritage Dictionary, 1987). An orphanage is an institution dedicated to the care and upbringing of children who have lost their parents.

Over 140 million children under the age of 18 in the developing world have lost one or both of their parents. In sub-Saharan Africa alone there are 43 million orphans, representing more than 12% of all children (UNAIDS et al., 2004).

Although most orphans are cared for by family members or communities in some way, many of these families are living in poverty. Some form of public assistance is required to provide these children with adequate food, health care, clothing, education and psychosocial support. The need for public assistance varies by country depending on the number of orphans, the socio- economic conditions and local decisions about the type of support to provide and the best way to provide this support (Stover et al., 2006).

Orphans in sub-Saharan countries are more vulnerable than non-orphan children on a series of health indicators. Data from Zimbabwe found strong associations between Orphan hood and nutritional status and health outcomes such as diarrhea, acute respiratory infection, and underweight status (Vinod, 2008).

Ethiopia, one of the sub-Saharan African countries, has a high number of Orphans. The country has 5.5 million orphans from which HIV/AIDS contributed 640,802 maternal orphans, 550,300 paternal orphans, and 304,282 dual orphans.

The number of children orphaned are different from region to region with Amhara the highest orphan rate 1,535,104 (39%) in the country followed by Oromo (22.4%). The main causes of orphan hood and vulnerability are HIV/AIDS, food insecurity, poverty, conflict, natural disasters, malaria, and other infectious diseases. Lack of parental care and support of children increased their vulnerability for food insecurity and chronic malnutrition, lack of protection, shelter, education, physical and sexual abuses (Kelley, 2009).

Though traditional Ethiopian kinship systems provide support for orphans, the third- world conditions have devastated this cultural safety network increasing the need for orphanage care. A great majority of Ethiopian orphans are placed in one of the nations numerous orphanages. Many foreign aid organizations have established orphanages in Ethiopia to help relieve this nation's strain (Bimal, 2014).

Orphan are potentially at greater risk of malnutrition because they are more likely to be extremely poor, receive less medical and social care. Many orphan children are suffering from cycles of poverty as a result of death of their parents (Sguassero, 2007).

While orphanages may provide some of the nurture, typical institutions do not provide the holistic care that children are entitled to for all round development. Research has shown that children in institutions lack basic and traditionally accepted social and cultural skills to function in their societies; have lower levels of educational attainment; have problems adjusting to independence after leaving the orphanage, lack basic living skills; have more difficulties with relationship, lack parental skills and some of them often have a misplaced sense of entitlement without a parallel sense of responsibility (Wright, 1999).

There has been shown nutrition related problems such as Protein Energy Malnutrition (PEM), Vitamin A and B Complex deficiencies, iron deficiency anemia and iodine deficiency disorders on children who are living in institutions/orphanages run by government and non-governmental organizations (Naheed, 2013).

In Ethiopia, specifically in the capital Addis Ababa 32,520 orphans and 30,895 AIDS orphans get support including food, clothing and schooling according to the data from Addis Ababa Women, Children and Youth Affairs report in 2014. According to the report, there are 4 government and 34 non government orphanages in Addis Ababa in which a total of 2202 children out of which 750 children in government orphanages and 1452 children in non government orphanages are sheltered.

4. Materials and methods

4.1. Study design

An institution based cross sectional study with multistage random sampling was applied and compared energy adequacy and nutritional status of children living in selected government and non government orphanages between January to February 2016.

4.2. Study area/location

The assessment on energy and micronutrient adequacy of the food consumed by the children was carried out in selected four orphanages found in Addis Ababa, Ethiopia. These orphanages were selected because they have relatively large number of orphan children. The selection of the orphanages was carried out based on the data obtained from Addis Ababa City Children, Youth and Women Affairs Office. A total of two government and two non government orphanages were selected for this study. The study on the nutritional status of the children was also conducted on children from these selected orphanages of Addis Ababa.

4.3. Study population

4.3.1. Orphanages

For the purpose of the study, children and adolescents in orphanages whose ages were between 7-17 years and were full time residents in the orphanages were considered. This was because there is only very limited data concerning the nutritional status of this segment of children. Also, the great majority of the orphanages in Addis Ababa give their services to children whose ages are between 7-17 years.

Addis Ababa had a total of thirty eight registered orphanages from which four are governmental and the rest thirty four are non government orphanages based on the data from Addis Ababa City Women, Children and Youth Affairs Office. Four orphanages were selected for the study, from which two are government and the other two are non government orphanages for the purpose of comparison. These orphanages had relatively large number of children.

There are 750 children sheltered in government orphanages out of which 597 (79.73 %) children are living in the selected two government orphanages. The rest 153 (20.27%) children are living in the other two government orphanages that were not considered for this study due to their relative small number of children.

There are also 1452 children sheltered in non government orphanages from whom 428 (29.48 %) children are living in the selected two orphanages under non government section. The rest 1024 (70.52 %) children are sheltered in the remaining 32 non government orphanages which were not considered in this study for their relative small number of children. The selected four orphanages constitute for 1025 (46.55%) children out of the overall 2202 children that are sheltered in the thirty eight orphanages of Addis Ababa.

The sample size of the children was calculated by the formula $n=z^2p(1-q)/(mE)^2$

where, n = sample size

z^2 = linked to 95% confidence interval (z = 1.96)

p = sample proportion

q = 1- p

mE^2 = margin of error(= 0.05)

For the purpose of ethical considerations, names of the orphanages was not mentioned throughout this study.

4.3.2. Inclusion criteria

- Children in orphanages who were 7-17 years old.
- Children in orphanages who had resided at the orphanage for at least three months.
- Children in orphanages for whom consent was obtained.
- Children in orphanages who were physically present during the study period.

4.3.3. Exclusion criteria

- Children residing in the orphanages for whom consent to the study was not provided.
- Children who were not physically present during the study period.
- Children with chronic illness.

4.4. Laboratory analysis

4.4.1. Sampling/Sample collection

A total of 4 orphanages, from which 2 government and 2 non government that are working on providing food, clothing and shelter to orphan children were selected based on their large orphan number size. This had helped to compare the differences in the nutrient adequacy of the food supplied between the government and the non government orphanages. In order to get data regarding the nutritional intake of the children, the food taken from the orphanages was recorded and analyzed to obtain relevant data concerning the intake of calories, proteins, fats and carbohydrates and the minerals calcium, iron, zinc and magnesium.

A total of 54 food samples from these institutions were collected by taking breakfast, lunch and dinner throughout the week and was analyzed for their nutrient composition/proximate analysis. Mineral analysis, specifically analysis of calcium, iron, zinc and magnesium was also done for the collected food samples.

There were no snacks in between in all the selected orphanages, so that it was not considered and analyzed for nutrient composition. For the sake of ethical considerations, the food samples taken from these selected orphanage centers were coded throughout the study.

The food samples collected from the orphanages were first homogenized and put in to hot air drying oven at 70^0c for overnight to remove all the moisture content that was initially present in the food samples. Then, the dried food samples were grinded and packed with poly ethylene plastic zipped bags. coding of the samples was initially done accordingly. The dried and grinded food samples were then analyzed for their nutrient and mineral composition

4.4.2. Proximate analysis

4.4.2.1. Moisture analysis

The moisture content of the food samples was determined by hot air oven drying method according to AOAC (2000) official method 625.09. First, steel crucibles were dried in a drying oven for 1 hour at 105°c. Then, the crucibles were taken out from the drying oven ,cooled in a desiccator for 30 minutes and the weight of the dried crucibles was measured as (W_1). 5 gram of the homogenized food sample was weighed in the before dried crucibles and the weight of the food sample and the crucible was recorded as (W_2).

After drying the food samples in a hot air drying oven for 3 hours at 105°c ,the crucibles were cooled in a desiccator until the temperature reaches room temperature and the crucibles were weighed to obtain a constant weight (W_3). Then, the moisture content of the food samples was calculated by using the following formula,

$$\text{Moisture (\%)} = \frac{(W2-W3)}{(W2-w1)} \times 100$$

Where, W_1 = weight of crucible

W_2 = weight of the crucible and the homogenized food sample before drying

W_3 = weight of the crucible and the homogenized food sample after drying.

4.4.2.2. Crude protein analysis

Protein content was determined by AOAC (2000) official method 979.09 by using Kjeldhal method. First 0.5 gram of the dried and milled food sample was weighed on a weighing paper and put in to tecator tube placed on a tecator rack.

Then 6 ml of concentrated sulfuric acid was added and mixed with the sample. 3.5 ml of 30% hydrogen peroxide was added drop by drop which resulted in a violent reaction. When the reaction stops, the tubes was shacked for few minutes by hand to mix the added reagents with the sample completely. 3 gram of catalyst mixture (mixture of grinded 0.5 g of copper sulphate and 100 gram of potassium sulphate) was added and left for 15 minutes.

Digestion

The digestion process took place in a protein digester at 370°c for 4 hours until a clear digest was obtained. But, the sample was put initially at low temperature to prevent frothing then the temperature increased progressively until it reaches 370°c. After digestion, the solution was cooled in a fume hood on the rack. 25 ml distilled water was added to the solution to prevent precipitation of the sulfate in the solution.

Distillation and Titration

25 ml of 40 % sodium hydroxide was added to the digested solution to neutralize sulfuric acid and ensure complete release of ammonia. A 250 ml Erlenmeyer flask containing 25 ml of 4% boric acid, 25ml of distilled water and three drops of methyl indicator was placed under the condenser of the distiller with its tip submerged in the solution. The distillation was continued for one to two minutes until the volume of the distillate reached 150 ml to 250 ml. Then the tip of the delivery was rinsed with distilled water before the receiver flask is removed. Finally, Titration was done with 0.1N hydrochloric acid until the appearance of pink color is observed. The amount of hydrochloric acid consumed by titration was recorded. The amount of crude protein was calculated by using the following formula,

$$\text{Crude protein}(\%) = \frac{(V2-V1)x\ N\ x\ 14.01\ x\ 6.25}{10\ x\ W}$$

Where, V_1 = volume (ml) of hydrochloric acid for the blank test

V_2 = volume (ml) of hydrochloric acid for the test sample

N = Normality of hydrochloric acid

W = weight of the test sample

10 = factor relating mg/g

14.01 = equivalent weight of nitrogen

6.25 = conversion factor of protein for foods

4.4.2.3. Crude fat analysis

The crude fat content was extracted according to AOAC (2000) official method 4.5.01 by using soxhlet extractor. First, the extraction cylinder was washed, cleaned and dried in a hot air oven at 105°c for 1 hour. Then, the extraction cylinder was cooled in a desiccator for 30 minutes and weighed (W_1). 2 grams of dried and grinded food sample was weighed(W) and put in a thimble containing fat free cotton and covered with fat free cotton. The thimbles were put in the extraction chambers of the soxhlet machine. 50 ml of petroleum ether was added to the extraction cylinders and the thimbles were immersed in the petroleum ether for 2 hours at 60°c. The extraction process was continued for another 2 hours at 60°c by making the thimbles up somehow above the extraction cylinders. The overall fat extraction took 4 hours at 60°c. After then, the extraction cylinders were removed from the soxhlet machine and were dried in a hot air drying oven at 70°c for 30 minutes. Finally, the extraction cylinders were cooled in a desiccator for 30 minutes and weighed until a constant weight was gained(W_2). The crude fat content was then calculated by using the formula,

$$\text{Crude fat (\%)} = \frac{W2 - W1}{W} \times 100$$

Where, W_1 = weight if the dried extraction cylinder

W_2 = weight of the extraction cylinder + weight of extracted fat

W = weight of the food sample

4.4.2.4. Crude fiber analysis

Crude fiber content of the food samples was analyzed according to AOAC(2000) official method 962.09. Determination of crude fiber was done by steps of digestion, filtration, washing, drying and combustion.

Digestion

1.5 grams of dried food sample was weighed(W_1) in a 600 ml beaker and 200 ml of 1.25 % sulfuric acid was added.

The mixture was gently heated on a hot plate for 30 minutes after the beaker was covered with a watch glass.20 ml of 28 % potassium hydroxide was added and the solution was boiled for extra 30 minutes by constantly stirring the solution.

Washing and filtration

A sintered glass crucible was taken and its bottom was covered with 10 mm thick sand and its layer moistened with distilled water. Then the solution was poured from the beaker to the sintered glass crucible and burned on a vacuum pump. The beaker was rinsed several times with hot distilled water. The solution was filtered and the residue in the crucible was rinsed with hot distilled water and filtered again.

1% sulfuric acid was added to the remaining residue, was filtered and then rinsed with hot distilled water and filtered. 1% alkaline solution (sodium hydroxide) was added to wash the crucible and filtered to the previous solution. 1% sulfuric acid was added to the crucible to wash it again and filtered to the solution to completely rinse the remaining residue. finally, the crucible was washed with water-free acetone .

Drying and combustion

The crucible was dried in a drying oven at 130°c for 2 hours. Then, the crucible was cooled in a desiccator for 30 minutes and its weight was recorded(W_2). The crucible was put into the muffle furnace at 550°c for 30 minutes for ashing. The crucible was cooled in a desiccator to room temperature and was weighed(W_3). Finally, the crude fiber content of the dried food samples was calculated by using the formula,

$$\text{Crude fiber (\%)} = \frac{W2-W3}{W1} \times 100$$

Where, W2 = crucible weight after drying

W3 = crucible weight after ashing

W1 = weight of the sample

4.4.2.5. Determination of total ash content

The ash content of the food samples was analyzed according to AOAC(2000) official method 923.03. First, clean porcelain crucible was dried at 105°c in a hot air oven and was put in to a muffle furnace at 550°c for 1 hour.

Then, the crucible was cooled in a desiccator for 30 minutes to room temperature and weighed until a constant weight was obtained (W_1). 2.5 gram of dried food sample was weighed on the cleaned crucible and recorded (W_2).

The weighed food sample was charred on a hot plate starting with low temperature and then progressively increase the temperature in order to avoid spattering of the sample. The food sample was charred until the smoke disappears from the porcelain crucible. The charred sample was then incinerated in a muffle furnace at 550°c for 5 hours. The residue was moistened with few drops of de ionized water and the water was evaporated on a hot plate. Few drops of de ionized water and few drops of concentrated nitric acid were added to the sample and was ash for 30 minutes at 500°c until the residue became white in appearance.

Finally, the sample was weighed after cooled in a desiccator for 1 hour to reach the room temperature until a constant weight is obtained(W_3).Total ash content of the sample was then calculated using the formula,

$$\text{Ash (\%)} = \frac{W3-W1}{W2-W1} \times 100$$

Where, W_1 = weight of the crucible

W_2 = weight of the crucible + dried sample

W_3 = weight of crucible + ash

W_2-W_1 = weight of the sample

W_3-W_1 = weight of ash

4.4.2.6. Total carbohydrate content

The amount of carbohydrates in the food samples was determined by subtracting the percentage of the overall addition of all the percentages of moisture, crude fat, crude protein, ash and crude fiber from 100.

i.e. % Carbohydrate = 100 - (% Moisture + % Crude fat + % Protein + % Crude fiber + % Ash)

Determination of dietary energy

The total dietary energy gained was determined by calculating the energy obtained from fat, carbohydrate and protein by multiplying with Atwater's conversion factors. The sources of energy are carbohydrates, fat and protein with physiological fuel values of 4, 9, 4 kcal/g (16.7kJ, 37.7kJ, 16.7kJ/g) respectively. The energy value of a food or diet is calculated by applying these factors to the amount of substrates determined by chemical analysis, or estimated from appropriate food composition tables (FAO/WHO/UNU, 2001).The total dietary energy content of the food was then calculated by multiplying the amount obtained by 9 kcal/g (37.4kJ/g) for fat, 4 kcal/g (16.7kJ/g) for protein and 4 kcal/g (16.7kJ/g) for carbohydrate. The results were summed up to get the total dietary energy of the food.

The results obtained after the analysis of the food samples were compared with RDA for children and adolescents as per guidelines of FAO/WHO/UNU recommendations (FAO/WHO/UNU Human energy requirements, 2001) and WHO/FAO vitamin and mineral requirements in human nutrition, 2001.

4.4.2.7. Mineral Analysis

The mineral analysis of the food samples was determined according to AOAC (2000) official method. Calcium, Iron, Zinc and Magnesium content of the food samples was determined by atomic absorption spectrophotometer (AAS).

Sample preparation

The dried food samples were first ashen according to AOAC (2000) official method 923.03. Then 7 ml of 6N hydrochloric acid was added to the ash of each sample and heated on a hot plate at low temperature until it becomes dried. 15 ml of 3N hydrochloric acid was added and heated on the hot plate until it boils. The solution was cooled and filtered with a filter paper into a 50 ml volumetric flask. 10 ml 3N hydrochloric acid was added again in to the crucible and heated until it boils. After the solution was cooled, it was filtered to the previous solution. The crucible and the filter paper was rinsed with de ionized water to the solution. 2.5 ml lanthanum chloride solution was added to the solution in the flask and filled with de ionized water until the volume reaches 50 ml on the volumetric flask. The solution was put in to plastic bottle and stored in a cool place until analysis was done by atomic absorption spectrophotometer.

Atomic absorption spectrophotometer analysis

A series of standard solutions of the respective minerals were prepared from stock solutions in order to get the right calibration curves. The standard solutions prepared were from 20 ppm stock solutions for calcium at concentrations of (0, 0.5, 2, 4, 6 and 8 ppm) ,for Iron concentrations of (0, 0.5, 1, 2, 3 and 4 ppm), for zinc concentrations of (0, 0.5, 1, 2, 3 and 4 ppm) and for magnesium concentrations of (0, 0.5, 1, 2, 3 and 4 ppm).

The atomic absorption spectrophotometer was calibrated with the prepared standard solutions and the blank solution to check for the right results. Then, the sample solutions were run and values were obtained. The mineral contents of the food samples were calculated by using the following formula.

$$\text{Mineral content (mg/100g)} = \frac{[(Cs - Cb)\ x\ V\ x\ D]}{10\ x\ W}$$

Where, Cs = concentration of the sample

Cb = concentration of the blank

V = volume of the extract (ml)

W = weight of the sample

D = dilution factor

4.5. 24 hour dietary recall/ dietary diversity score

The dietary data collected through the 24-hour dietary recall were computed into 9 food groups (1. Basic staples, 2. Vitamin A rich fruits and vegetables, 3. Other fruits, 4. Other vegetables, 5. Legumes and pulses, 6. Meat or Fish, 7. Oil, 8. Dairy and 9. Eggs) based on the FAO/FANTA Household Dietary Diversity Questionnaire and Guidelines, 2008.

4.6. Anthropometric analysis

Anthropometric data, which includes, height, weight and age was collected from orphanages children that are in a range of ages 7-17 years old from the selected highly populated 4 orphanage centers of Addis Ababa. Date of birth was obtained from the orphanages' records and verbally from the caretakers and the children.

Anthropometric measurements was used for quantitative data collection. According to the previous study by Degarege et al.,2015, the prevalence of stunting was 19.6% and therefore the sample size of this study was based on this prevalence according to the formula $n=z^2p(1-q)/(mE)^2$ where, n = sample size

z^2 = linked to 95% confidence interval (z = 1.96)

p = sample proportion(0.196 ~ 0.2)

q = 1- p (1- 0.2 =0.8)

mE^2 = margin of error(= 0.05)

based on the above formula,

$n = (1.96)^2 \times 0.2(0.8) / (0.05)^2$

n= 248

Nutritional status of the children were assessed by recording their age prior to measuring their body height in cm and their body weight in Kg from 248 children from the selected 4 centers based on the formula. i.e. 62 children was taken from each orphanage by simple random sampling.

A digital weighing scale was used to take the weight of the children. Weight was taken as the average of two consecutive measurements in kilograms. A stadiometre that was attached to the digital scale was used to take the height of the children. The children were taken the measurements with no shoes, standing straight and with minimum clothing.

Height was taken as the average of two consecutive measurements for accuracy in centimeters. Sex of child was also indicated. All anthropometric measurements were taken by the same individual for the sake of avoiding inter-examiner errors.

Three indicators of nutritional status; height for age (HAZ), weight for age (WAZ) and body mass index for age (BAZ) was computed using WHO Anthro plus for Personal Computers Manual(WHO, 2009): software for Assessing Growth of the World's Children and Adolescents. The results were compared with WHO child growth reference (WHO,2007). Children with HAZ,WAZ and BAZ z-scores less than -3 SD were considered to have severe stunting, severe wasting and severe underweight. While those with HAZ,WAZ and BAZ z-scores between -3SD to -2 SD were considered moderately stunted, wasted and underweight. Those children with -2 SD to +1 SD were considered normal. HAZ,WAZ and BAZ z-scores > +1 SD were considered indicator of tall stature for HAZ ,overweight for WAZ and BAZ. Children with >2SD was considered indicator of obesity for BAZ according to WHO child growth reference (WHO, 2007).

4.7. Questionnaires

Questionnaire and observational assessment was used for collecting information on age, sex, the date of entry to the orphanage center of the children and age, sex and educational levels of the caretakers of the children in the orphanages.

4.8. Data collection

Data collection was done by carefully recording the proximate and mineral analysis results of the foods analyzed on a separate sheet. Demographic data was also collected which included, age, sex, period of stay in the orphanage and educational level of the children and the caretakers of the children in orphanages using structured questionnaires (Annexes 4,5, 6 and 7).

The 24 hour dietary recall method was used to obtain data on the foods consumed for breakfast, lunch and dinner throughout the week for all the selected orphanages. Amounts of foods/ meals served were weighed prior to proximate analysis using analytical balance to the decimal place of 0.1 gram.

Anthropometric data, which included, height, weight and age was collected from children in the four selected orphanages which are then developed into indices of nutritional status; weight-for-age, height-for-age, and weight-for-height, as indicators of underweight, stunting, and wasting, respectively. The children were considered to be malnourished when the respective Z scores were below -2 SD from the median for WHO (2007) children growth reference. Children with Z scores between -2.99 and -2.00 were considered to have moderate malnutrition, while those with -3.00 and below were severely malnourished (WHO, 2007).

4.9. Ethical consideration

The objectives of the study was communicated to the Orphanages managers, caretakers and the children so that participation was completely voluntary.
Study participants were provided with written consent prior to participation. Informed consent forms (Annexes 2 and 3) was signed by the management and the care-takers of the children in orphanages before commencing the study.
The food samples taken from the selected orphanage centers were coded throughout the study for the sake of confidentiality.

The information obtained from the participants was held in confidence. Permission was asked from all the responsible authorities: Addis Ababa city children, youth and women affairs office and from Addis Ababa University, College of Natural and Institutional Review Board (IRB).

4.10. Statistical analysis

Analysis was done in duplicate for minerals and proximate analysis. Data was computed using SPSS version 20 statistical software package.

An independent sample t-test was used to compare dietary energy means of government and non government orphanage groups. One sample t-test was used to compare the mean dietary energy intakes of the orphanages to the recommended daily allowances of FAO/WHO/UNU guidelines of human energy requirements,2001. One sample t-test was also used to compare the mean meal energy intakes of the children in government and non government orphanages to the recommended daily allowances as per guidelines of FAO/WHO/UNU,2001. One sample t- test was also used to compare the mean mineral intakes of the children in the orphanages specifically mean intakes of calcium, iron, zinc and magnesium to recommended daily allowances of WHO/FAO vitamin and mineral requirements in human nutrition,2001. Paired-samples t-test was used to compare within-subject differences. The difference was considered significant for $P < 0.05$. Descriptive statistics was used for the proximate analysis and the results were presented in mean ± standard deviation and was computed based on FAO/WHO/UNU guidelines of human energy requirements,2001. The mineral requirements of the children was computed based on WHO/FAO vitamin and mineral requirements in human nutrition, 2001.

The t-test for proportions was used to test the differences in prevalence of malnutrition indices (stunting, wasting, and underweight) among the children in government orphanages and non-government orphanages children. The t-test for proportions was also used to test the differences in malnutrition indices by sex among children in government and non government orphanages.

5. Results and Discussion

5.1.Socio-Demographic characteristics of the children and caretakers in the orphanages

5.1.1.Demographic characteristics of the children

The sample consisted of children and adolescents who were between age 7 - 17 years (mean age 12), children in government and non-government orphanages. The ratio of boys to girls was 1:1. The study was carried out in four selected orphanages from which two are government (G_1 and G_2) and the other two are non-government (NG_1 and NG_2). For the purpose of ethical consideration, names of the orphanages were coded in which G_1 and G_2 belong to government while NG_1 and NG_2 belong to non-government orphanages. The total number of children was 248, from whom 124 children belong to the government orphanages and the other 124 children belong to the non government orphanage group as shown in Table 5.1.

Table 5.1. Distribution of children by age, sex and orphanage type

		Government orphanages		Non-government orphanages	
		n	%	N	%
Center	G_1	62	25		
	G_2	62	25		
	NG_1			62	25
	NG_2			62	25
Age	7-9	41	16.53	41	16.53
	10-14	42	16.94	41	16.53
	15-17	41	16.53	42	16.94
Sex	Boys	62	25	62	25
	Girls	62	25	62	25
Total		124	50	124	50
Overall total (n)		248			

5.1.2. Socio-demographic characteristics of the care takers

There were a total of 63 care takers that were employed on a full time basis to take care of the children in the orphanages out of whom 12 caretakers were males and the remaining 51 caretakers were females. The distribution of the caretakers was 14 in one of the orphanages,17 caretakers on the second, 13 caretakers on the third and 19 caretakers on the fourth orphanage. The highest number of the caretakers rely on the age group 40-50 (33.33%) which was followed by 30-40 age group (26.98%). Caretakers of age group 20-30 are the least (15.87%) from the overall care takers. The majority of the caretakers attained primary education (39.68%) followed by those caretakers that attained secondary education (30.16%). Only 6.35 % of the care takers attained tertiary education. About a quarter of the caretakers had no formal education which contributes to 23.81 % of the total caretakers. Majority of the caretakers were Christians (88.89%) and the rest 11.11 % were Muslims.

Table 5.2. Socio-demographic characteristics of the caretakers

		n	%
Age	20 - 30	10	15.87
	30 - 40	17	26.98
	40 - 50	21	33.33
	50 - 60	15	23.82
Sex	Male	12	19.05
	Female	51	80.95
Religion	Christian	56	88.89
	Muslim	7	11.11
Education	No formal education	15	23.81
	Primary	25	39.68
	Secondary	19	30.16
	Tertiary	4	6.35
Total		63	100

5.2. Proximate composition of the food consumed by the children in the orphanages

5.2.1. Feeding frequency in the orphanages

The children in both government and non government orphanages had three meals (breakfast, lunch and dinner) per day throughout the week.

5.2.2. Mean energy intake (kcal) of the children

Table 5.3. Comparison of energy intake of the children with RDA

Age	Sex	RDA	Government orphanages				Non government orphanages			
			G_1	p-value	G_2	p-value	NG_1	p-value	NG_2	p-value
7-9	Boys	1698	1231	0.000	1156	0.000	1772	0.180	1123	0.000
	Girls	1560	1231	0.000	1156	0.000	1772	0.005	1123	0.000
10-14	Boys	2357	1231	0.000	1156	0.000	1772	0.000	1123	0.000
	Girls	2133	1231	0.000	1156	0.000	1772	0.000	1123	0.000
15-17	Boys	3163	1231	0.000	1156	0.000	1772	0.000	1123	0.000
	Girls	2481	1231	0.000	1156	0.000	1772	0.000	1123	0.000

The mean energy intake of the children and adolescents as a whole was 1320 ± 304 Kcal per day. There is significant difference ($p < 0.05$) between the mean meal energy intakes of the children in the orphanages and the recommended dietary allowances set by WHO/FAO/UNU 2001, human energy requirements as shown in table 5.3. However the difference was not significant for the age group 7-9 ($p > 0.05$) only in one of the non government orphanages (NG_1). 19 (7.66 %) of the children out of which 7 (2.82%) boys and 12 (4.84%) girls aged 7-9 years took adequate energy intake in only one of the orphanages (NG_1) as per guidelines of WHO/FAO/UNU, 2001.

The proportion of non-government orphanage children aged 7- 9 years who had adequate energy intake (15.33%) was significantly ($p < 0.05$) higher than that of children in government orphanages.

5.2.3. Serving estimation of the food given in government and non government orphanages

Table 5.4. Mean energy intake among children in government orphanages and non-government orphanages

	Mean energy intake (Kcal)				
Meal	Government orphanages Mean ± SD(Kcal)	Percent contribution (%)	Non government orphanages Mean ± SD (Kcal)	Percent contribution (%)	**p-value**
Breakfast	364 ± 54	30.5	448 ± 51	30.99	0.012
Lunch	431 ± 60	36.13	505 ± 57	34.89	0.036
Dinner	398 ± 35	33.37	494 ± 51	34.12	0.002
Total	1193 ± 69	100	1447 ± 81	100	0.000

The total mean energy intake among the government-orphanage children was 1193 Kcal per day and was significantly lower ($p < 0.05$) than that of the children in non-government orphanages, 1447 Kcal per day. Breakfast relatively contributed the lowest mean energy intake for the day among both the children in government orphanages (30.5%) and non- government orphanages (30.99 %). Lunch contributed the highest mean energy intake for the day among children in government (36.13%) and non-government (34.89%) orphanage children relatively. Dinner had average mean energy intake contribution per day relatively for both government (33.37%) and non- government (34.12%) orphanage children. There is significant difference in energy ($p < 0.05$) in servings of breakfast, lunch and dinner between government and non government orphanages as shown in table 5.4.

5.2.4. Adequacy of energy intake among children in government and non government orphanages

Table 5.5. Comparison of adequacy of calorie intake among the children with RDA

Age (years)	Sex	RDA	Government orphanages Mean (Kcal)	P-value	Non-government orphanages Mean (Kcal)	P-value
7-9	Boys	1698	1193	0.000	1447	0.000
	Girls	1560	1193	0.000	1447	0.010
10-14	Boys	2357	1193	0.000	1447	0.000
	Girls	2133	1193	0.000	1447	0.000
15-17	Boys	3163	1193	0.000	1447	0.000
	Girls	2481	1193	0.000	1447	0.000

The average energy intake of the children and adolescents in government orphanages was 1193 ± 69 Kcal per day while the average energy intake of the children and adolescents in non government orphanages was 1447 ± 81 Kcal per day.

Adequacy of the total energy intake was computed and compared to the recommended daily allowance for each age group and sex of children and adolescents (WHO, FAO, UNU 2001), human energy requirements. Overall, none of the children took adequate energy calories per day in government orphanages and were significantly ($p < 0.05$) lower compared to (WHO, FAO, UNU 2001) guidelines (Table 5.5).

5.3. Micronutrient intakes of the children in the orphanages

5.3.1. Overall Iron, Zinc, Calcium and Magnesium intakes (mg/day) of the children

The micronutrient intakes of the children specifically the calcium, iron, zinc and magnesium intakes are computed and compared with the recommended daily allowance for each age group and sex of children based on FAO/WHO 2001, human vitamin and mineral requirements.

The daily mean calcium intake of the children was 450 mg/day. 5.56 mg/day was the daily mean intake of zinc by the children. The daily mean iron intake of the children was 7.83 mg/day, while their daily mean magnesium intake was 110 mg/day.

Only 47 (26 boys and 21 girls) children took adequate intakes of iron based on the recommendation. 38 of the children took adequate intakes of zinc from which 22 were boys and the rest 16 were girls. none of the children took adequate intakes of calcium as recommended. 53 of the study children took adequate intakes of magnesium from which 31 were boys and the rest 22 of the children were girls.(Fig 5.1)

Overall 18.95 % of the children took adequate intakes of iron from whom 10.48 % were boys and the rest 8.47 % were girls. 15.32 % (8.87 % boys and 6.45 % girls) of the children took adequate intakes of zinc as per guidelines of FAO/WHO 2001, human vitamin and mineral requirements. None of the children in all age groups took adequate intakes of calcium. From the total children, 21.37 % took adequate intakes of magnesium out of whom 12.5 % were boys and 8.87 % were girls. (Fig. 5.1)

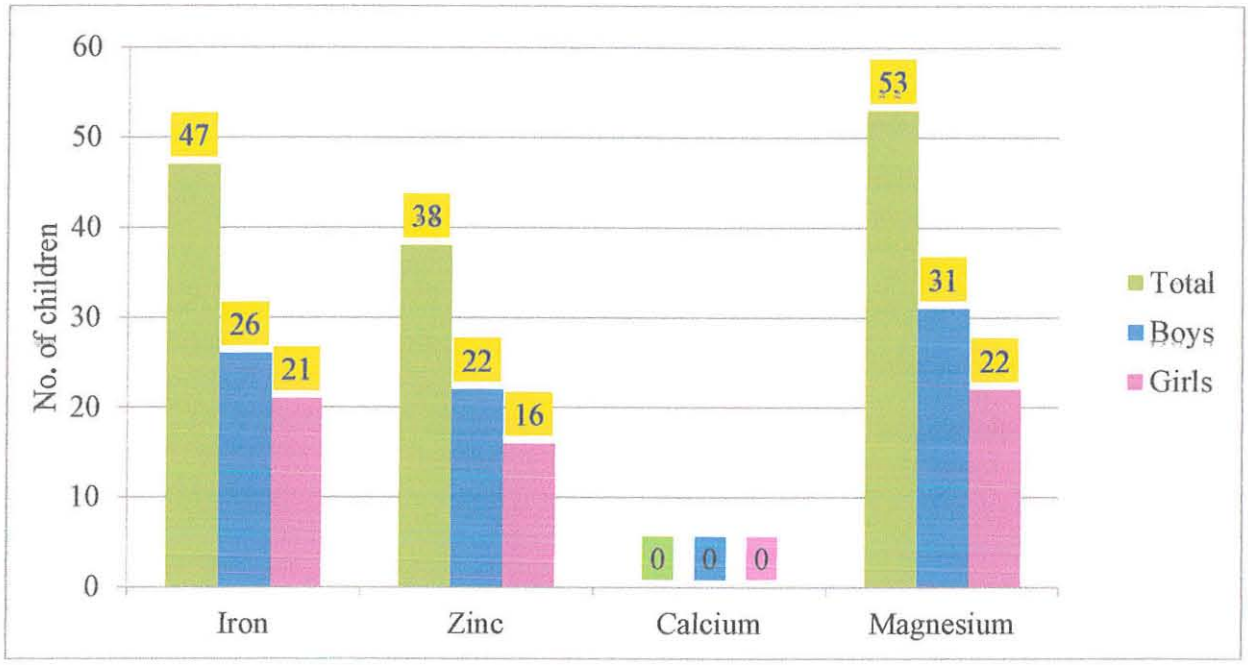

Fig.5.1. Number of children that took adequate intakes of Iron, Zinc, Calcium and Magnesium

5.3.2. Calcium, Zinc, Iron and Magnesium intakes (mg/day) of the children in government and non government orphanages

Adequacy of the average micronutrient intakes of the children specifically in this study, daily mean intakes of Calcium, Zinc, Iron and Magnesium are computed and compared with the recommended daily allowance for each age group and sex of children based on FAO/WHO 2001, human vitamin and mineral requirements.

The recommended daily allowance for Calcium was 700 mg/day for both sexes for the age group 7- 9 years, while for the age group 10-18 years it was 1300 mg/day for both boys and girls. However, none of the children from both government and non government orphanages took adequate calcium intakes per day as recommended. Especially for the age group 10-18 years, the children cannot fulfill even one third of their daily Calcium requirements.(Table 5.6)

The recommended daily allowance for Zinc is 5.6 mg/day for the age group 7-9 years for both sexes. For the age group 10-18 years, it is 9.7 mg/day for boys and 7.8 mg/day for girls. 15.32 % (38) of the total children took adequate intakes of zinc. Only 15.33 % of children from government orphanages out of whom 15 boys and 4 girls took adequate levels of zinc. Similarly 15.33 % (7 boys and 12 girls) non government orphanages children took adequate levels of zinc as recommended. But, none of the children aged 10-18 years took adequate levels of zinc in both government and non government orphanages. (fig. 5.2)

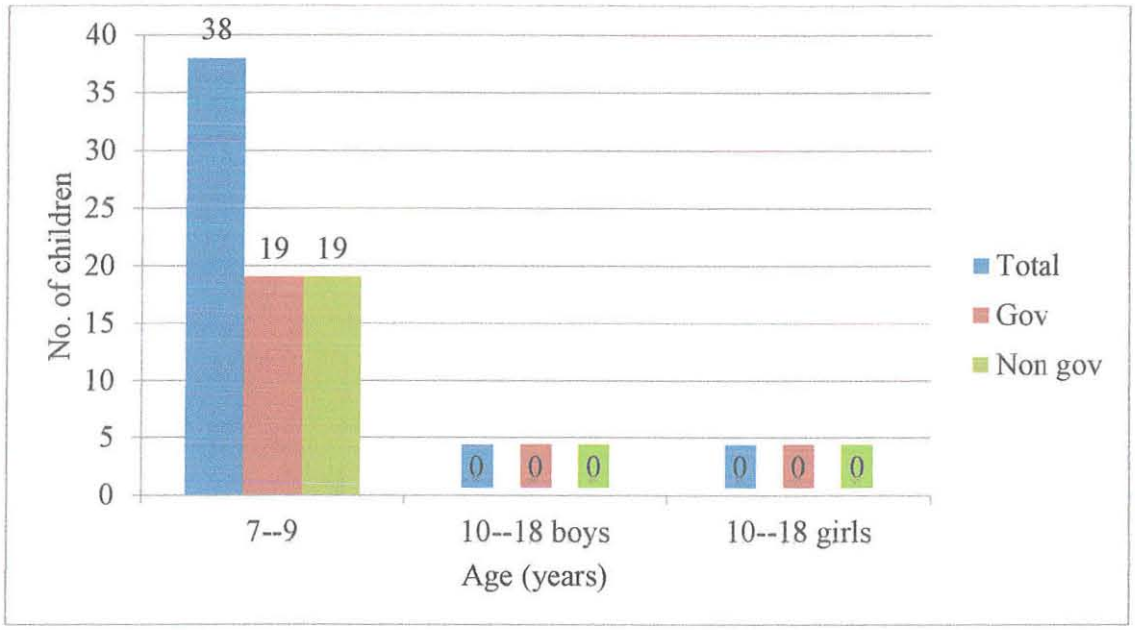

Fig.5.2. Number of children that took adequate intakes of zinc among orphanages

Iron content of the test meal was adequate for 19.36 % of the children in government orphanages specifically for those whose age group ranges between 7-9 years for both sexes. Similarly 18.55 % of the children from non government orphanages whose age ranges from 7-9 years and belongs to both sexes took adequate levels of Iron as recommended. From the total number of children, 18.95 % took adequate intakes of Iron. The recommended daily allowance of Iron for age group 7-9 years is 9 mg/day for both sexes. For those children whose age group belongs to 10-14 years, it is 15 mg/day for boys ,14 mg/day for girls and 33 mg/day for menstruating girls.

Iron is recommended 19 mg/day for boys and 31 mg/day for girls for children whose age ranges from 15-18 years. However, none of the children whose age ranges from 10-14 years and 15-18 years took adequate levels Iron in both government and non government orphanages as recommended by FAO/WHO 2001, human vitamin and mineral requirements.(Fig. 5.3)

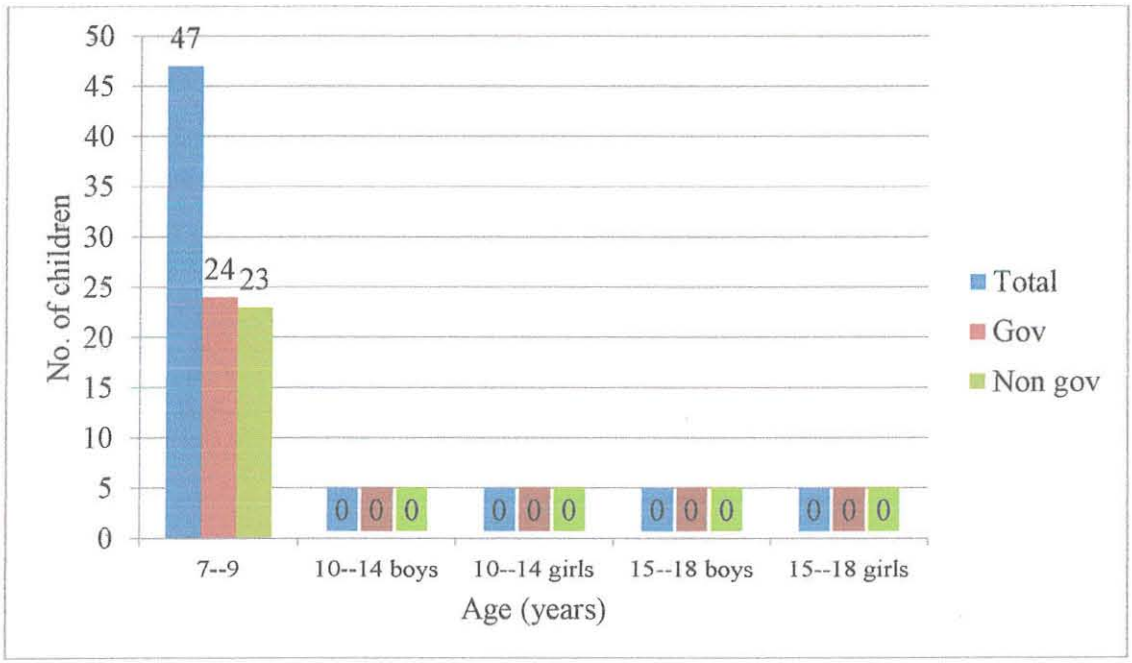

Fig.5.3. Number of children that took adequate intakes of iron among orphanages

The recommended daily allowance of magnesium for children whose age ranges from 7-9 years is 100 mg/day for both sexes while for children whose age ranges from 10-18 years is 250 mg/day for boys and 230 mg/day for girls. From the total number of children, 21.37 % (53) took adequate levels of magnesium.15.33 % (19) of the children from government orphanages took adequate intakes of magnesium while 27.42 % (34) of the children from non government orphanages took adequate intakes of magnesium.(Fig. 5.4)

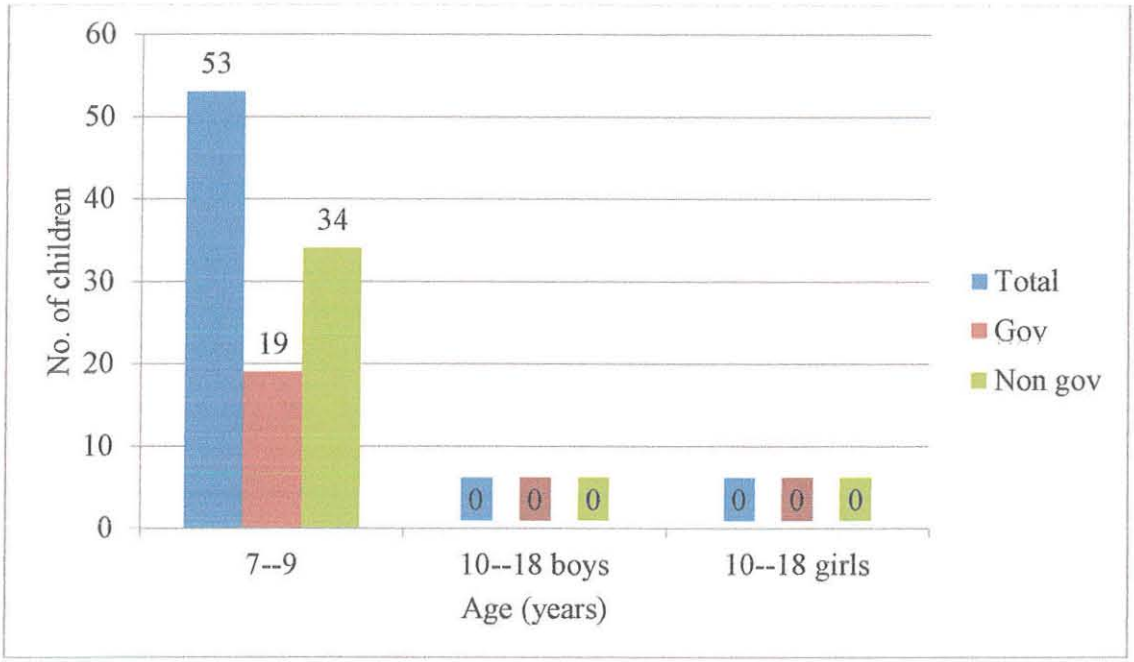

Fig.5.4. Number of children that took adequate intakes of magnesium among orphanages

5.3.3. Calcium, Zinc, Iron and Magnesium intakes of the children among orphanages

The daily mean calcium intake of the children ranged from 430 mg/day in G_2 orphanage to 475 mg/day in NG_1 orphanage. However, none of the orphanages fulfill the daily mean requirements of the children as recommendations of FAO/WHO 2001, human vitamin and mineral requirements. The daily mean calcium intake of the children in all orphanages was significantly lower ($p<0.05$) than the recommended dietary allowances.(Table 5.6)

The mean daily zinc intake of the children ranged from 4.29 mg/day in NG_2 to 6.03 mg/day in NG_1 orphanages. There is no significant difference ($p>0.05$) between daily mean zinc intakes of the children in G_1, G_2 and NG_1 orphanages and the RDA for the age group 7-9 years. However. the difference in the mean daily zinc intakes of the children in the orphanages and the RDA is significant for the age group 10-18 years.(Table 5.6)

The mean daily iron intakes of the children ranged from 5.5 mg/day in NG_2 orphanage to 9.4 mg/day in NG_1 orphanage. There is no significant difference ($p > 0.05$) between mean iron intake of the children in G_1 and NG_1 orphanages and the recommended dietary allowances for the age group 7-9 years only. But, the difference is significant ($p<0.05$) between G_2 and NG_2 orphanages and the recommended dietary allowances for 7-9 years age group. For the age groups 10-14 years and 15-17 years, the mean daily iron intakes of the children in all the orphanages is significantly lower($p<0.05$) than the recommended dietary allowances.(Table 5.6)

The mean daily magnesium intakes of the children ranged from 103 mg/day in NG_2 orphanage to 117 mg/day in NG_1 orphanage which was adequate for the age group 7-9 years only in all the orphanages. However, the mean daily magnesium intakes of the children for the age group 10-18 years is significantly lower ($p<0.05$) than the recommended dietary allowances set by FAO/WHO 2001, human vitamin and mineral requirements.(Table 5.6)

Table 5.6. Calcium, Zinc, Iron and Magnesium intakes (mg/day) of children in government and non government orphanages

				Government orphanages				Non-government orphanages			
ıeral	Age	Sex	RDA (mg/day)	G_1	p-value	G_2	p-value	NG_1	p-value	NG_2	p-value
Ca	7-9	Boys / Girls	700	444	0.000	430	0.000	475	0.002	451	0.000
	10-18	Boys	1300	444	0.000	430	0.000	475	0.000	451	0.000
		Girls	1300	444	0.000	430	0.000	475	0.000	451	0.000
Zn	7-9	Boys / Girls	5.6	6.0	0.543	5.93	0.357	6.03	0.630	4.29	0.009
	10-18	Boys	9.7	6.0	0.006	5.93	0.000	6.03	0.023	4.29	0.000
		Girls	7.8	6.0	0.102	5.93	0.009	6.03	0.215	4.29	0.000
Fe	7-9	Boys / Girls	9	9.1	0.753	7.3	0.004	9.4	0.453	5.5	0.000
	10-14	Boys	15	9.1	0.000	7.3	0.000	9.4	0.000	5.5	0.000
		Girls	14	9.1	0.000	7.3	0.000	9.4	0.000	5.5	0.000
			33*		0.000		0.000		0.000		0.000
	15-17	Boys	19	9.1	0.000	7.3	0.000	9.4	0.000	5.5	0.000
		Girls	31	9.1	0.000	7.3	0.000	9.4	0.000	5.5	0.000
Mg	7-9	Boys / Girls	100	114	0.000	108	0.004	117	0.006	103	0.068
	10-18	Boys	250	114	0.000	108	0.000	117	0.000	103	0.000
		Girls	230	114	0.000	108	0.000	117	0.000	103	0.000

5.4. Diversity of foods consumed by the children

Data from the study showed that diversity of food groups consumed by the orphanages children is very low. None of children in government orphanages consumed more than four food groups compared to 50 % of non-government orphanages children who consume more than four food groups as shown in Table 5.7. These differences were significant.

Children with > 4 food groups diversify well and children with ≤ 4 food groups have poor dietary diversity habit and hence their needs of nutrients does not meet to the recommended allowances according to FAO/FANTA guidelines, 2008. Non government orphanage children whose energy intake fell below the recommended energy intake /105 out of the 124 study children / (84.68%) was an indication that even though the diet was varied, for some children especially for those whose age group between 11-14 years and 15-17 years, the diet was still inadequate. It could therefore be suggested that for those children whose energy intake fell below the recommended energy intake in both government and non government orphanages /229 children out of the total 248 study children/ (92.34%), they were at risk of suffering from nutritional deficiencies.

The consumption of a varied diet is associated with increased intake of energy and better health (Gibson et al., 2001).

In this study non government orphanage children had significantly higher diversity of foods served than the government orphanage children even though the diversity of foods was applied only in one of the non government orphanages. The diet of children in both government and non government orphanages was dominated by basic staple foods supplemented by complimentary foods usually, in form of stews.

Table 5.7. Diversity of foods consumed by the children in government and non-government orphanages

	Children in government orphanages		Non-government orphanage children	
	AA	AB	BA	BB
≤ 4 food groups	Yes	Yes	No	Yes
> 4 food groups	No	No	Yes	No

5.5. Nutritional status of the children

5.5.1. Prevalence of malnutrition among the children

Prevalence of stunting was / 20.96 % / from which / 7.25 %/ of the children were severely stunted and / 13.71 % / were moderately stunted. Prevalence of underweight was / 17.34 % / from which / 6.45 % / was severe and / 10.89 % / was moderate. The prevalence of wasting was / 9.27 % /, from which / 3.63% / was severe and / 5.64 % / was moderate. (Fig. 5.5)

The prevalence of stunting in this study (20.96 %) is in agreement with the previous study by Degarege et al., (2015) where 19.6% of the school children were stunted during the study period. The findings of this study on the prevalence of stunting is also similar with the previous study by Amare et al., (2012) where 23% of the study children were stunted.

The high levels of stunting could imply that children received inadequate care from the caregivers in the orphanages which include food, healthcare and emotional support necessary for the healthy growth and development of children possibly due to insufficient resources such as time, energy and money (Mwaniki et al., 2013).

The prevalence of stunting in school children, was reported as 9.8 % by Zerfu et al., (2006) in Addis Ababa. Also, in different parts of Ethiopia, the prevalence of stunting among school children was reported as 8.9 % (Mesfin et al., 2015), 39.8% (Herrador et al., 2014), 45.7% (Teklemariam et al., 2014), 48.1% (Zelellw et al., 2014), 30.7% (Mekonnen et al., 2013), 11% (Nguyen et al., 2012) and 27% (Worku et al., 2009).

The variations in the reported prevalence of stunting across studies could result from differences in the study methods and existing under nutrition programs across the country. In addition socio-economic differences between areas(for example rural vs. urban) and cultural differences could explain the differences in the prevalence of under nutrition across Ethiopia.

Also, in different parts of the world, stunting was reported as 47.2 % in Kenya (Mwaniki et al., 2013), 42.1 % in Columbia (Hackett et al., 2009), 49 % in Bangladesh (Rahman et al., 2014).

The variation in the reported prevalence of stunting across studies may be explained by the difference in study setting, socio-demographic and cultural differences.

Children stunted at school age are likely to have been exposed to poor nutrition since early childhood and the degree of stunting can tend to increase through the school age years (Gillespie et al., 2004).

Underweight had an overall prevalence of 17.34 % in this study which is similar to the previous study by Degarege et al., 2015 (15.9%).

However the finding of this study on underweight among children living in orphanages is not similar to the previous studies reported as 21.4% (Herrador et al., 2014), 27.8% (Teklemariam et al., 2014), 59.7% (Mekonnen et al., 2013), 21% (Amare et al., 2012), 20.8% (Nguyen et al., 2012), 34.8% (Worku et al., 2009) and 24% (Zerfu et al., 2006).

The prevalence of underweight among the children in orphanages may be explained in association with limited varieties and diversity of foods served to the children in orphanages, the frequency of meals taken in a day, inadequate energy intake, dependency on foods that provide poor quality nutrients and possibly with the prevalence of intestinal parasites.

Underweight, in previous studies, was reported in different parts of the world as 47 % in Bangladesh (Rahman et al., 2014), 33.2 % in Kenya (Mwaniki et al., 2013), 37.5 % in Columbia (Hackett et al., 2009).

The variation in the reported prevalence of underweight across studies may be explained by the difference in study setting, socio-demographic and cultural differences.

The prevalence of wasting in this study is 9.27 % out of which 3.63 % was severe and 5.64 % was moderate.(Table 5.8) The finding of this study on wasting is in agreement with the previous study by Teklemariam et al., (2014) in which 9.9 % of the study children were wasted.

The prevalence of wasting in previous studies was reported as, 37.2 % (Mekonnen et al., 2013), 11 % (Amare et al., 2012), 19.6 % (Nguyen et al., 2012), and 50% (Worku et al., 2009).

In studies conducted in other parts of the world, the prevalence of wasting is reported as 51 % in Bangladesh(Rahman et al., 2014), 9.2 % in Kenya (Mwaniki et al., 2013) and 18.7 % in Columbia (Hackett et al., 2009).

In older children, i.e. above 10 years, weight-for-age is not a good indicator as it cannot distinguish between height and body mass in an age period where many children are experiencing the pubertal growth spurt and may appear as having excess weight (by weight-for-age) when in fact they are just tall. BMI-for-age is the recommended indicator for assessing thinness, overweight and obesity in children 10-19 years according to WHO child growth reference 2007.

Table 5.8. Prevalence of malnutrition among the children

Overall malnutrition		n	%
Stunting	Severe	18	7.25
	Moderate	34	13.71
	Total	52	20.96
Underweight	Severe	16	6.45
	Moderate	27	10.89
	Total	43	17.34
Wasting	Severe	9	3.63
	Moderate	14	5.64
	Total	23	9.27

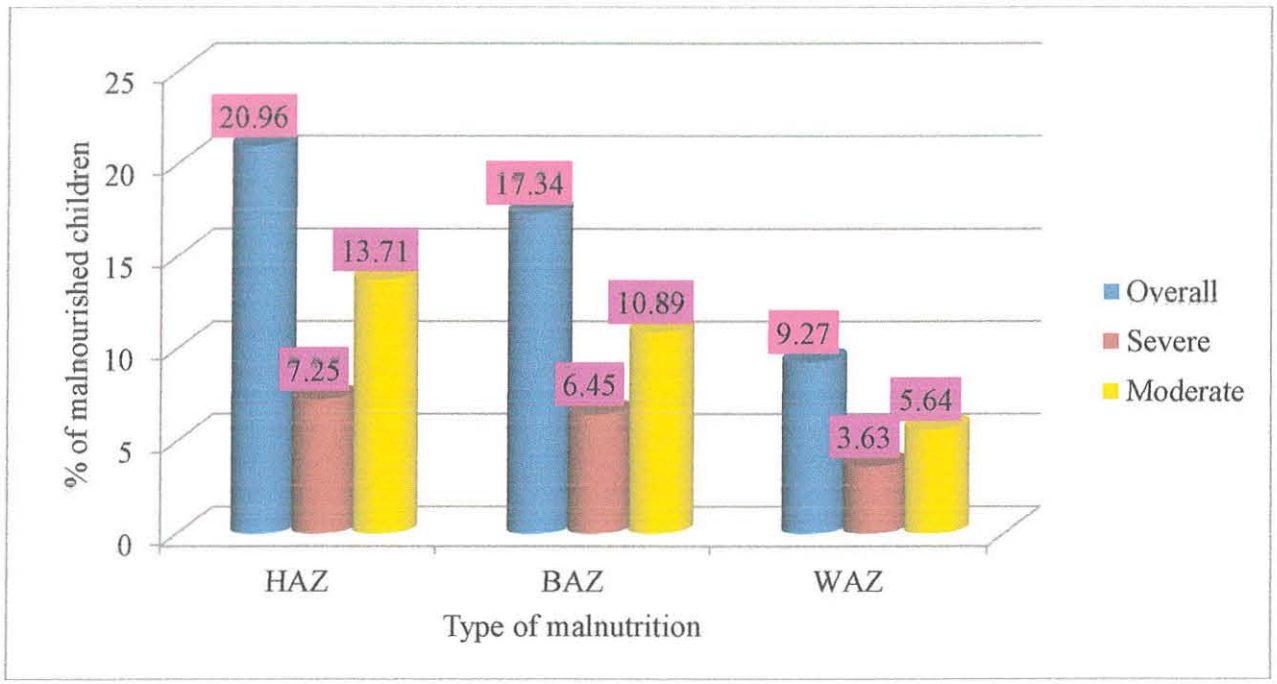

Fig 5.5. Overall malnutrition status of the children

5.5.2. Prevalence of malnutrition among children in government and non government orphanages

Children in government orphanages had a significantly higher rate ($p < 0.05$) of stunting and underweight than non-government orphanage children. However, children in non government orphanages had significantly higher rate of wasting then government orphanage children. (Table 5.9)

Table 5.9. Prevalence of malnutrition among children in government and non-government orphanages

Overall malnutrition	Children in government orphanages (n=124)		Children in non government orphanages (n=124)		p-value (t-test)
	n	%	N	%	
Stunting	**36**	**29.03**	**16**	**12.90**	**0.001**
Severe	13	10.48	5	4.03	0.05
Moderate	23	18.55	11	8.87	0.026
Underweight	**28**	**22.58**	**15**	**12.10**	**0.029**
Severe	10	8.06	6	4.84	0.303
Moderate	18	14.52	9	7.26	0.067
Wasting	**9**	**7.26**	**14**	**11.29**	**0.275**
Severe	3	2.42	6	4.84	0.307
Moderate	6	4.84	8	6.45	0.582

5.5.3. Overall nutritional status of children by sex

Boys had a higher prevalence of stunting (21.77%) and underweight (17.74%) than girls prevalence of stunting(20.16%) and underweight (16.93%) respectively. Wasting rate was higher among girls (9.68%) than boys (8.87%). However these differences were not significant ($p>0.05$) for stunting, underweight and wasting.(Fig.5.6)

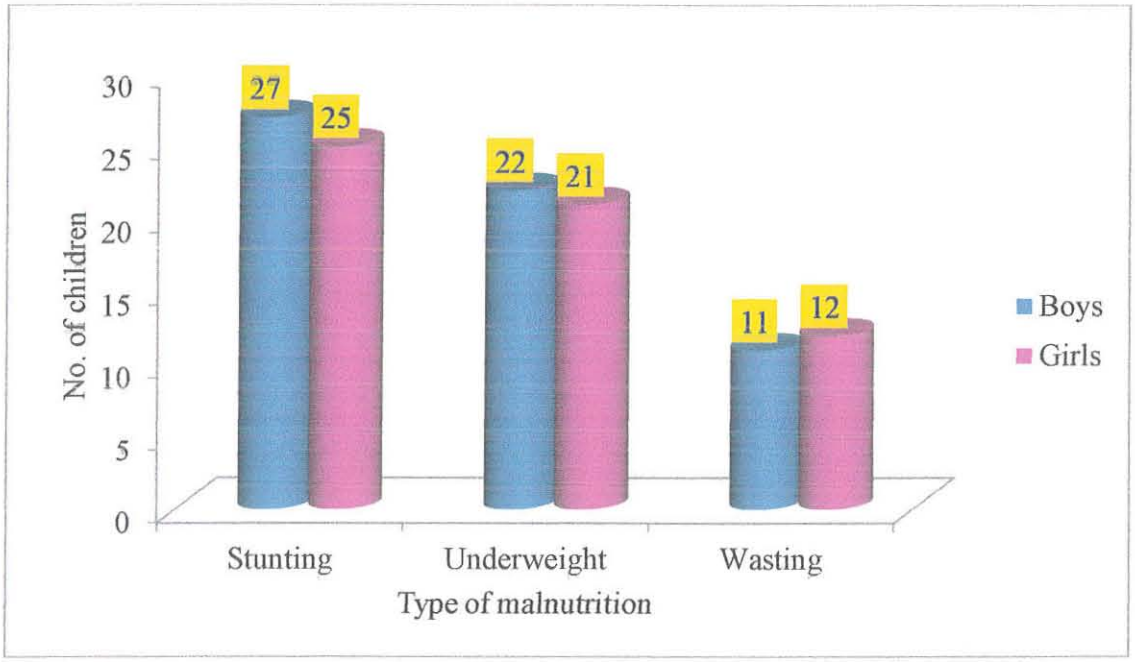

Fig.5.6. overall nutritional status of the children by sex

5.5.4. Overall nutritional status of children by age

In older children, i.e. above 10 years, weight-for-age is not a good indicator as it cannot distinguish between height and body mass in an age period where many children are experiencing the pubertal growth spurt and may appear as having excess weight (by weight-for-age) when in fact they are just tall. BMI-for-age is the recommended indicator for assessing thinness, overweight and obesity in children 10-19 years according to WHO child growth reference 2007.

Children of age 10-14 years are more active and lose a greater amount of energy. Excess energy loss, together with lack of nutritious food, could make them undernourished. Indeed, it was the underweight children (compared to those that were overweight) who demonstrated a high level of physical activity (Dennison et al., 2002).

Table 5.10. Overall nutritional status of children by age

Type of malnutrition (Z scores ≤ - 2.00)	Age range (years)	n	%
Stunting	7 - 9(n=82)	7	8.53
	10 - 14(n=83)	26	31.32
	15 - 17(n=83)	19	22.89
Underweight	7 - 9	8	9.75
	10 - 14	15	18.07
	15 - 17	20	24.09
Wasting	7 - 9	5	6.09
	10 - 14	11	13.25
	15 - 17	7	8.43

5.5.5. Nutritional status of children in government and non government orphanages by sex

Boys in government orphanages had a significantly ($p < 0.05$) higher rate of stunting and underweight compared with non-government orphanage boys' rate of stunting and underweight. On the other hand boys in non government orphanages had a higher rate of wasting compared with government orphanage boys. Similarly, girls in government orphanages had a significantly ($p < 0.05$) higher rate of stunting compared with the non-government orphanage girls' rate of stunting. (Table 5.11)

There was no significant difference ($p > 0.05$) in the prevalence of underweight among girls in government orphanages and non-government orphanages. Girls in non government orphanages had relatively higher rate of wasting compared to girls in government orphanages but, the difference was not significant.

Table 5.11. Nutritional status among children by sex

Type of malnutrition		**Sex**	**Government (Male=62,Female=62)**		**Non-government (Male=62,Female=62)**		**p-value**
			n	%	n	%	
Stunting	Severe	Boys	6	9.67	3	4.83	0.298
		Girls	8	12.90	1	1.61	0.015
	Moderate	Boys	14	22.58	5	8.06	0.025
		Girls	9	14.51	6	9.67	0.406
Underweight	Severe	Boys	5	8.06	2	3.22	0.242
		Girls	5	8.06	4	6.45	0.726
	Moderate	Boys	12	19.35	3	4.83	0.013
		Girls	5	8.06	7	11.29	0.541
Wasting	Severe	Boys	1	1.61	3	4.83	0.307
		Girls	2	3.22	3	4.83	0.645
	Moderate	Boys	2	3.22	6	9.67	0.144
		Girls	2	3.22	4	6.45	0.400

5.5.6. Malnutrition among children by Orphanages

Stunting rates ranged from 9.67 % in NG_1 to 30.64 % in G_2 orphanages (Table 5.12). The prevalence of underweight ranged from 8.06 % in NG_1 to 27.41 % in G_2 orphanages. Wasting ranged from 3.22 % in G_1 to 19.35 % in NG_2 orphanages.

Table 5.12. malnutrition among children by orphanage

Type of malnutrition (Z scores ≤ - 2.00)	**Orphanage**	**n**	**%**
Stunting	G_1 (n=62)	18	29.03
	G_2 (n=62)	19	30.64
	NG_1 (n=62)	6	9.67
	NG_2 (n=62)	9	14.51
Underweight	G_1	11	17.74
	G_2	17	27.41
	NG_1	5	8.06
	NG_2	10	16.12
Wasting	G_1	2	3.22
	G_2	5	8.06
	NG_1	4	6.45
	NG_2	12	19.35

6. Conclusions and Recommendations

6.1. Conclusions

The daily average energy intake of the children was below ($p < 0.05$) the recommendations of FAO/WHO/UNU,2004 human energy requirements. However, the daily average energy intake of the children for the age group 7-9 years was adequate in only one of the orphanages. The daily energy intake for the children in government orphanages was significantly lower ($p < 0.05$) compared to the daily energy intake for children in non government orphanages.

Children in non government orphanages had a relatively better variety of foods consumption than that of government orphanages children. However, the frequency of food consumption is the same for both groups.

The daily average calcium intakes of the children in both orphanage groups was far below the recommendations of FAO/WHO 2001, human vitamin and mineral requirements. The daily average zinc intakes of the children was not adequate for 84.67 % of the overall children. From the total number of children, 18.95 % took adequate intakes of Iron. But, the rest of the children (81.05%) had inadequate intakes of Iron per day which include menstruating girls whose Iron requirements are high as per guidelines of FAO/WHO 2001, human vitamin and mineral requirements. Magnesium was not adequate for 78.63 % of the total children. Even one-third of the total number of children did not took adequate intakes of calcium, zinc, iron and magnesium as recommended by FAO/WHO 2001, human vitamin and mineral requirements.

The prevalence of stunting, underweight and wasting was high among the children as a whole. The prevalence of stunting and underweight was higher among children in government orphanages than among children in non government orphanages. However, the prevalence of wasting was slightly higher among non government orphanages children. The prevalence of stunting, underweight and wasting was almost similar for boys and girls as a whole.

However, boys and girls from government orphanages had higher rates of stunting than non government orphanages' boys and girls.

In the case of underweight, boys from government orphanages had higher rates compared with boys from non government orphanages. However, girls had the same rates of underweight in both groups.

Boys from non government orphanages had higher prevalence of wasting compared with boys from government orphanages. However, the rates of wasting for girls is similar for both groups. Stunting was higher among children whose ages were between 10-14 years while underweight was relatively higher among children of age 15-17 years.

The main factors associated with the higher rates of malnutrition among the children in orphanages as a whole may possibly be associated with inadequate amounts of food served, the low diversity of foods served and the frequency of meals served to the children.

6.2. Recommendations

The energy intakes of the children should be improved by increasing the amount and the frequency of food served to the children and by adding snacks in addition to the regular feeding programs in order to contribute for the improvement of the children nutritional status.

The orphanages management should ensure diet diversification, addition of more animal source foods and fruits to the existing feeding programs to improve the nutritional status of the children in the study orphanages.

The orphanages should better serve their children by giving adequate amounts of food based on age and sex of the children in order to achieve better nutritional status of the children in the future.

Awareness building activities in orphanages concerning diversification and amount of foods served, that address better nutritional practices.

The government should ensure that the registered orphanages have adequate resources to properly take care of the children.

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COLLEGE OF NATURAL SCIENCES
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የተፈጥሮ ሣይንስ ኮሌጅ
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Ref. ቁጥር CNSDO/200/08/2016

Date. ቀን January 27, 2016

To Whom It May Concern

The Ethical Committee of the College of Natural Sciences in its meeting held on December 31, 2015 has examined the project entitle "**Assessment on the adequacy of energy of the food supplied and the nutritional status of children from selected orphanage centers in Addis Ababa.**" by Woinishet Yabibal from Center for Food Science and Nutrition. The proposal was approved for implementation.

The proposal was approved for implementation.

With regards,

Shibru Temesgen, Dr.
Dean, College of Natural Science

Encl.

- Review Summary

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Please quote our reference number in your correspondence.

"Exmine all things; hold fast that which is good"

"ሁሉን መርምሩ መልካሙን ያዙ"

Annex 2

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

CENTER FOR FOOD SCIENCE AND NUTRITION

Consent form

Title: Assessment on the adequacy of nutrients in the food supplied and the nutritional status of children from selected orphanage centers in Addis Ababa.

Principal investigator: Woinshet Yabibal

Institution: Addis Ababa University, center for food science and nutrition

Introduction:

Better nutritional status of children reflects a healthy and a productive generation in future. In particular for school children, it is a critical factor for optimum growth and it should be neither inadequate nor excessive manner. It is widely believed and scientifically proved that improved nutrition and health enhance the learning ability of the children. In the long run, it leads to an increase in the strength of the labor force and thereby it contributes positively for the economic growth.

Malnutrition in children is a major public- health problem in most of the developing countries and Protein Energy Malnutrition (PEM) is more common. The experimental results gained from this research increases the knowledge and understanding of the caretakers and the responsible bodies on the type of malnutrition ,if any ,and the possible recommendations to alleviate the problem, if any, and also to maintain the good sides of the care giving program.

Procedures

If you agree to participate, I will collect food samples supplied in your orphanage center and I will take measurements of height, weight and ages of children from your institution.

Risks

Nothing harmful will come from your children participation.

Benefits

There are no direct benefits to you or your children. However the results will possibly help others. Based on the finding, I will inform the authorized person and respective stakeholders to work on it.

Cost

There is no cost to you for your participation.

Compensation

There will be no compensation to you for your participation.

Participant's right

You have the right to ask questions and things that are not clear for you without any fear and with full freedom. I will give you the answers and appropriate explanations . Your children participation in the study is entirely based on voluntarism and you have full right to decide. There is no penalty if you don't agree to participate. You can say no without worry and without any fear.

Confidentiality

I will exclude names and other identifying numbers that are related to your orphanage centers and your children in order to assure confidentiality of my study. Anthropometric results and any information about your children will be kept private.

Contact person

If you have any question, you can ask at any time, if you have additional questions about the study you may contact Woinshet Yabibal, Tel - 0912 166488 or by e-mail (woinshet9823@yahoo.com).

Do you want to participate in the study?

Yes I want to participate ( )

Name _____

Signature _____

Date _____

No I do not want to participate ( )

Thank you in advance for your cooperation!

Annex 3

አዲስ አበባ ዩኒቨርስቲ

የምግብ ሳይንስና ኒውትሪሽን ማዕከል

የሦስተኛ ዓመት የድህረ ምረቃ ተማሪ የሚያደርጉት ጥናት

የጥናት ፈቃድ ፎርም

አዲስ አበባ ዉስጥ በሚገኙ አራት የተመረጡ ወላጅ አልባ ህጻናት መርጃ/ማሳደጊያ ማእከላት ዉስጥ የሚሰጠዉን ምግብ ይዘት እና በ ህጻናቱ የእድገት ደረጃ ላይ የሚደረግ የ ዳሰሳ ጥናት

ዋና ተመራማሪ፡- ወይንሸት ያብባል ከአዲስ አበባ ዩኒቨርስቲ የምግብ ሳይንስና ኒውትሪሽን ማዕከል

ማብራሪያ፡- ምግብ ለ ህጻናት ጤናማ የ አእምሮና የ ሰዉነት አድገት ወሳኝ መሆኑ ይታወቃል፡፡ጤናማ የአእምሮና የ ሰዉነት አድገት ያለዉ ህጻን ደግሞ በ ትምህርት ገበታዉ እና በተለያዩ ሌሎች ክህሎቶች ላይ የሚያሳየዉ ብቃት እመኑ ነው፡፡ከ ራሱም አልፎ ለ ሀገሪቱ የሚያበረክተዉ የ ኢኮኖሚ አስተዋጽዎም እጅግ ከፍተኛ መሆኑ በብዙ ጥናቶች ተረጋግጠዋል፡፡በመሆኑም ህጻናት አመጋገብ ላይ ይበልጥ መሰራት እንዳለበትና ንቃተ ህሊናችንን ማስፋት እንዳለብን ያመላክታል፡፡ ነገር ግን ወላጅ አልባ ህጻናት ማሳደጊያ ማእከላት ዉስጥ ከዚህ በፊት የተደረጉ ጥናቶች እምብዛም አይደሉም፡፡በመሆኑም ይህ የ ዳሰሳ ጥናት በነዚህ ማእከላት ያሉ ችግሮችን አውቆ መፍትሄ ለመስጠት ያስችል ዘንድ እንዲሁም ያሉትን መልካም ጎኖች ለማበረታታትና ለማስቀጠል የሚደረግ ጥናት ነው፡፡

መመሪያዎች፡-ጥናቱ ላይ ለመሳተፍ ከተስማሙ በተቁዋሙ ዉስጥ ለ ልጆች የሚሰጠዉ የምግብ ናሙና እና በ ተቁዋሙ ዉስጥ የሚገኙ ልጆች ቁመት፤ክብደት እና እድሜ የሚወሰድ ይሆናል፡፡

ሰጋት፡- የእርሶ በ ጥናቱ ላይ መሳተፍ ምንም አይነት ጉዳት በልጆቹ ላይ አያደርስም፡፡

ጥቅም፡- ምንም አይነት ቀጥተኛ ጥቅም ለእርሶም ለልጆቹም አይኖርም፡፡ ግን በተዘዋዋሪ በሌሎች ልጆችም ሆነ በእነዚህ ልጆች የጥናቱ ውጤት ላይ ተመርኩዞ ለውጥ ሊያመጡ የሚችሉ ባለድርሻ አካላት በማሳወቅ እንዲሰሩበት ያስችላል፡፡

ዋጋ:- በመሳተፍዎ ምንም አይነት ዋጋ አያስከፍልም።

ማካካሻ:- በመሳተፍዎ ምንም አይነት ማካካሻ አይኖረውም።

የተሳታፊ መብቶች:- ምንም አይነት ግልጽ ያልሆነ ነገር ካለ የፈለግውትን ጥያቄ ካለምንም ፍርሀትና ጭንቀት መጠየቅ ይችላሉ። የልጆቹ ተሳታፎ በሙሉ ፍቃደኝነት ላይ የተመሰረተ ነው።

ባለመሳተፍዎ የሚደርስብዎ ምንም አይነት ቅጣት አይኖርም።

ሚስጥራዊነቱን ከመጠበቅ አንጻር ማንኛውም ገላጭ የሆኑ ነገሮች ማለትም ስም ቁጥር የመሳሰሉትን በማስወገድ ማንኛውም መረጃ በሚስጥር ይጠበቃል።

ምንም አይነት ጥያቄ ወይም አስተያየት ካለዎት በ ስልክ ቁጥር ፡ 0912166488

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ጥናቱ ላይ ለመሳተፍ ፍቃደኛ ነዎት?

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ፊርማ ----------

ቀን ----------

የጥናቱ አስተባባሪ ፊርማ ----------

ለሚያደርጉልን ትብብር በቅድሚያ እናመሰግናለን።

Annex 4

Questionnaire for children living in selected orphanage centers in Addis Ababa

Type of orphanage governmental ☐ non governmental ☐

Name of orphanage .....

Name .....

Code .....

Child's background

1. Age .....

2. Sex Male ☐ Female ☐

3. Educational level .....

4. For how long would you stay in the orphanage ?

A. Less than one year B. One to two years C. Two to three years D. More than three years

5. Nutritional status of the children

A. First height in cm .....

B. Second height in cm .....

Average height of the child .....

C. First weight in Kg .....

D. Second weight in Kg .....

Average weight of the child in Kg .....

Annex 5

በአዲስ አበባ ዉስጥ በሚገኙ የተመረጡ ወላጅ አልባ ህጻናት ማሳደጊያ ማእከላት ዉስጥ ለሚኖሩ ህጻናት የቀረበ

መጠይቅ

የህጻናት ማሳደጊያዉ አይነት መንግስታዊ ☐ መንግስታዊ ያልሆነ ☐

የህጻናት ማሳደጊያው ስም.....

ስም.....

ኮድ.....

የተማሪዉ/ዋ አጠቃላይ ሁኔታ

1. እድሜ .....

2. ጾታ ወንድ ☐ ሴት ☐

3. የትምህርት ደረጃ .....

4. ወደ ህጻናት ማሳደጊያ ማእከሉ ከገባህ/ሽ ስንት ጊዜ ሆነህ/ሽ ?

ሀ. ከአንድ አመት ወዲህ ለ. ከ አንድ እስከ ሁለት አመት ሐ. ከ ሁለት እስከ ሶስት አመት መ. ከ ሶስት አመት በላይ

5. የህጻናቱ እና የታዳጊዎቹ የእድገት ሁኔታ

ሀ.ቁመት (ሣ.ሜ) .....

ለ.ቁመት (ሣ.ሜ) .....

አማካይ ቁመት (ሣ.ሜ) .....

ሐ. ክብደት (ኪ.ግ) .....

መ. ክብደት (ኪ.ግ) .....

አማካይ ክብደት (ኪ.ግ) .....

Annex 6

Questionnaire for caretakers working in selected orphanage centers in Addis Ababa

Type of orphanage government ☐ non government ☐

Name of orphanage .....

Name .....

Code .....

1. Age .....

2. Sex Male ☐ Female ☐

3. Educational level

A. Illiterate / no formal education C. Secondary education

B. Primary education D. Tertiary education

4. Religion

A. Christian B. Muslim C. Other

Food consumption of the children

1. How many times do the children feed per day?

A. once a day B. twice a day C. thrice a day D. More than thrice a day

2. Are all the children in all age groups given the same meals daily?

A. Yes B. No

3. If no, which age groups are given the different meals

A. Children of age 7-9 years C. Children of age 15-17 years

B. Children of age 10-14 years D. Others (specify)

4. Is there a difference on the type and quantity of food given to boys and girls ?

A. Yes B. No

5. If yes, who are given the different meals ?

A. Boys B. Girls

6. Is there a fixed meal schedule for each day?

A. Yes B. No

7. If yes what are the meals given to the children on each day of the week?

Day	Breakfast	Lunch	Dinner
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			
Sunday			

Annex 7

በአዲስ አበባ ዉስጥ በሚገኙ የተመረጡ ወላጅ አልባ ህጻናት ማሳደጊያ ማእከላት ዉስጥ ለሚሰሩ ህጻናት አሳዳጊዎች የቀረበ መጠይቅ

የህጻናት ማሳደጊያዉ አይነት መንግስታዊ ☐ መንግስታዊ ያልሆነ ☐

የህጻናት ማሳደጊያው ስም .....

ስም .....

ኮድ .....

1. እድሜ .....

2. ጾታ ወንድ ☐ ሴት ☐

3. የትምህርት ደረጃ

ሀ. ማንበብና መጻፍ የማይችሉ ለ. አንደኛ ደረጃ ሐ. ሁለተኛ ደረጃ መ. ከሁለተኛ ደረጃ በላይ

4. ሀይማኖት

ሀ. ክርስትያን ለ. ሙስሊም ሐ. ሌላ

ስለ ልጆቹ አመጋገብ ሁኔታ

1. ልጆቹ በቀን ምን ያህል ጊዜ ይመገባሉ ?

ሀ. አንድ ጊዜ ለ. ሁለት ጊዜ ሐ. ሶስት ጊዜ

2. በሁሉም የእድሜ ክልል ላሉ ልጆች የሚሰጠዉ ምግብ አንድ አይነት ነዉ ?

ሀ. አንድ አይነት ነዉ ለ. ይለያያል

3. የሚለያይ ከሆነ በየትኛዉ የእድሜ ክልል ላሉ ልጆች ነዉ የተለየ ምግብ የሚሰጠዉ ?

ሀ. ከ 7-9 አመት ለ. ከ 10-14 አመት ሐ. ከ 15-17አመት መ. ሌላ ካለ ይጥቀሱ

4. በሴቶችና በወንዶች ልጆች መካከል የምግብ አይነትና መጠን ልዩነት አለ ?

ሀ. አዎ አለ ለ. የለም

5. ልዩነት ካለ ለየትኛዎቹ ልጆች ነዉ የተለየ አይነትና መጠን ያለዉ ምግብ የሚሰጠዉ ?

ሀ. ለወንዶች ለ. ለሴቶች

6. ለእያንዳንዱ ቀን የወጣ የምግብ ፕሮግራም አለ ?

ሀ. አለ ለ. የለም

7. ካለ በ እያንዳንዱ ቀን ያለዉን የ ምግብ ዝርዝር ይጻፉ

ቀን	ቁርስ	ምሳ	እራት
ሰኞ			
ማክሰኞ			
እሮብ			
ሐሙስ			
አርብ			
ቅዳሜ			
እሁድ			

Approved by the board of examiners

This thesis by Woinshet Yabibal is accepted in its present form by the board of examiners as satisfying thesis requirement for the degree of Master of Science in Food science and nutrition.

Internal examiner

Dr. Kaleab Baye  03/04/2017

Date

External examiner

Mr. Kelbessa Urga 

Date 30/03/017