ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL SCIENCES

CENTER FOR FOOD SCIENCE AND NUTRITION

NUTRITIONAL STATUS OF SCHOOL CHILDREN IN ADDIS BABA INVOLVED IN SCHOOL FEEDING PROGRAM: A COMPARATIVE STUDY

By:

Alemnesh Assefa

Advisors:

Dr. Ashagrie Zewdu

Mr. Kelbessa Urga

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Food Science and Nutrition.

June, 2015

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Declaration

I, the undersigned, declare that this thesis is my original work and that all sources of materials used for the thesis work have been fully acknowledged.

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Lists of Abbreviations

AAS	Atomic absorption spectrophotometer
BMI	Body Mass Index
AOAC	Association of Official Analytical Chemists
EPHI	Ethiopian public health institute
FANTA	Food and Nutrition Technical Assistance
GABA	Gamma Amino Butyric Acid
GDP	Gross Domestic Product
GH	Growth Hormone
HAZ	Height for Age Z score
HCL	Hydrochloric Acid
HFA	Height for Age
IDDS	Individual Dietary Diversity Score
IGF-I	Insulin like growth factor-1
KOH	Potassium Hydroxide
NACS	Nutrition Assessment, Counseling, and Support
NCHS	National Center for Health Statistics
NaOH	Sodium Hydroxide
NTs	Neurotransmitters
RAP	Rapid Assessment Procedures
RDA	Recommended Dietary Allowance
SD	Standard Deviation
SPSS	Statistical Package for the Social Science

WAZ	Weight for age Z score
WFA	Weight for Age
WFH	Weight for height
WFP	World Food Program
WHO	World Health Organization
WHZ	Weight for height Z score

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Abstract

Nutritional status of children is an important component of primary health care. School age is a period of rapid growth in human development when nutritional demand is increased. In this descriptive cross sectional comparative study the nutritional status of children, dietary diversity status and food composition of the food given to the children who were involved in the feeding program were assessed from 10 different primary schools of Addis Ababa of which 280 students were recruited for the study. From the study results prevalence of wasting among the feeding group was found to be 7.1% and for the non-feeding it was 10%, 5.6% were underweight from the feeding group and 10.5% from the non feeding group. The prevalence of stunting for the feeding group was found to be 23.6% and for the non-feeding it was 16.5%. This study found that the dietary diversity score were influenced by educational status of the parents/caregivers (p-vale, 0.000). Children from the feeding group had better food diversity profile than those who were not involved in the program. Most of the school meals composition was not sufficient to meet the children's need though they need nutrient and energy dense foods. From the present study the prevalence of acute malnutrition was found to be low and chronic malnutrition was medium in terms of public health significance. The nutritional status of the school children involved in the feeding program was different from those who were not involved in the program even though the difference was not statistically significant. The food composition served for the children in the feeding program was analyzed and its protein content was adequate but it did not fulfill the daily requirement of most of the nutrients and energy requirement. School feeding program should be implemented along with the school curriculum for primary schools at the national level till citizens will able to insure individual-household food security.

Key Words: *nutritional status, anthropometry, school feeding, dietary diversity, food composition.*

Chapter One
Introduction

1. INTRODUCTION

1.1. Background

Nutritional status is the condition of health of an individual as influenced by nutrient intake and utilization in the body. Nutrition plays a vital role, as inadequate nutrition during childhood may lead to malnutrition, growth retardation, reduced work capacity and poor mental and social development (Sridhar *et al.*, 2014). Malnutrition is a major public health problem in developing countries. Nutritional status is an important component of primary health care which is one of the goals of the millennium development goals and a fundamental indicator of the socioeconomic status of a community (Siddique *et al.*, 2013).

The school age is a period of growth and cognitive development of primary school children, during which rapid growth in human development and nutritional demand is increased (Choi *et al.*, 2008). Healthy and adequate dietary habits during childhood promote optimal health, growth and cognitive development of the child, and contribute to the prevention of chronic diseases in later life (Sabinsky *et al*., 2013) Therefore, ensuring that children have adequate nutrition is an important step towards a healthy population which can reduce public expenditure on health curative related issues and also promotes economic growth (Annim *et al.*, 2014).

School children are often thought of as naturally healthy, but studies have shown that many school children are stunted in height, underweight, wasted, anaemic, and iodine or vitamin A deficient (Daboné *et al.*,2011). The nutritional status of school-age children impacts their health, cognition, and subsequently their educational achievement (Mekonnen *et al.*, 2013). According to World Food Program (WFP), Ethiopia is amongst the countries in the world with the highest rate of school age children with special needs mainly attributed to

impairments from malnutrition. Despite the economic growth observed in developing countries, malnutrition is still prevalent. There are also low awareness levels on the effect of poor health and nutrition on children's ability to learn. From a policy and strategy perspective, there is lack of ownership and coordination as well as ineffective utilization of resources due to different standards being applied by different organizations on the delivery of comprehensive school health and nutrition interventions (Ministry of Education, 2012).

There are number of factors that contribute for one's nutritional status, among which socioeconomic status, parents education, breakfast consumption and diversification are the major contributors (Babar *et al.*, 2010). Food fortification, supplementation, school feeding programs and giving health and nutrition education to the target population in order to broaden the knowledge of the population towards health and nutrition are interventions mostly implemented to prevent or treat malnutrition (Acharya *et al.*, 2013).

Anthropometry is the quantitative method commonly used for the assessment of growth in the children (Griffiths *et al.*, 2004). It is a valuable, inexpensive and universally applicable method to assess the size, proportion and composition of human body (Ahmed, 2012 ; Hossain *et al.*,2013). In a recent period anthropometric measurements have become a popular tool for the assessment of nutritional status among children and adolescents (Srivastav *et al.*, 2013). It is widely accepted that, for practical purposes, anthropometry is the most useful tool for assessing the nutritional status of children (Mulugeta *el al.*, 2009).

1.2. Statement of the problem

In Ethiopia, child undernutrition continues to be a major public health problem (Amare *et al.*,2012). Despite emergence of a number of advancements in areas of health and nutrition services in developing countries including Ethiopia, nutritional status of school children is not yet improved and understudied (Mekonnen *et al.*, 2013) and children are by far the most commonly affected group (Asres & Eidelman, 2011). The health and nutrition needs of school-age children have been largely ignored in Ethiopia. The focus has instead been on pre-school children because they are at greater risk of mortality. However, since more children are now attending school than ever before, the concerns shift away from mere survival towards improving the quality of life. The school is an opportune setting to provide health and nutrition services to disadvantaged children but school age children are not commonly included in health and nutrition surveys (Best *et al.*, 2010).

The basis of this study was initiated from information of different mass medias and followed by observation and qualitative preliminary works. The preliminary work was done to identify and make sure the existence of hunger in the schools as a general problem. The randomly selected children were interviewed on how many times they eat per day and whether they usually eat their breakfast and after school. The work revealed that there were children who came to school without having breakfast. According to D. Gashaw (personal communication, September 2014) students usually faint down during school period due to hunger, and even though there is school feeding program in the schools it is not sufficient due to that the teachers contribute from their salary. As he noticed the problem was a major concern which has been a challenge for the health of the students and also for the learning teaching

processes. There is a food shortage problem in slum areas of Addis Ababa but most interventions have focused on the rural setting.

1.3. Significance of the study

The study assesses the prevalence of malnutrition among the school children and provides the gap to be filled by capable and willing citizens or humanitarians. The study output will also answer "Do the school children need an integrated and formal school feeding program?" because the currently available school feeding program is not well organized and formal. Therefore, the study contributes to school feeding need assessment as intervention programs by evaluating effectiveness of currently available school feeding program and it can be used as a reference for those who are planning to give school feeding program. The study also initiates stakeholders and policy makers to play a role concerning school children malnutrition.

1.4. Objective

General objective

- To compare the nutritional status of school children in Addis Ababa involved in school feeding program and those who are not involved.

Specific objectives

- To determine the prevalence of acute malnutrition (wasting) and chronic malnutrition (stunting) among selected school children.
- To compare the nutritional status of children in the feeding program with those who are not involved in the program.
- To determine the nutrient composition of the food given to the children by proximate analysis.

Chapter Two
Literature Review

2. LITERATURE REVIEW

2.1. Assessment of nutritional status

Assessment of nutritional status is a measurement of the extent to which an individual's physiologic need for nutrients is being met and it is a key indicator of nutritional and health assessment (Srivastava *et al.*, 2012; Aurisinkala-Appadoo *et al.*, 2013). The nutritional status of a community particularly of its vulnerable groups comprising of children, expectant mother and lactating mothers has been recognized as an important indicator of national development (Frye, 2013). Assessment of nutritional status of an individual involves direct and indirect methods. The direct methods are: Anthropometric methods, biochemical, dietary evaluation methods, laboratory methods and clinical methods. Indirect methods use community health indices that reflects nutritional influences. These are: ecological variables including crop production, economic factors e.g. per capita income, population density and social habits, vital health statistics (Nabag, 2011; Ismail & Mustaquim, 2013).

2.1.1. Nutritional assessment methods

Nutritional assessment can be defined as the interpretation of information obtained from dietary, biochemical, anthropometric and clinical studies. As to the diet, food consumption may be measured at the national level (per capita), household level, or individual level (Lennernas, 1998). There are four standard methods used in assessing nutritional status:

- Anthropometric
- Dietary: Nutritional history of current intake
- Biochemical or Laboratory
- Clinical (physical exam)

2.1.1.1. Anthropometric methods

Anthropometry is the measurement or assessment of the size, proportions, and composition of the human body, reflecting both health and nutritional status and predicting performance, health, and survival (NACS, 2014). Anthropometric measurements include weight, height, and mid-upper arm circumference (MUAC). Body mass index (BMI), weight-for-height are anthropometric measurements presented as indexes for acute malnutrition whereas, Height-for-age (HFA) is an index for chronic under nutrition and weight-for-age (WFA) is an aggregate measure of underweight or wasting and stunting. Each of these indexes is recorded as a z-score. Z-scores are measured in standard deviations (SD), which describe how far and in what direction an individual's anthropometric measurement deviates from the mean for a healthy person of the same age and sex.

Weight: Weighing is usually the first step in anthropometric assessment and a prerequisite for finding weight-for-height z-score (WHZ) for children and BMI for adults. Weight is strongly correlated with the development of disease. Unintentional weight loss can mean poor health and reduced ability to fight infection. Weighing clients requires a functioning weighing scale that measures weight in kg to within the nearest 0.1kg. Accurate weight measurement is important because errors can lead to incorrect classification of nutritional status and the wrong care and treatment.

Length/height: Measuring length or height requires a height board or measuring tape marked in centimeters (cm). The tools measure height for children 2 years and older who are more than 87 cm tall and for adults.

The nutritional indices commonly calculated for children are:

- Weight-for-height (WFH) – a measure of wasting or acute malnutrition
- Height-for-age (HFA) – a measure of stunting or chronic under nutrition
- Weight-for-age (WFA) – a measure of underweight or wasting and stunting combined
- MUAC – a measure of wasting or acute malnutrition

Weight-for-height: A measurement of body weight relative to height. Low weight-for-height in children reflects wasting. High weight-for-height is described as "overweight." Weight-for-height z-score (WHZ) is a nutritional index that shows how a child's weight compares to the weight of a child of the same length/height and sex in the WHO growth standards. Inadequate weight for length or height, reflecting acute malnutrition, defined by WHZ z-score < −2 in children. An individual's z-score can be used to classify how malnourished he or she is. A mean z-score can also be calculated to determine the nutritional status of a population group (NACS, 2014).

Height-for-age z-score (HAZ): The number of standard deviations of the height of a child from the median height of children of the same age and sex in the WHO growth standards. HAZ is a measure of stunting or chronic malnutrition. Inadequate length or height for age resulting from chronic undernutrition is defined by height-for-age z-score (HAZ) < −2 (NACS, 2014).

Weight-for-age: A measurement of body mass relative to age. Low weight-for-age in children reflects underweight. Weight-for-age z-score (WAZ) is a nutritional index that shows how a child's weight compares to the weight of a child of the same age and sex in the WHO growth standards. Inadequate weight relative to age, reflecting both chronic and acute malnutrition is defined by WAZ z-score < −2 (NACS, 2014).

Mid-upper arm circumference (MUAC): The circumference of the mid-upper arm measured on a straight left arm (in right-handed people) midway between the tip of the shoulder and the tip of the elbow. In children 6–59 months old, MUAC is a better indicator of mortality risk associated with acute malnutrition than weight-for-height z-score (NACS, 2014).

Body mass index (BMI): BMI is an anthropometric indicator based on weight-to-height ratio. BMI is not an accurate indicator of nutritional status in pregnant women or adults with edema, whose weight gain is not linked to their nutritional status, using MUAC for these groups is more useful. BMI is calculated by dividing a person's weight in kg by the square of the person's height in meters (FSAU/FAO, 2005; NACS, 2014).

BMI can be used as an indicator of nutritional status for adults over 18 years who have completed their physical development, but for older children and adolescents who are still growing and developing, age and sex must be considered when using BMI. The preferred indicator of body thinness used to classify malnutrition in children and adolescents 5–19 years old. Below are the WHO BMI-for-age classifications of malnutrition in adolescents' 5−19 years of age (NACS, 2014). WHO cutoffs indicates a need for nutrition interventions to slow or reverse weight loss.

Table 2.1. Classification of malnutrition of children and adolescents 5-19 years of age

BMI-for-age-Z-score	**Nutritional Status**
< −3 z-score	Severe thinness
≥ −3 and < − 2 z-score	Moderate Thinness
≥ −2 and +1 z-score	Normal
>+1 and ≤+2 z-score	Overweight
>+2 z-score	Obesity

Source: WHO, 2007. Growth Reference Data for 5−19 Years.

2.1.1.2. Biochemical assessment

This is a specific measure of nutrients in blood, urine and other biological samples for example serum retinol levels to assess vitamin A status. Compared to other methods, biochemical methods of nutritional assessment provide the most objective and quantitative data on nutritional status but it is generally expensive, time consuming and not possible in an emergency. The usefulness of biochemical tests is that they provide indications of nutrient deficits long before clinical manifestations and signs appear (FSAU/FAO, 2005; NACS, 2014).

2.1.1.3. Clinical assessment

Clinical assessment is an essential features of all nutritional surveys. It is the simplest & most practical method of nutritional status of a group of individuals. It utilizes a number of physical signs, (specific and non specific), that are known to be associated with malnutrition and deficiency of vitamins & micronutrients**.** General clinical examination, with special attention to organs like hair, angles of the mouth, gums, nails, skin, eyes, tongue, muscles, bones and thyroid gland. Detection of relevant signs helps in establishing the nutritional diagnosis and treatment. Clinical assessment includes checking for visible signs and symptoms of nutritional deficiencies such as bilateral pitting edema (fluid retention on both sides of the body), emaciation (a sign of wasting, which is loss of muscle and fat tissue as a result of low energy intake and/or nutrient loss from infection), hair loss, and changes in hair color (FSAU/FAO, 2005; NACS, 2013).

2.1.1.4. Dietary evaluation methods

Assessing food and fluid intake is an essential part of nutrition assessment and it provides information on dietary quantity and quality. The results are compared with recommended

intake such as recommended dietary allowance and dietary diversity scores based on the food group's classification in addition to other standards. Some common ways to assess dietary intake for individuals are described below, along with the major strengths and limitations of each:

Food records: Food records, also called food diaries, require that the subject (or observer) report all foods and beverages consumed for a specified period (usually one to seven days). Amounts of each food item may or may not be recorded, depending on the study objectives. If nutrient intakes are to be calculated, the amounts consumed should be estimated as accurately as possible. Amounts may be determined by weighing or by estimating volumes. In some situations, only those foods of particular interest are recorded. For example, to estimate intake of a food component found only in animal products, food records might be limited to foods containing meat, poultry, fish, eggs or dairy products. However, if total energy intake is required, the food record should include all foods consumed (Roohani, 2012).

24-hour dietary recall: The 24-hour dietary recall consists of a listing of foods and beverages consumed the previous day or the 24 hours prior to the recall interview. Foods and amounts are recalled from memory with the aid of an interviewer who has been trained in methods for requesting dietary information. The interview is usually conducted face to face, but may also be conducted by telephone. In some situations, the recall is self-administered by the subject. A brief activity history may be incorporated into the interview to facilitate probing for foods and beverages consumed (FSAU/FAO, 2005; Roohani, 2012).

Food frequency questionnaire: A food frequency questionnaire is designed to obtain information on overall dietary quality rather than nutrient composition and intake. The food

frequency questionnaire examines how often someone eats certain foods, and sometimes the size of the portions. This method is quick and inexpensive but under-reporting is common (NACS, 2013).

Dietary histories: The meal-based diet history is designed to assess usual individual intake. It consists of a detailed listing of the types of foods and beverages commonly consumed at each eating occasion over a defined time period which is often a "typical" week. A trained interviewer probes for the respondent's customary pattern of food intake on each day of the typical week. The reference time frame is often the past month or the past several months, or may reflect seasonal differences if the time frame is the past year (NACS, 2013).

Food habit questionnaires: May be designed to collect either general or specific types of information, such as food perceptions and beliefs, food likes and dislikes, methods of preparing foods, use of dietary supplements, social settings surrounding eating occasions. This type of information is frequently included along with the other four methods, but it may also be used as the sole data collection method. These approaches are commonly used in rapid assessment procedures. The questionnaires may be either open-ended or structured, self- or interviewer-administered, and may include any number of questions depending on the information required.

Table 2.2. Summary of dietary assessment methods

Type of method	Major strengths	Major limitations
Food record	- does not rely on memory - easy to quantify amounts - open-ended	- high participation burden - requires literacy - may alter intake behavior
24-h dietary recall	- little respondent burden - relies on memory - no literacy requirement	- requires skilled interviewer - does not alter intake behavior - difficulty to estimate amounts
Food frequency questionnaire	- relatively inexpensive - relies on memory - preferable method for nutrients with very high day variability	- requires complex calculations - today to estimate frequencies - requires literacy - does not alter intake behavior - limited flexibility for describing foods
Diet history (meal-based)	- no literacy requirement - relies on memory - does not alter intake behavior	- requires highly trained interviewer - open-ended - difficulty to estimate amounts
Food habit	- rapid and low cost - may relay on memory questionnaires - does not alter intake behavior	- may require a trained interviewer - open-ended

Source: FAO/WHO, 1996

2.1.2. The purpose of nutritional assessment

The purpose of nutritional assessment is to identify people at risk of malnutrition for early intervention or referral before they become malnourished. It is also used to identify malnourished clients for treatment. Malnourished people who are not treated early have longer hospital stays, slower recovery from infection and complications, and higher morbidity and mortality. Nutritional assessment used to detect practices that can increase the

risk of malnutrition and infection and it can identify clients who require nutrition education and counseling, particularly on improving use of local food sources. Therefore nutritional assessment used to establish appropriate nutrition care plans identify individuals or population groups at risk of becoming malnourished, or who are already malnourished and to develop health care programs that meet the community needs which are defined by the assessment. It is also used to measure the effectiveness of the nutritional programs & intervention once initiated (Ismail & Mustaquim, 2013).

2.2. Determinants of nutritional status

2.2.1. Socio-economic factors

Our health and well-being, quality of life and ability to learn, work and play depend on how well we are nourished. Good nutrition or nutritional status is the outcome of many interrelated determinants (Ismail & Mustaquim, 2013). Nutritional problems specially childhood malnutrition is associated with a number of socioeconomic and environmental characteristics such as poverty, parents' education/occupation, access to health care services, income, family size. Low levels of nutrition among children cause serious long and short-term consequences in their physical and mental growth (Macharia *et al.*, 2005).

The children from households with a low or very low socioeconomic status may have the risk of being underweight relative to children who came from households with middle to upper socioeconomic status. Both prevalence and the severity of food insecurity increase as household incomes decrease (Babar *et al.*, 2010).

According to Ministry of Education, school-age children in Ethiopia are affected by a wide range of health- and nutrition-related problems that constrain their ability to thrive and benefit from education. According to a study by the Ethiopian Ministry of Economic

Development and Cooperation, 50% of the Ethiopian population are living below the food poverty line and cannot meet their daily minimum nutritional requirement. As such, children are particularly vulnerable to malnutrition because of low dietary intakes, inequitable distribution of food with in the household, improper food storage and preparation and infectious diseases. The nutritional status of an individual is often the result of many inter-related factors (Asres & Eidelman, 2011).

2.2.2. Parent's or Caregivers' Education

The educational levels of the parents significantly influences the nutritional status of their children which may affect their children's nutritional and health status. Parents' education level even within the same social class is a key determinant of their children's health (Emam *et al.,* 2005; Nabag, 2011). Maternal literacy has a great role on nutritional status of their children which can be explained on basis of a strong linkage between maternal education and attitude towards health care. Literate mothers can influence health of their children by challenging traditional beliefs and attitudes, leading to a greater willingness to accept developmental initiative and utilize modern healthcare systems. A high level of maternal education could lower childhood malnutrition through other pathways such as increased awareness of healthy behavior, sanitation practices and a more equitable sharing of household resources in favour of the children. More educated parents have higher probability of being more efficient in using health resources and thus improve the effectiveness of child health services (Wang *et al.,* 2013).

Father's education is important because he plays more active role in certain health-seeking decisions and household income in our social set up. It is another important determinant and has a positive impact on child health and nutritional status. Usually father is the main earner

and decision maker of a family and so their higher level of education plays an important role to ensure better nutritional status of children (Babar *et al.*, 2010).

2.2.3. Breakfast consumption

Several studies have indicated that omission of breakfast or consumption of an inadequate breakfast is a factor contributing to poor school performance. Even temporary hunger, common in children who are not fed before going to school, can have an adverse effect on learning (Ghosh *et al.*, 2013). Academic performance influences future educational attainment and income, which in turn affect health and quality of life (San Juan, 2006).

Break-fast consumption, in particular consumption of breakfast cereals with milk, has been linked to higher micronutrient intakes (Weichselbaum & Buttriss, 2014). Eating breakfast is associated with more healthful food choices or diet habits in children and adolescents. Breakfast skippers are more likely to have overall diets defined as poor or inadequate. But breakfast consumers tended to make better food choices throughout the day because they had better diet quality (Rampersaud *et al*., 2005).

2.2.4. Dietary diversification

Dietary diversity is one of the most important factors that affect child nutrition & health outcomes (Annim, 2014). All people need a variety of foods to meet requirements for essential nutrients, and the value of a diverse diet has long been known. Individuals consuming more diverse diets are thought to be more likely to meet their nutrient needs. Nutritional status of children is influenced by diet and both under nutrition and over nutrition could be reduced by increasing the diversity of foods available for consumption (Hooshmand & Udipi, 2013).

Dietary diversity indicators are relatively simple to measure and they are thought to reflect nutrient adequacy. Dietary diversity measurements (often called dietary diversity scores) have recently become the preferred method for studying dietary adequacy in developing countries. These scores consider the number of different food items or food groups contributing to the diet in a given time period. They are useful because they are correlated with nutrient intakes as well as various anthropometric measures in children; measurements are simple to collect and easily adapted to diet in various settings. They have been used to study diet in both early childhood and adulthood (Hooshmand & Udipi, 2013).

2.3. School children and their nutritional status

School age is the active growing phase of childhood it is a dynamic period of physical growth as well as of mental development of the child (Begum, 2008; Amare *et al*, 2013). It is a period of rapid growth in human development when nutritional demand is increased and dietary habit is established. It is also the prime time to build up body stores of nutrients in preparation for rapid growth of adolescence. Nutrition plays a vital role, as inadequate nutrition during childhood may lead to malnutrition, growth retardation, reduced work capacity and poor mental and social development (Sridhar *et al.*, 2014). Health problems due to reduced nutritional status in primary school-age children are among the most common causes of low school enrolment, high absenteeism, early dropout and unsatisfactory class room performance (Jarotimi & Ijadunola, 2007).

The nutritional status of children does not only directly reflect the socioeconomic status of the family and social wellbeing of the community, but also the efficiency of the health care system, and the influence of the surrounding environment (Vinod *et al.*, 2011; Singh and Babu, 2013). The best global indicator of children's well being is growth. Poor growth is

attributable to a range of factors closely linked to overall standards of living and the ability of populations to meet their basic needs, such as access to food, housing and healthcare. Assessment of growth is the single measurement that best defines the nutritional and health status of children, and provides a measurement of the quality of life of the entire population (Joshi *et al.*, 2011).

2.4. Nutrition and cognition

Nutrients can affect not only neuroanatomy, but also neurochemistry and neurophysiology. Neurochemical alterations include changes in neurotransmitter synthesis, receptor synthesis, and neurotransmitter reuptake mechanisms. Neurophysiologic changes reflect changes in metabolism and signal propagation. The changes across all this three venues ultimately result in altered neuronal performance at the time that the nutrient status is altered. All nutrients are important for neuronal cell growth and development, but some appear to have greater effects. periods. These include protein, iron, zinc, selenium, iodine, folate, vitaminA, choline, and long-chain polyunsaturated fatty acids (Georgieff, 2007).

2.4.1. Macronutrients

2.4.1.1. Proteins

They are used to make most of the body's tissues, including neurotransmitters, earlier identified as chemical messengers that carry information from brain cells to other brain cells. Proteins are found in foods such as meat, fish, milk, cheese, cereals and legumes. Amino acids are precursor molecules obtained from the blood that are needed for the brain to function normally. The concentration of amino acids let the brain create and use many of its neurotransmitters such as serotonin, acetylcholine, dopamine and nor-epinephrine. Food consumption is vital to the brain being able to make the right amount of amino acids

(Georgieff, 2007). A lack of protein, also known as protein energy malnutrition (Fazili *et al.*, 2012) led to poor school performance by children and caused young children to be lethargic, withdrawn and passive, all of which affect social and emotional development (Ross & Anderson, 2010).

2.4.1.2. Carbohydrates

All digestible carbohydrates are ultimately broken down into monosaccharides, primarily glucose. After absorption from the gastrointestinal tract, glucose is carried in the blood stream to the liver, brain and other tissues. The brain lacks enzymes that are present in the liver for converting amino acids and fats into glucose (D'Anci *et al.,* 2009).

Carbohydrates are commonly found in grains, fruits, and vegetables. They are broken down into glucose which is where the brain gets its energy. Fluctuating levels of carbohydrates may cause dizziness and mental confusion, both of which can affect cognitive performance. Eating a carbohydrate-heavy meal can cause one to feel more calm and relaxed because of a brain chemical called serotonin and its effect on mood. Serotonin is created within the brain through the absorption and conversion of tryptophan. Tryptophan is absorbed within the blood and this absorption is enhanced with carbohydrates (Ross & Anderson, 2010).

2.4.1.3. Essential fatty acids

Essential fatty acids and their derivatives, including docosahexaeonic acid and arachidonic acid neurobiological agents that are part of the structure of brain tissue, including cell membranes and involved in synaptogenesis, and myelination. Low dietary levels of essential fatty acid are potentially problematic given the involvement of this nutrient in mediating several critical brain functions (Smith & Scholey, 2014). Inadequate intake of docosahexaeonic acid and arachidonic acid affects their levels in the brain and the membrane

activity that depends on them (Georgieff, 2007) Omega-3 fatty acids support synaptic plasticity and positively affect the expression of several molecules related to learning and memory that are found on the synapses. Generally inadequate availability of nutrients impairs the neuro-developmental processes (Prado & Dewey, 2014)

2.4.2. Micronutrients

2.4.2.1. B-Vitamins

Micronutrients may influence nerve impulse propagation by affecting the integrity of the myelin sheath of nerves. They are directly or indirectly involved in a number of cognitive processes that are dependent on energy metabolism in brain cells, blood supply to the brain, synthesis of neurotransmitters. Though micronutrients are needed in small amounts, they are absolutely necessary for brain health. Micronutrient malnutrition also called “hidden hunger” is a widespread problem. Some key vitamins are the B-vitamin family, which aid in producing energy for brain cells, and help to manufacture key NTs like serotonin, which gives a sense of well-being, and GABA, which aids in focus and concentration. B-vitamins are found not only in the hull of grains but in leafy green vegetables as well (Georgieff, 2007).

2.4.2.2. Iodine

Iodine is required for the synthesis of thyroid hormones, which are important for myelination of the central nervous system. Iodine is critical for normal development of the brain; therefore, deficiency of this mineral during critical periods of fetal development or childhood can have damaging effects on cognition. The most extreme cognitive effect of developmental iodine deficiency may have serious consequences in children, including retarded mental and physical development, impaired intellectual function and diminished school performance (Monárrez-Espino *et al.*, 2004).

2.4.2.3. Iron

Iron is an essential component of hundreds of proteins and enzymes involved in various aspects of cellular metabolism. The mineral is needed for proper development of oligodendrocytes (myelin-producing cells of the brain) and for several enzymes that synthesize neurotransmitters. Accordingly, iron deficiency during various stages of brain development has negative consequences. Maternal iron deficiency during pregnancy has serious consequences for the woman and the fetus's myelination process, including permanent learning and memory deficits in the offspring. Iron deficiency during childhood may be associated with impaired cognitive development (Georgieff, 2007).

2.4.2.4. Zinc

Zinc is essential to learning: it is used in the growth of dendrites, cell repair and pruning. It aids in synaptic adhesion, the process of "cementing" a new connection between neurons. In addition, zinc is essential in the formation of memory, and is found abundantly in the hippocampus, the area of the brain responsible for processing short-term and long-term memory. Zinc is found in seeds and nuts, as well as red meat. In the brain, most of the zinc ion is tightly bound to proteins, but free zinc is present in synaptic vesicles and has a role in neurotransmission mediated by glutamate and gamma amino butyric acid (GABA) (Georgieff, 2007). The risk of zinc deficiency is particularly high in populations depending on diets with low levels of absorbable zinc and with no or only limited access to sources rich in bioavailable zinc such as meat. Zinc deficiency impairs mental and neurologic function and cause neuropsychological and neurobehavioral abnormalities (Fesharakinia *et al.*, 2009).

Table 2.3. Daily Energy requirements of children 7–14 years old

Age (years)	Energy requirements (Kcal/day)	
	Girls	**Boys**
7–8	1,554	1,692
8–9	1,698	1,830
9–10	1,854	1,978
10–11	2,006	2,150
11–12	2,149	2,341
12–13	2,276	2,548
13–14	2,379	2,770

Source: FAO, WHO, and UNU. 2004.

2.5. Malnutrition and its consequences

The world health organization (WHO) defines malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance and specific functions". Malnutrition is commonly used as an alternative to undernutrition or overnutrition. People are malnourished if their diet does not provide adequate nutrients for growth and maintenance or they are unable to fully utilize the food they eat (undernutrition). They are also malnourished if they consume too many calories (overnutrition). Under nutrition is the outcome of insufficient food intake, inadequate care and infectious diseases. It includes underweight, stunting, wasting and micronutrient deficiencies (Ismail & Suffla, 2013). Under nutrition among school age children is a major public health problem globally, particularly in Africa (Lee & Wan, 2014). The consequences of malnutrition are severe and can have affects into adulthood. Children are at high nutritional risk of being malnourished because of their physiological demands at this age (Intiful *et al*, 2013). Under nutrition is the most serious children health problem and the main cause of children mortality (Roy *et al.*, 2007; Arimi, 2013).

A child suffering from malnutrition will undergo more frequent, long lasting, and severe illness than a child receiving proper nutrition. Without proper nutrition during a child's development, he or she can experience delayed motor skills, lower enrollment in school, lower cognition and school performance and harmful effects on intelligence. Malnutrition can lead to mineral and vitamin deficiencies that impair growth of children, resulting in stunting (indicative of chronic malnutrition), wasting (indicative of acute malnutrition) and protein-energy malnutrition (Abi *et al.*, 2011). An adult, who suffered from malnutrition as a child, will have reproductive difficulties, diminished work performance and potentially unhealthy offspring (Alderman *et al.*, 2004).

Globally, malnutrition among school age children is becoming a major public health concern. Despite the economic growth observed in developing countries, malnutrition and particularly under nutrition is still highly prevalent (El-Sabely *et al.*, 2013). In addition to the physical and cognitive consequences, malnutrition can have devastating effects on the economy (Frye, 2013; Lwanga *et al.*, 2012). According to the World Bank, malnutrition affects the economy of a country in three ways: directly through a loss of productivity, indirectly through a loss of cognitive function, and losses caused by a build up health care costs. The loss of productivity can cost an individual suffering from malnutrition 10% of his or her lifetime earnings, which can translate into a 2-3% loss in GDP. On the other hand, decreasing the prevalence of malnutrition can have the reverse effect; a 1% decrease in stunting can increase wages by approximately 1.4%.

Malnutrition leads to alterations in both the structure and function of neurons and neurotransmitters that persist beyond improvements in nutritional status (Sokolovic *et al.*, 2013). Poor nutrition and health among children have been identified to contribute to the

general inefficiency of educational systems. This shows that what we eat directly influences the brain and hence one's cognitive functioning (Emmanuel *et al.*, 2013).

Table 2.4. Cut-off values for public health significance

Indicator	Prevalence cut-off values for public health significance
Wasting	< 5%: Acceptable 5-9%: Poor 10-14%: Serious = 15%: Critical
Stunting	< 20%: Low prevalence 20-29%: Medium prevalence 30-39%: High prevalence = 40%: Very high prevalence
Underweight	< 10%: Low prevalence 10-19%: Medium prevalence 20-29%: High prevalence = 30%: Very high prevalence

Source: WHO, 1995.

Ethiopia remains one of the poorest countries in the world economically and malnutrition is one of the major and most pressing health problems; especially among children (Edris, 2007). According to World Food Program, Ethiopia is amongst the countries in the world with the highest rate of school age children with special needs mainly attributed to impairments from malnutrition.

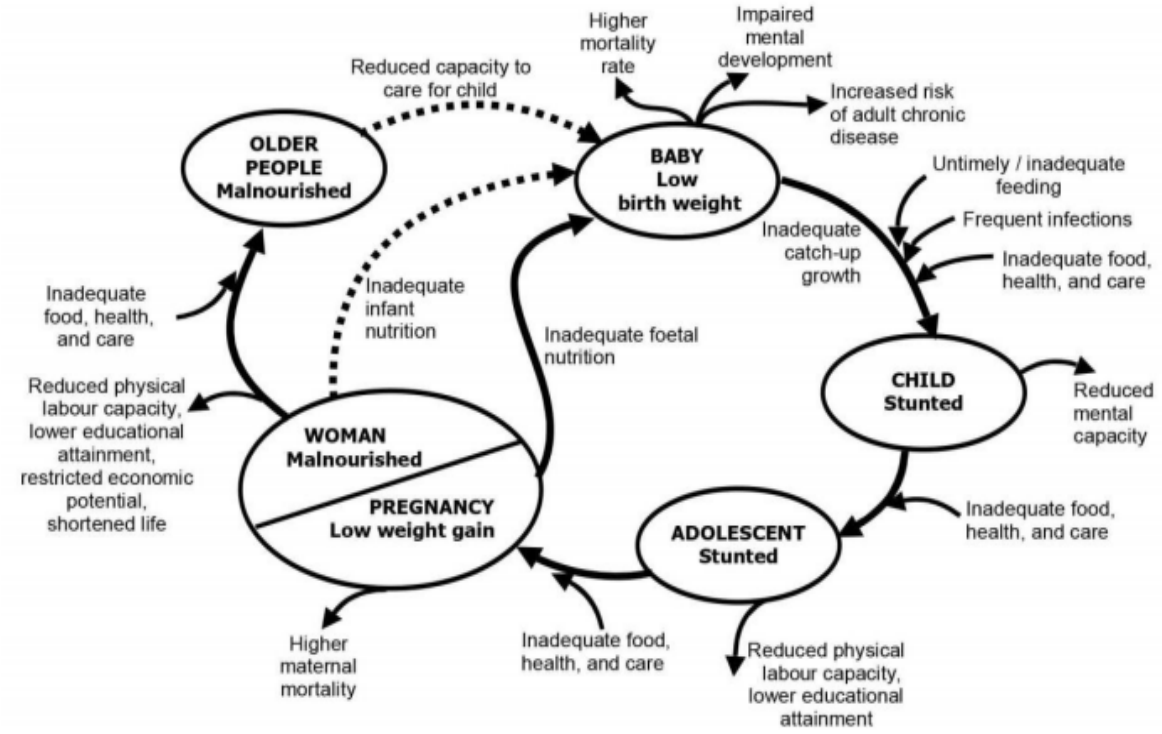

Figure 2.1. Life cycle of malnutrition

2.6. Nutrition and health interventions

To break the cycle of malnutrition there are various ways to address macro and micronutrient deficiencies. Proper diet and nutrition program is required to protect health and fitness in children. Interventions can be prevention or treatment based. Improved nutrition, sanitation and hygiene practices for the household are preventive interventions. Treatment of severe acute malnutrition with ready to use therapeutic foods, treatment of moderate acute malnutrition with improved, fortified foods and deworming for children are treatment based interventions. School meals are one form of supplemental feeding that have the potential to play an important role in addressing both education and hunger relief (Buhl, 2010; Del Rosso, 1999).

Several initiatives such as Growth monitoring, vitamin A distribution can be taken to reduce the impact of nutritional deficiency and promotion of health of children (Acharya *et al.*,

2013). Focusing on improving the nutritional well being of school-age children has the potential to reduce the severity of stunting, increase weight, and support cognitive function and possibly prevent the severe consequences of malnutrition. Interventions aimed at school children are being vital to improving the health and nutrition status of the population as a whole (Rampersaud *et al.*, 2005). According to the United Nations World Food Program, one out of four children in developing countries are currently underweight; this presents an urgent need and a real challenge for countries everywhere to invest additional resources in to creating and sustaining nutritious school feeding programs.

2.6.1. School feeding program

Healthy dietary habits are important for promoting optimal health, growth and cognitive development in children (Sabinsky *et al.*, 2013). School feeding programs are one of several interventions that can address some of the nutrition and health problems of school age children. It plays a role in student behavior, cognition and academic performance. A School feeding program is essential to provide a balanced diet to children which would in turn enable the children to increase their attention span hence better academic achievement. Nutritional and health status are powerful influences on a child's learning and on how well a child performs in school. Children who lack certain nutrients in their diet particularly iron, zinc and iodine or who suffer from protein-energy malnutrition do not have the same potential for learning as healthy and well-nourished children. Children who are hungry have more difficulty concentrating and performing complex tasks, even if otherwise well nourished (Del Rosso, 1999).

School feeding is a provision of food to school children. There are many types of school feeding programs and they can be classified into two main groups: in-school feeding, where

children are fed in school; and take-home rations, where families are given food if their children attend school. School meals can be prepared in schools or in the community, or can be delivered from centralized kitchens. They can be an important source of micronutrients if prepared using fortified commodities, or if micronutrient powder is added during or after preparation (Buhl, 2010). According to WFP school feeding is helping to eliminate hunger for millions of children around the globe and is contributing to their education, nutrition, health and future productivity as adults. School feeding facilitates education, food security, health and nutrition, the effects of which all contribute to ending hunger. School feeding in general terms represents a more varied and comprehensive set of uses of food for the achievement of educational outcomes. It impacts positively on school attendance and attentiveness in class which enhanced participation in the teaching and learning process leading to improvement in their academic performance (Abotsi, 2013).

School feeding programs and other school-based nutrition and health programs can motivate parents to enroll their children in school and to see that they attend regularly, programs effectively reduce absenteeism and drop outs. Alleviating this hunger in school children helps them to perform better in school (Chepkwony *et al.*, 2013).

Figure 2.2. School feeding program in some of the study sites

2.6.2. Food fortification

Micronutrient fortification of widely consumed basic foods is a public health approach that has been widely used and continues to evolve. Fortification of foods can be conceptualized as centrally with micronutrients added in commercial or other central processing, prior to distribution or marketing, or peripherally involving the addition of micronutrient substances to foods at the household or other consumption level (Harrison, 2010).

The process of fortification involves the addition of small quantities of vitamins and minerals to foods and condiments that are regularly consumed by a significant proportion of the population. Simply adding micronutrients such as iron, iodine, and vitamin A to commonly eaten foods such as salt, flours, or oils can effectively reduce micronutrient deficiencies. Micronutrient deficiency is common among school children in poor communities. Unlike stunting and other consequences of long-term malnutrition, micronutrient deficiencies can be rapidly reversed, by giving support for the incorporation of fortified foods into school feeding programs (Buhl, 2010).

2.6.3. Supplementation

Direct supplementation of vulnerable populations with micronutrients, usually through a primary healthcare system or healthcare delivery system such as an immunization program, has been shown to be effective and very cost-effective for young children. A direct supplementation approach through a healthcare delivery system has the advantage of directly reaching portions of the population most at risk while not putting other segments of the population at risk of overconsumption or adverse interactions (Harrison, 2010).

The long-term disadvantages, however, are obvious and relate primarily to sustainability, coverage and compliance. Supplementation depends upon a feasible delivery system with

built in quality control, as well as upon wide coverage and high take-up rates among vulnerable individuals and families. Supplementation only works if the supplements are available and accessible and the intended individuals actually take them. Recently, much attention has been devoted to using multiple micronutrient supplementations, rather than the traditional iron and folic acid only (Harrison, 2010).

2.6.4. Nutrition and health education

To change the nutritional status of population, it is critical to change the behavior of caregivers, families, and communities (Sanghvi & Murray, 1997). Although food shortage may be a leading cause of malnutrition, nutrition education intervention programs have also proved to be equally important in addressing malnutrition. Despite the importance of nutrition education interventions in addressing malnutrition, these interventions have not been given much emphasis (David *et al.*, 2012). The purpose of nutrition and health education is to inform and motivate individuals to actively care for their own health. It enables the individual to gain knowledge from different points of view and behavioral patterns for a healthy lifestyle (Donev *et al*., 2007).

Nutrition education can have a significant effect in promoting healthy eating habits, and schools can contribute to reduce nutrition-related problems by integrating nutrition interventions into a comprehensive school health program. Nutrition education target groups can be parents, teachers, children and family as a whole, and it should focus on communication for behavioral change (Srivastava, 2012).

The chances of success are good only when there are no other serious constraining factors in terms of access to foods, when the target audience is motivated and when the educational intervention is well designed and delivered. The major advantage to education and behavior

change is sustainability. Any changes in knowledge and practices will be within the economic and social capabilities of the target audience and transmissible to the next generation. This makes it possible to address multiple nutrient deficiencies (Harrison, 2010).

Chapter Three
Materials and Methods

3. MATERIALS AND METHODS

3.1. Study area

The study is conducted in randomly selected governmental primary schools in Addis Ababa. The study was conducted from September 2014 to March 2015. A total of 280 children were recruited to the study among which 140 belong to the feeding program and the rest 140 were not involved in the program and 47.9% were male students and 52.1% were female students. The study was conducted in randomly selected 10 primary schools of Addis Ababa of which Arada, Kolfekeranio, Addisketema, lideta and gulele sub cities were the areas addressed.

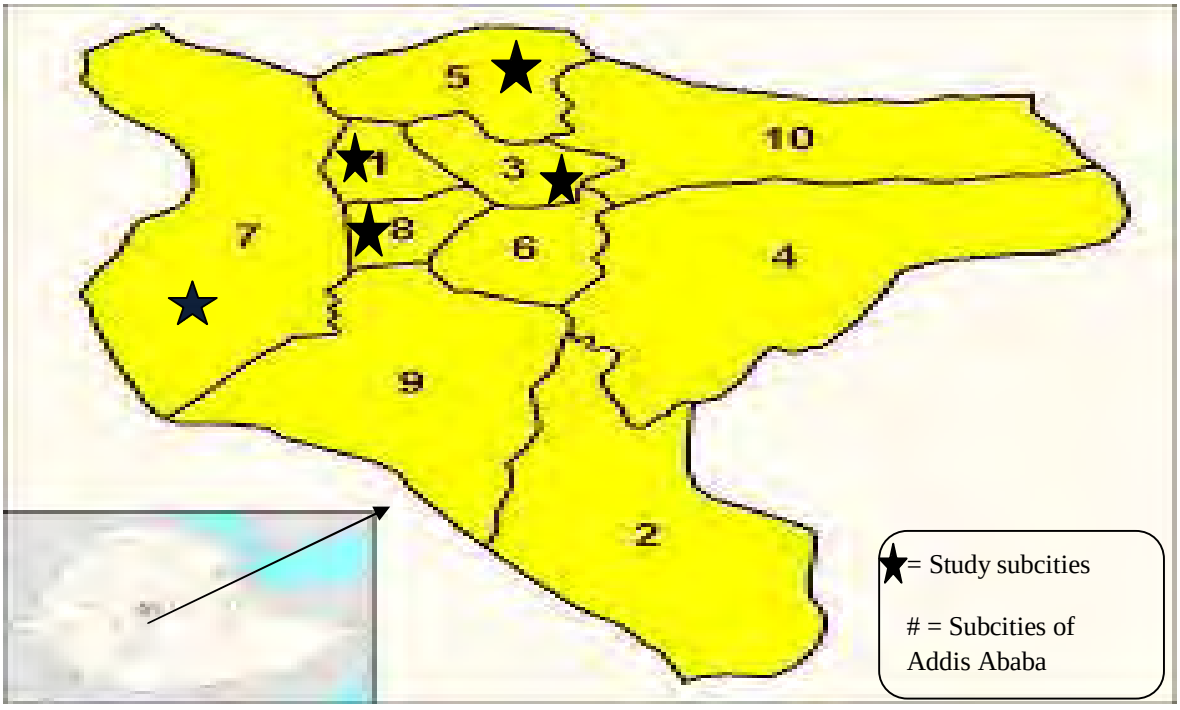

Figure 3.1. Geographical presentation of Addis Ababa

3.2. Study population

According to the Ethiopian education and training policy, primary education is a level of education that ranges from grade 1 through grade 8. This level of education is divided in to first cycle (grades 1-4) and second cycle (grades 5-8) education. Normally, the age of students in grades 1-8 has to be in the range of 7-14. Therefore the study subjects were school aged children of 7 to 14 years old (Education Statistics Annual Abstract, 2003). Age of the children was determined using the school records.

Inclusion criteria: Children of age group of 7-14 years.

Exclusion criteria: Children those who were out of the age group and who were ill.

3.3. Study design and sampling

A descriptive comparative cross sectional institution based survey with multistage random sampling was applied. According to the study by Zerfu and Masresha (2006) malnutrition among school children was found to be 24% and therefore, the sample size of this study was determined based on this prevalence and a single population proportion formula, $n = [(Z \alpha/2)2\ p\ (1-p)]/ME^2$, was used to estimate the sample size, ($p = 0.24$), at 95% confidence level (z-value =1.96) and margin of error (ME) = 0.05. Using the formula:

$$n= (1.96)^2 x 0.24 x 0.76/(0.05)^2$$

n = 280. This was distributed proportionally to the size of school children involved in the feeding program of each school. There were a total of 1250 students involved in the feeding program the data were collected according to the number of the students involved in the school feeding in each school. The total number of the sample that is, 280 were divided by 1250 and then multiplied by number of children who are in the school feeding program for

each school and dividing the value in to two gave number of samples in each group of the schools.

3.4. Ethical consideration

Ethical approval was obtained from Addis Ababa University Ethical Board in its meeting held on 01/08/2014. And consent was obtained from administrators of the selected schools prior to starting the data collection and oral consent was obtained from the caregivers.

3.5. Data collection

The data was collected from ten primary schools, the schools were coded by their two convenient letters, AF, DM, EB, EF, GS, JK, KM, LS, TK and WE. For each group 11 students were taken from AF, DM, EB, LS and TK, 10 students were taken from EF, 54 from GS, 7 from JK, 5 from KM and 9 from WE. The study used direct method of nutritional assessment among which anthropometric method and dietary evaluation methods (24 hour dietary recall) were used. Food composition analysis was also done for the school meal given to the children.

3.5.1. Anthropometric measurements

3.5.1.1. Height; It was measured by prestige height scale model AIWA, made in India. The subject stand erect & bare footed on the scale with a movable head piece & height was recorded to the nearest 0.5cm.

3.5.1.2. Weight; It was measured by Seca weighting scale (Model 8811021659, made in Germany). Weighing balance is calibrated in kilogram & students were weighted in to the nearest 0.1kg in light clothes and no shoes.

Figure 3.2. Anthropometric data collection

3.5.2. Dietary diversity by 24 hour dietary recall

Semi structured questioner was applied to determine dietary diversity status of the children. Number of food-groups consumed preceding 24 hours to the survey was assessed. The foods consumed in the preceding 24-hour recall was grouped in 8 food-groups, that is:

1. Grains, roots or tubers
2. Vitamin A-rich plant foods
3. Other fruits or vegetables
4. Meat, poultry, fish, seafood
5. Eggs
6. Pulses/legumes/nuts
7. Milk and milk products and
8. Foods cooked in oil/fat (FANTA, 2006). Based on the total number of food-groups dietary diversity was measured qualitatively. And the number of food groups consumed were shown to be a potential proxy indicator of adequacy of nutrients, attached in the annex. The semi

structured questioner also contains socio-demographic characteristics, educational status of the care givers, school performance/attendance status, socioeconomic status and family size.

3.5.3. Proximate analysis of the school meals

A proximate analysis was done for the determination of the nutrient composition of the food given to the children who were involved in the feeding program. From the schools, meals consumed were collected and their food composition was determined.

3.5.3.1. Moisture

Moisture content of the samples was determined according to AOAC (2000) official method 925.09. A crucible dish was cleaned and placed in an oven at 105^{o}C for 1 hour for drying and was placed in desiccators to cool down at least for 30 minutes. The crucible dish weight (W1) was measured after cooling. 5g of sample was measured on the crucible dish (W2) and dried at 105^{o}C for 3 hrs. After cooling in desiccators to room temperature the weight was measured (W3). The moisture content was determined using the equation,

$$\text{Moisture content in percent (\%)} = \frac{(W2-W3) * 100}{(W2-W1)}$$

Table 3.1. Weekly menu of the school feeding program

School ID	Weekly Menu					
	Monday	Tuesday	Wednesday	Thursday	Friday	Weight
AF	mixture of milk and bread	mixture of milk and bread	mixture of milk and bread	mixture of milk and bread	mixture of milk and bread	357.6g
DM	Prepared rice and bread	Prepared rice and bread	Prepared rice and bread	Prepared rice and bread	Prepared rice and bread	274.1g
EB	prepared Rice	Enjera & lentils sauce	prepared Rice	Enjera & lentils sauce	prepared Rice	517gm
EF	Enjera, soya and vegetable sauce	prepared Macaroni	Enjera, soya and vegetable sauce	prepared Macaroni	Enjera, soya and vegetable sauce	529.6gm
GS	milk, Banana and bread	milk, Banana and bread	milk, Banana and bread	milk, Banana and bread	milk, Banana and bread	428.5gm
JK	Prepared Rice	Prepared Rice	Prepared Rice	Prepared Rice	Prepared Rice	211.2g
KM	Enjera and lentils sauce	Enjera and legume based sauce	Enjera and lentils sauce	Enjera and legume based sauce	Enjera and lentils sauce	438.6g
LS	prepared Rice with vegetable	prepared Rice with vegetable	prepared Rice with vegetable	prepared Rice with vegetable	prepared Rice with vegetable	247.3g
TK	Enjera and potato sauce, lentils sauce	Prepared Macaroni	Enjera and potato sauce, lentils sauce	Prepared Macaroni	Enjera and potato sauce, lentils sauce	446.4g
WE	Bread and prepared Cabbage	Rice and bread	Bread and prepared Cabbage	Rice and bread	Bread & prepared Cabbage	442.8g

3.5.3.2. Determination of crude Protein

Protein content was determined according to AOAC (2000) using the official method 979.09. First 0.5g of the sample was weighted in a tecator tube and placed on a tecator rack. 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, resulting violent reaction. When the reaction stops, the tube was shacked for few times by hand. A catalyst mixture was added (mixture of grinded 0.5g of selenium metal with 100 g of potassium sulfate) and was kept for 5-15mins.

Digestion

The digester temperature was set at 370^{o}c where the rack containing the tubes was lowered in to it. Digestion continued until a clear solution is obtained. The solution was transferred in to the fume hood for cooling. 50 ml of distilled water was added and shaken to avoid precipitation of sulphate in the solution.

Distillation and titration

In to the digested and diluted solution 25 ml of the 40 % sodium hydroxide solution was added. A 250 ml conical flask having 25 ml of boric acid, 25 ml distilled water and indicator solution was placed under the condenser of the distiller with its tip immersed in the solution. Distillation continued until a total volume become between 200ml and 250ml. The tip was rinsed with few ml of water before the receiver is removed. Titration was done with 0.1N Hydrochloric acids to a reddish color. Finally the percentage of nitrogen and protein was determined as:

$$\text{Nitrogen (\%)} = \frac{V_{HCL} \text{ in L} * N_{HCL} \text{ (ca.0.1)} * 14.00 * 100}{W_o}$$

$$\text{Protein (\%)} = 6.25 * \text{\% Nitrogen}$$

Where: V is the volume of HCL in L consumed to the end point of titration

N is the normality of HCL (used often is 0.1N)

Wo is sample weight on dry matter basis

14.00 is the molecular weight nitrogen.

The % of nitrogen is converted to % of protein by using appropriate conversion factor i.e (% protein = 6.25*%N).

3.5.3.3. Determination of crude fat

The crude fat was extracted according to AOAC (2000) official method 4.5.01.The extraction cylinder was cleaned and dried in an oven at 105^0 C for one hour. The extraction cylinder was dried in a desiccators and weighed (W_1). The bottom of extraction tube was covered by a layer of defatted cotton. Approximately 2g of sample (W) was measured and covered with defatted cotton. The thimble was placed in the extraction chamber. 50 ml of diethyl ether was added by using measuring cylinder and move in to the heating plank. The extraction continued for four hours at 55^0C. At 30 minute interval the extractor was checked to know whether the solvent is evaporated or not. After the extraction, the cylinder was placed in drying oven at 70^0C for 30 minute to remove the solvent and be cooled in desiccators for 30 minute. The extraction cylinder and the fat were weighed immediately after taken from the desiccators (W_2). The crude fat was determined using the equation:

$$\text{Crude fat, percent by weight} = \frac{W2-W1}{W} * 100$$

Where: W1= weight of the extraction flask (g)

W2 = weight of the extraction flask plus the dried crude fat (g)

W = weight of sample (g)

3.5.3.4. Determination of ash content

The ash content was determined by AOAC (2000) using official method 923.03.The porcelain crucible dish was cleaned and dried in a muffle furnace for 30 minutes at 550^{o}C. The dishes was cooled in desiccators (with granular silica gel) for about 30 minutes at room temperature and weighed to the nearest milligram (M1). 2.5g of sample was weighed and placed in the dish (M2).The sample was charred on hot plate under a fume-hood with increasing the temperature slowly until the smoke ceases. The sample was converted into ash in muffle furnace at 550^{o}C for 5 hours until a whitish ash is obtained. When cooled to room temperature, each dish with ash was reweighed to the nearest milligram (M3). The total ash is calculated as:

$$\text{Total Ash (\%)} = \frac{M_3 - M_1}{M2 - M1} * 100$$

Where:

(M2-M1) is sample mass in gram on dry base and

(M3-M1) mass of ash in gram.

3.5.3.5 Determination of crude fiber

Determination of crude fiber was determined by the AOAC official method 960.52

Digestion

A 1 g of sample (W3) was measured and placed into a 660 ml beaker where 200 ml of 1.25% sulfuric acid was added, boiled gently for 30 minutes putting watch glass on top of the beaker. Hot distilled water was applied to top up to keep constant the level of the solution. 20 ml of 28% KOH was measured and be added and boiled gently for another 30 minutes, with stirring.

Filtration

The bottom of a sintered glass crucible was covered with 10mm sand layer and wetted with distilled water. The heated solution was poured on the crucible and filtered using high performance vacuum pump. The wall of the beaker was rinsed with hot distilled water several times where it was transferred to the crucible and filtered.

Washing

The residue on the crucible was washed with 1% sulfuric acid and filtered, and again by hot distilled water and filtered. Washing will continue and this time by 1% NaOH and filtered. The washing step was repeated again and finally the residue was washed with water free acetone.

Drying and combustion

Drying was done by placing the crucible in a drying oven for 2 hours at 130^{o}C and cooled for 30 min in desiccators, and then weighed (W1). The crucible was cooled in desiccators and weighed (W2).

$$\text{Crude fiber g/100g} = \frac{W1-W2}{W3} * 100$$

Where:

W1= weight of crucible with sample after drying

W2= weight of crucible with sample after ashing

W3= fresh sample weight.

3.5.3.6. Carbohydrate

Carbohydrate content was determined by difference with the equation:-

%C = 100-[%M + %P + %F + %Fb + %A]

Where: C is Carbohydrate content,

M is Moisture content,

P is Protein content,

F is Fat content

Fb is Fiber content, and

A is Ash content.

3.5.3.7. Determination of mineral contents, iron and zinc

Mineral content was determined by using atomic absorption spectrophotometer method utilized by Osborne and Voogt (1978). The ash was wetted completely with 5ml of 6N HCl, and dried on a low temperature hot plate. 15ml of 3NHCl was added to dried ash and heated on the hot plate until the solution boiled. The ash solution cooled to room temperature in a hood and was filtered into a 100ml graduated flask using filter paper.10ml of 3N HCl was added into each crucible dishes and was heated until a solution boiled then cooled and was filtered into the flask. The crucible dishes are again washed three times with deionized water, the washing was filtered into a flask .Then the solution was cooled and diluted 100 ml with de-ionized water. Finally the solution sent to Ethiopian public health institute (EPHI) for AAS reading of Iron and zinc.

Figure 3.3. School meal nutrient composition analysis

3.5.3.8. Determination of energy

Energy in terms of Kcal per 100g of food is determined as;

Kcal per 100g of food = 4 x available carbohydrates + 4 x protein + 9 x total fat

3.6. Statistical analysis

The World Health Organization's (WHO) Anthro plus software which is for the global application of the WHO reference 2007 for 5-19 years to monitor the growth of school age children was used to assess the nutritional status of the children. Nutritional status of all the selected children was assessed by measuring body height (cm) and weight (kg) which is compared with the WHO Growth Reference (WHO, 2007). Three indicators were measured by this software: weight for age, height for age and body mass index for age. The indicators were calculated by Z-score for all children. Weight for age (WAZ), height for age (HAZ) and body mass index for age (BAZ) less than -3SD shows severe underweight, severe stunting and severe wasting. WAZ, HAZ and BAZ between -3SD to -2SD is classified as moderately underweight, moderately stunted and moderately wasted. Children with WAZ, HAZ and BAZ between -2SD to +1SD were classified as normal weight, normal height and normal body mass index. WAZ, HAZ and BAZ more than +1SD were indicative of overweight for WAZ and BAZ, tall stature for HAZ. BAZ more than +2SD is indicative of obesity.

The dietary diversity was compared with FANTA individual dietary diversity score reference. Data was analyzed using SPSS version 20. An independent sample t- test was used to compare means of the feeding and non feeding group, and statistical significance was assigned for p values less than 0.05. For the proximate analysis descriptive statistic were used and the results were presented in mean and standard deviation.

Chapter Four
Result and Discussion

4. RESULTS AND DISCUSSION

4.1. Socio-demographic characteristics

Most of the socio demographic characteristics of the children between the groups were not significantly different. From the sample population 63.2 % were orthodox Christians, 27.1% were Islam and 9.6% were protestant Christians.

Table 4.1. Socio-demographic characteristics

Variables	Students category			
	Feeding (n=140)		Non-Feeding (n=140)	
	Number	Percent	Number	Percent
Sex				
Female	69	49.3	77	55
Male	71	50.7	63	45
Religion				
Orthodox	93	66.4	84	60
Muslim	35	25	41	29.3
Protestant	12	8.6	15	10.7
Occupation of caregivers				
Civil Servant	51	36.4	62	44.3
Private Employed	44	31.4	43	30.7
Other	45	32.1	35	25
Socioeconomic status				
Have Radio Only	25	17.9	12	8.6
Have TV Only	26	18.6	30	21.4
Have Radio &TV	59	42.1	89	63.6
Have no Radio & TV	30	21.4	9	6.4

Caregiver type				
Mother	57	40.7	39	27.9
Father	14	10.0	18	12.9
Mother & Father	39	27.9	57	40.7
Sister	5	3.6	9	6.4
Grandmother	8	5.7	1	.7
Aunt	14	10.0	13	9.3
Uncle	3	2.1	3	2.1
Education status of caregivers				
Illiterate	59	42.1	46	32.9
Primary	48	34.3	39	27.9
Secondary	20	14.3	28	20
Tertiary	6	4.3	14	10
Mother primary Father secondary	6	4.3	6	4.3
Mother secondary Father primary	0	0	1	0.7
Mother Illiterate Father Primary	1	0.7	5	3.6
Mother Primary Father Illiterate	0	0	1	0.7
School attendance/ performance				
Do not repeat or drop out	115	82.1	109	77.9
Drop out class	11	7.9	12	8.6
Repeat class	13	9.3	19	13.6
Drop out and repeat class	1	0.7	0	0

Majority of the children who are out of the school feeding program had a family size of greater than five but most of the children in the feeding program had a family size less than five this can be an indicator that family size might not always has a negative effect on nutritional status of the children.

Most of the students of the non feeding category were living with their mother and father. But most of the children in the feeding program were living with their mothers only which

can be a major factor for poor nutrition status of the children because mothers are not capable of fulfilling the basic need of their children as most of their occupation rate fall in the category of 'other'. As 'other' described in the occupation part included caregivers with very low income, pensioners, who are supported by their relatives and also beggars.

Studies pointed to social and environmental factors can be associated with poor nutrition status in children, such as poverty, mother's literacy level, single parent households (Arthur, 2005). Women's employment increases household income, with consequent benefit to household nutrition in general. Employment may increase women's status and power, and may strengthen a woman's preference to spend her earnings on health and nutrition. Women who receive even a minimal education are generally more aware than those who have no education of how to utilize available resources for the improvement of their own nutritional status and that of their families. Education may enable women to make independent decisions, to be accepted by other household members, and to have greater access to household resources that are important to nutritional status (Girma & Genebo, 2002). The school performance/attendance level in this study was measured by number of school children who repeated classes and or who had dropped out of classes.

From table 4.1, the school performance/ attendance level of children in the feeding program was better than those who are not in the program even though the difference is not statistically significant. As indicated in the study done in Kenya by Chepkwony (2013) and Abotsi (2013) school performance, attendance and enrolment level was higher in the children who were in the feeding program than who were not. This can show that the feeding program helped the children not to be absent in the class which can maximize enrollment of even new children to schools because poor parents/caregivers find the feeding program useful to ensure

that their children attend and remain in school every day till the end of academic year because they cannot provide sufficient food for their children in school every day throughout the term.

4.2. Nutritional status of all the school age children

From the total study population, 6.4% were wasted (2.1% severely and 4.3 % moderately wasted). Prevalence of underweight was 8.1% were found to be moderately. Stunting was 20% (3.2% severely, 16.8% moderately stunted and 0.7 % tall stature). According to WHO 2007, in older children, that is, 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.

Table 4.2. Anthropometric measurement of the study sample

Degree of malnutrition	Types of malnutrition											
	Wasting (P=0.494)				Stunting (P=0.123)				Underweight (P=0.441)			
	Feeding -0.861±0.872		Non Feeding -1.007±0.956		Feeding -1.20±1.040		Non Feeding -1.026±1.068		Feeding -0.662±0.877		Non Feeding -0.617±0.947	
	N	%	N	%	N	%	N	%	N	%	N	%
Sever	3	2.1	3	2.1	6	4.3	3	2.1	-	-	-	-
Moderate	7	5.0	11	7.9	27	19.3	20	14.4	2	5	4	10.5
Normal	127	90.7	122	87.1	105	75	112	80.6	36	90	34	89.5
Over nutrition	3	2.1	4	2.9	2	1.4	4	2.9	2	5	-	-
Total	140	100	140	100	140	100	140	100	40	100	38	100

Statistically significance difference between the groups (if, $P<0.05$)

4.2.1. Nutritional status for the feeding group

When the data was analyzed independently for the two groups nutritional status, prevalence of wasting among the feeding group was found to be 7.1% (2.1% sever thinness and 5% were moderately) 2.1% were overweight and they had a low prevalence of wasting than those who were not in the feeding program. This result might show the contribution of the feeding program as intervention to reduce prevalence of acute malnutrition.

The prevalence of underweight from table 4.2, was 5% moderately and 5% were overweight for the feeding group. The prevalence of stunting for the feeding group was found to be 23.6% (4.3% severely and 19.3% moderately) among the group 1.4% were tall stature. The prevalence of stunting of this study were less than the prevalence of stunting (25.2%) found from previous study by Amare *et al*. (2013) in Gondar.

4.2.2. Nutritional status for the non feeding group

The prevalence of wasting for children who were not involved in the non feeding was 10% (2.1% severely and 7.9% moderately) which is greater than the prevalence of wasting (8.9%) found in Gondar town school children by Amare *et al*. (2013) and 2.9% were overweight. The prevalence of underweight was found to be 10.5% moderately for the non feeding group which was less than the prevalence of underweight (15.1%) found in school children of Gondar town by Amare *et al*. (2013). The prevalence of stunting for the non feeding was 16.5% (2.1% severely and 14.4% moderately) and 2.9% were tall stature. The prevalence of wasting and underweight from table 4.2,were lower in the feeding group but the prevalence of stunting among the group was higher than the prevalence of stunting in the non feeding group but the difference was not significant.

Prevalence of malnutrition of this study as a whole found to be less than the prevalence of malnutrition found in the school children of Fogera district, northwest Ethiopia done by Mekonnen *et al*, (2013) which can be an indicator that the prevalence of malnutrition among rural areas are higher than in urban areas even though the problem in both cases has its own public health significance.

Among the socio-economic variables included in the study only educational status of the parents/caregivers was significantly associated with malnutrition. It was observed that the level of illiteracy among parents/caregivers of school children involved in the feeding program was higher compared to those who are not in the program. The educational levels of the parents/caregivers significantly influenced the nutritional status of the children which can be correlated with prevalence of stunting as it is supported by Babar *et al*. (2010) and Kumari (2007) where maternal and paternal illiteracy significantly contributed for malnutrition.

4.3. Nutrient composition of the school meal

Nutrition plays a key role in the control of linear growth through a variety of mechanisms. Energy and protein restriction reduces insulin like growth factor-1(IGF-I) plasma concentration, which is an anabolic hormone that plays an active role in the maintenance of muscle mass and strength. It has been shown as a sensitive marker of nutritional status. The association between nutritional status and the IGF-I system has been observed in humans: IGF-I is reduced during protein-energy malnutrition. IGF-1 modulates growth hormone (GH) secretion and GH/IGF-1 signaling is essential for normal growth in children (Maggio *et al.*, 2013).

Table 4.3. Nutrient composition of the school meal (Mean ±SD)

Macronutrients especially protein are essential component for school children because they are on growth and they need it for their development. In the study, majority of the school meals in table 4.3, found to contain protein more than 10% energy contribution which is adequate in terms of fulfilling the requirement. Majority of the analyzed school meals have shown to contain inadequate level of fat. Majority of the school meals contain less amount of carbohydrate which is below the adequacy level indicated by Yasmin *et al*. (2014).

The brain is dependent on circulating blood glucose since glucose is the brain's primary fuel. Carbohydrate consumption appears to improve cognitive and physical performance. Therefore, taking inadequate amount of this nutrient may cause the children to be weak in concentration and it will influence their mood and have its own impact on the learning teaching process (D'Anci *et al.*, 2009).

Several minerals, including zinc, appear to be important determinants of IGF-1 bioactivity. Zinc deficiency causes not only growth retardation but also a decrease in both IGF-I plasma concentration and GH receptors. Additionally, through its influence on the GH/IGF-I system, zinc deficiency has been observed to affect bone metabolism (Rivera *et al*, 2003). From the school meals the meal from DM, TK and WE school meals found to contain adequate amount of carbohydrate.

Deficiencies of some micronutrients, such as iron and zinc, result in anorexia. Therefore, these nutrient deficiencies also may contribute to growth retardation indirectly by reducing the intake of other growth-limiting factors, such as energy and protein. Mild to moderate zinc deficiency and sever iron deficiency may affect growth. Deficiency of these micronutrients are associated with immune function and risk of morbidity, which in turn affect growth.

Therefore, micronutrient deficiencies may have an indirect effect on growth by increasing the prevalence or severity of morbidity and anorexia (Rivera *et al.*, 2003).

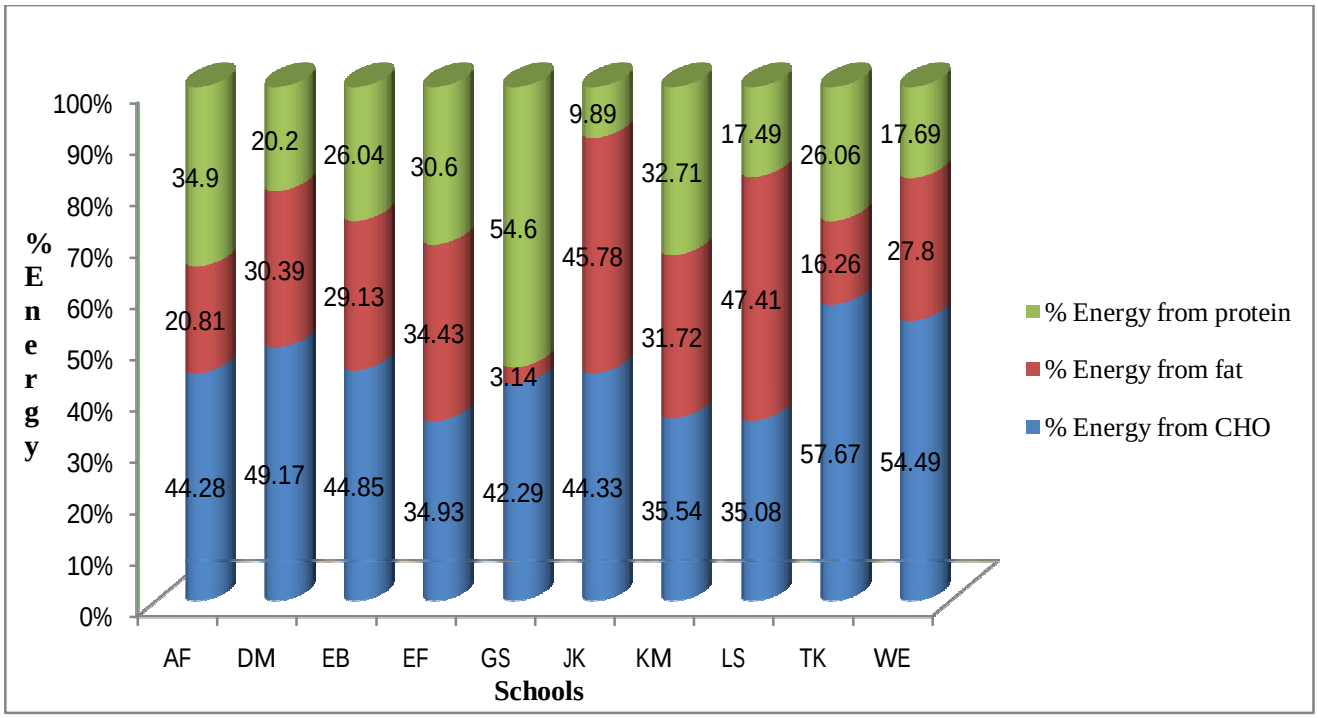

Figure 4.1. Energy composition of the school meals

Percentage of energy from carbohydrate was categorized as deficit if it is <55% and sufficient if it is >55%, percentage of energy from protein was categorized as deficit if it is (<10% for age 6-9 years and <15% for age 10-12 years) and sufficient if it is(>10% for age 6-9 >15% for age 10-12 years) and percentage of energy from fat was categorized as deficit if it is (<35% for age 6-9 years and <30% for age 10-12 years) and sufficient if it is (>35% for age 6-9 years and >30% for age 10-12 years) (FAO/WHO/UNU, 2004; Whiteney & Rolfes, 2008; Yasmin *et al.*, 2014).

Adequacy levels of iron are 10mg/day for age 4-8years, 8mg/day for age 9-13 years, 11mg/day for male of age 14-18 and 15mg/day female of age 14-18. Adequacy level of zinc is 5mg/day for age 4-8, 8mg/day for age 9-13, 11mg/day for male of age 14-18 and 9mg/day

female of 14-18. (FAO/WHO/UNU, 2004; Whiteney & Rolfes, 2008; Yasmin *et al.*, 2014). The energy was found to be very low in terms of fulfilling one third of the daily requirements assuming that most of the children have three meals per day. Majority of the school meals in table 4.3, contain inadequate level of iron and zinc which is a potential indicator for poor dietary diversity of the school meal.

4.4. Dietary diversity status

Children with four or more food group diversify well but children who have a food group less than four did not diversify well or have poor dietary diversity habit. Children who are in the feeding program diversify better than those who are not in the feeding program. This indicates the contribution of the school feeding program for diet diversity by increasing the number of food groups and hence good micronutrient nutrition even though the micronutrient of the school meals by itself is not sufficient.

Table 4.4. Dietary diversity status

IDDS (P=0.524)	Student's Category			
	Feeding		Non Feeding	
	Number	Percent	Number	Percent
Food group <4	117	83.6	120	85.7
Food group from 4-5	22	15.7	20	14.3
Food group >5	1	0.7	-	-

Dietary diversity status of the children was influenced by the educational status of the caregivers (p-value=0.000). Children who are living with illiterate or less educated parents/caregivers diversify less than children who are living with literate or more educated parents/caregivers. Majority of the school meals were from plant origin and there is insufficient serving of quality proteins which are mostly found from animal food sources.

Lack of diversity is severe problem among poor populations in the developing world. For vulnerable growing children, the problem is particularly critical because they need energy- and nutrient-dense foods to grow and develop both physically and mentally and to live a healthy life (Hooshmand and Udipi, 2013).

Chapter Five
Conclusion and Recommendation

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

From the present study the prevalence of acute malnutrition was found to be low and chronic malnutrition was medium in terms of public health significance. The nutritional status of the school children involved in the feeding program was not statistically different from those who were not involved in the program. The food composition served for the children in the feeding program was analyzed and its protein content was adequate but it did not fulfill the daily requirement of most of the nutrients and energy. The available school feeding program implemented in the schools included in this study showed positive effects on reduction of prevalence of acute malnutrition, improving school attendance and degree of food diversity but less effective in providing nutrition and energy dense food for the school children.

5.2. Recommendation

To reduce the prevalence of malnutrition among school children it is better to work on the factors contributing for poor nutrition. Parents/caregivers education is found to be one of the factors and it should be improved in order to reduce the prevalence of malnutrition among school children in Addis Ababa because the socioeconomic status of the children's parents/caregivers do not have significant variation even though it can be the main reason for high prevalence of malnutrition as a whole.

The available school feeding program is not sufficient enough to address most of the school children who are in need of feeding. Moreover, the program is not sustainable to bring about long term effect on the children's nutritional status due to the budget constraints. School feeding program should be considered as a basic and an important way of improving the quality of life of school children and should be consistent enough in order to deliver nutrition and energy dense food. The school feeding programs should incorporate animal source foods because most high quality proteins and more bioavailable micronutrients are found in animal food products which can increase brain functioning and hence improve the children's educational outcomes.

Fulfilling the need of school children nutrition is the basic requirement for having healthy and productive citizens for the country. Therefore, it will be better if feeding program can be widened and implemented along with the school curriculum for primary schools at the national level till citizens will able to insure individual-household food security.

STRENGTH AND LIMITATION OF THE STUDY

Strength of the Study

- It addresses the less studied & less focused but most important issue which is the assessment of nutritional status of school children with100% response rate.
- The study was open to make many responsible officers participate and contribute their parts.

Limitation of the study

- The study is limited to include more school children of Addis Ababa and to determine additional micronutrients in the school meals nutrient composition analysis due to budget constraints.

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ANNEX 1.

Consent form

Title: Nutritional status of school children in Addis Ababa involved in school feeding program; a comparative study

Principal Investigator: Alemnesh Assefa

Introduction

The nutritional status of children is a good indicator of health status of a community. School age is the active growing phase of childhood, Primary school age is a dynamic period of physical growth as well as of mental development of the child.

The consequences of malnutrition among school age children streams from severe under-nutrition such as underweight, stunted and wasted to over-nutrition. Poor nutrition and health among children have been identified to contribute to the general inefficiency of educational systems world-wide.

Procedures

If you agree to participate, we will be asking your students some basic information, measure their weight and height by trained person. And also we will take the food given to the children as a sample from the feeding unit.

Risks

From the assessment of nutritional status of the school children, there is no risk other than that students will contribute their break time.

Benefits

From the assessment of nutritional status of the school children, students who have poor nutritional status will be selected and contacted with the sectors who are involved in the

feeding program. And also the study is important in improving the quality of available school feeding program by showing the gaps.

Cost

There is no cost to you for participating.

Compensation

There will be no financial compensation for participating but you will be able to know your students' nutritional status.

Participant Rights

If I have said things that are not clear to you, you may ask without hesitation and I will answer. Your participation in the study is entirely voluntary.

Confidentiality

The nutritional status assessment results and any information about your students will be kept confidential. Only the research team will have access to your students' information. When I write a report, everyone's information will be put together so that information about your students cannot be seen because your students will be coded.

Persons to contact:

If you have any questions, you can ask any time. If you have additional questions or any other concern about the study, you may contact:

Alemnesh Assefa; Phone Number 09 13 03 75 43

If you agree your students to participate in the study, please sign at the space provided below. And I thank you for your cooperation!

The study has been explained to me and my questions have been answered to my satisfaction.

I agree to participate in this study.

_____	_____	_____
Signature	Name	Date
_____	_____	_____
Signature of study representative	Name	Date

<u>የፈቃደኝነት መግለጫ ቅፅ</u>

<u>ርዕስ፡</u> በተመረጡ የአዲስ አበባ ከተማ አንደኛ ደረጃ ት/ቤቶች የምገባ መርሀ ግብር ውስጥ ያሉና የሌሉ ተማሪዎችን የምግብና የሰውነት እድገት መጠን መለካትና ማወዳደር

<u>የጥናቱ ተጠሪ፡</u> አለምነሽ አሰፋ

<u>መግቢያ</u>

የሰው ልጅ የጤናና የእድገት ደረጃን ከሚወስኑ ነገሮች መካከል ጤናና የአመጋገብ ሁኔታዎች ዋነኞቹ ናቸው፡፡ ተማሪዎች አድገት ላይ ስላሉ በቂና ተመጣጣኝ ምግብ ያስፈልጋቸዋል፡፡ ከበቂ በታች መመገብ ልጆችን ለተለያዩ ችግሮች ያጋልጣል፡፡ ከነዚህም ችግሮች መካከል የአእምሮና የአካል አድገት ውስንነት ናቸው በዚህም ምክንያት የተማሪዎች በክፍል ውስጥ የመማር ፍላጎትና በትኩረት የመማር አቅማቸው ይቀንሳል፡፡ ስለሆነም ከበቂ በታች የሚመገቡ ተማሪዎች በትምህርትና በስራቸው ውጤታማ የመሆን እድላቸው ይቀንሳል፡፡ ይህ ሁኔታም ለአንድ ሀገር የወደፊት አድገት ትልቅ እንቅፋት ይሆናል፡፡

ይህ ጥናት በየት/ቤቶቹ ባለው የምገባ መርሃግብር ተጠቃሚ የሆኑና ያልሆኑ ተማሪዎች የእድገት መጠንን ይለካል እንዲሁም ያወዳድራል በተጨማሪም የተማሪዎቹን የተመጣጠነ ምግብ አወሳሰድ ሁኔታን ያጠናል፡፡

<u>የስራ ቅደም ተከተል</u>

<u>በዚህ የምርምር ስራ ላይ ለመሳተፍ ፍቃደኛ ከሆናችሁ፤</u>

- ለምርምር ስራው አስፈላጊ የሆኑ ጥያቄዎችን እንጠይቃችሁአለን፡፡
- የተማሪዎቹን ቁመት፣ ክብደት እንለካለን፡፡ ተማሪዎቹ በቀን ውስጥ የሚመገቡትን የምግብ አይነት እንጠይቃለ፡፡
- ምገባ ላይ ያሉ ተማሪዎች የሚመገቡትን ምግብ ለናሙና እንወስዳለን፡፡

<u>የአደጋ መጠን</u>

የአደጋ መጠኑ እጅግ ዝቅተኛ አና የተማሪዎቹን የእረፍት ጊዜ ብቻ መጠቀምን ያካትታል፡፡

<u>ከምርምሩ የሚገኙ ጥቅሞች</u>

ከምርምሩ ውጤት በመነሳት ለተመረጡ ተማሪዎች የምገባ አገልግሎት ከሚሰጡ ድርጅቶች ጋር በማገናኘት ተጠቃሚ እንዲሆኑ ጥረት ይደረጋል፡፡ እንዲሁም እየተሰጠ ባለው የምገባ አገልግሎት ላይ ያሉ ክፍተቶችን ለይቶ በማውጣት አገልግሎቱን የተሻለ ለማድረግ ከፍተኛ አስተዋፅዎ ያደርጋል፡፡

<u>ክፍያ</u>

በዚህ የምርምር ስራ ላይ ለመሳተፍ ምንም አይነት ክፍያ አትጠየቁም፡፡

<u>ማካካሻ</u>

በዚህ የምርምር ስራ ላይ በመሳተፋችሁ የገንዘብም ሆነ ምንም አይነት ድጋፍ አይደረግላችሁም፡፡

<u>የተሳታፊዎች መብት</u>

ያልገባችሁ ነገር ካለ በነፃነት እና ያለምንም ማመንታት መጠየቅ ትችላላችሁ፡፡ በዚህ የምርምር ስራ ላይ መሳተፍ ሙሉ በሙሉ በእናንተ ፈቃደኝነት ላይ የተመሰረተ ነው፡፡

<u>ሚስጥራዊነት</u>

የምርምሩ ውጤቶች እና ማንኛውም መረጃ በሚስጥር ይያዛል፡፡ ተመራማሪዋ (እኔ) ብቻ መረጃዎቹን አገኛለሁ፡፡ እንዲሁም ሪፖርቱ ሲፃፍ መረጃዎቹን ሌላ ሰው እንዳያገኛቸው በተለየ ስም (ኮድ) ይቀመጣሉ፡፡
ማንኛውም አይነት ጥያቄ ካለዎት የሚከተለውን አድራሻ ይጠቀሙ

አለምነሽ አሰፋ፤ ስልክ ቁጥር 0913037543

በዚህ የምርምር ስራ ላይ ለመሳተፍ ፈቃደኛ ከሆኑ እባክዎ በክፈት ቦታው ላይ ይፈርሙ:: ስለትብብርዎ እናመሰግናለን፡፡

ስለምርምሩ በበቂ ሁኔታ ተገልፆልኛል እንዲሁም ጥያቄዎቹ በሚገባ ተመልሰዋል ስለዚህ በዚህ ምርምር ላይ ለመሳተፍ ተስማምቻለሁ፡፡

_____	_____	_____
ፊርማ	ስም	ቀን
_____	_____	_____
የምርምሩ ተወካይ ፊርማ	ስም	ቀን

ANNEX 2.

Interview

ID_____

Date of Interview_____

Starting time_____

Ending time_____

A. Socio-demographic Characteristics of the Students

Age_____

Sex Female ☐ Male ☐

Grade_____

Do you have brothers and/or Sisters?

Yes ☐ No ☐

If yes how many are they?

Sister_____ Brother_____

Your Position_____

B. Caregiver Type

Mother☐ Father☐ Mother and Father ☐ Sister☐ Brother☐

Grandmother☐ Grandfather☐ Uncle☐ Aunt☐ Other ☐

C. Educational level of caregivers

do your caregivers read and write?

Yes☐ No☐

If yes which is their level?

Primary☐ Secondary☐ Tertiary☐

D. Religion

Orthodox☐ Muslim☐ Catholic☐

Protestant☐ Other_____

E. Occupation of Caregivers

Private☐

Civil servant☐

Other_____

F. Socioeconomic Status, Do you have?

Radio	Yes☐	No☐
Television	Yes☐	No☐
Refrigerator	Yes☐	No☐
Mobile Telephone	Yes☐	No☐
Non mobile telephone	Yes☐	No☐

What type fuel does your household mainly used for cooking?

Electric☐ Kerosene☐ Charcoal☐ Wood☐

Do you have a separate room used as kitchen?

Yes☐ No☐

G. School feeding status of the children

Are you involved in the school feeding program?

Yes☐ No☐

If yes, when did you start using the program_____

Have you ever been in other feeding program before?

Yes☐ No☐

H. 24 Hour dietary Recall

Foods eaten preceding 24 hours?

_____

_____

_____

_____

_____

_____

Have you ever drop out or repeat class?

Yes☐ No☐

If yes how many times?_____

IDDS (Children) Food Groups (Score: 0-8), (FANTA, 2006).

Grains, roots or tubers,
Vitamin A-rich plant foods,
Other fruits or vegetables,
Meat, poultry, fish, seafood,
Eggs,
Pulses/legumes/nuts,
Milk and milk products,
Foods cooked in oil/fat

<u>ለተማሪዎች የቀረበ ቃለ መጠይቅ</u>

ኮድ _____

ቃለ መጠይቅ የተደረገበት ቀን _____

የተጀመረበት ሰአት_____

ያለቀበት ሰአት_____

ሀ. የተማሪው/ዋ አጠቃላይ ሁኔታ

እድሜ_____

ፆታ ሴት☐ ወንድ☐

የትምሕርት ደረጃ_____

እህቶችና ወንድሞች አሉህ/ሽ?

አለኝ☐ የለኝም☐

ካሉህ/ሽ ስንት?

እህት_____ ወንድም_____

ስንትኛ ልጅ ነህ/ሽ?_____

ለ. በአሁኑ ወቅት ከማን ጋር ነው የምትኖረው/የምትኖሪው?

እናት☐ እህት☐ አባት☐ እናትና አባት☐ ወንድም☐

ሴት አያት☐ አጎት☐አክስት☐ ወንድ አያት☐ ሌላ☐

ሐ. የወላጆች/ የአሳዳጊዎች የትምሕርት ደረጃ

ወላጆችህ/ አሳዳጊዎችህ/ሽ ማንበብና መፃፍ ይችላሉ?

ይችላሉ☐ አይችሉም☐

የወላጆችህ/የአሳዳጊዎችህ/ሽ የትምሕርት ደረጃ?

አንደኛ ደረጃ☐ ሁለተኛ ደረጃ☐ ከሁለተኛ ደረጃ በላይ☐

መ. ሐይማኖት

ኦርቶዶክስ☐ ሙስሊም☐ ካቶሊክ☐

ፕሮቴስታንት☐ ሌላ☐

ሠ. ወላጆች/የአሳዳጊዎች የስራ አና የኑሮ ሁኔታ

ወላጆችህ/የአሳዳጊዎችህ/ሽ ስራ ምንድነው?

የቅጥር ሰራተኛ☐ የግል ሰራተኛ☐ ሌላ_____

ራድዮ አላችሁ?

አለ☐ የለም☐

ቴሌቪዥን አላችሁ?

አለ☐ የለም☐

ፍሪጅ አላችሁ

አለ☐ የለም☐

መደበኛ የቤት ስልክ አላችሁ?

አለ☐ የለም☐

ተንቀሳቃሽ ሰልክ አላችሁ?

አለ☐ የለም☐

ምግብ ለማብሰል የምጠቀሙት ምንድን ነው?

ኤሌክትሪክ☐ ነጭ ጋዝ☐ ከሰል☐ እንጨት☐

ምግብ የምታበስሉት መኣድ ቤት ነው ወይስ ቤት?

መኣድ ቤት☐ ቤት☐

ረ. የምገባ መርሀግብርን የተመለከተ መጠይቅ

ት/ቤቱ ውስጥ ባለው የምገባ መርሀግብር ተጠቃሚ ነህ/ሽ?

ነኝ☐ አይደለሁም☐ ከሆንክ/ሽ፣☐

መመገብ የጀመርከው/ሽው መቼ ነው?_____

ከዚህ በፊት ሌላ የምግባ መርሀግብር ተጠቃሚ ነበርክ/ሽ?

ነበርኩ☐ አልነበርኩም☐

ሰ. ባለፉት 24 ሰኣታት ውስጥ የተበሉ ምግቦቸ መጠይቅ

ትናንትና ሙሉ ቀን የተበሉ ምግቦች ዝርዝር_____
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ትምሕርት አበርጠህ ወይም ደግመህ ታውቃለህ/ሽ?

አዎ☐ አላውቅም☐

አዎ ከሆነ ስንት ጊዜ_____
_____

ANNEX 3.

Ethical approval

COLLEGE OF NATURAL SCIENCES
Addis Ababa University
OFFICE OF THE DEAN
የዲን ጽ/ቤት

የተፈጥሮ ሣይንስ ኮሌጅ
አዲስ አበባ ዩኒቨርሲቲ

Ref: ቁጥር: CNSDO/99/07/14
Date: ቀን: November 5, 2014

To Whom It May Concern

The Ethical Committee of the College of Natural Sciences in its meeting held on 01/08/2014 (Minutes No.11) has examined the project entitled '**Nutritional status of school children in Addis Ababa involved in school feeding program, a comparative study"** by Alemnesh Assefa (Center for Food Sciences and Nutrition) for ethical approval.

The Proposal is approved for implementation.

With regards,

Negussie Retta, (Professor)
Dean, College of Natural Sciences

Encl: RERC minutes

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Please quote our reference number in your correspondence.

"Examine all things; hold fast that which is good"
"ሁሉን መርምሩ ፣ መልካሙን ያዙ"