ADDIS ABABAUNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF NATURAL SCIENCES
CENTER FOR FOOD SCIENCEAND NUTRITION

Nutritional status and school performance of children benefited from school feeding program in selected elementary school, Arada Sub city, Addis Ababa, Ethiopia.

BY

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A THESIS SUBMITED TO THEGRADUATE STUDIES OF ADDIS ABABA UNIVERSITY, CENTER FOR FOOD SCIENCE AND NUTRITION IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTERS OF SCIENCE IN FOOD SCIENCE AND NUTRITION.

Jan, 2017.

Declaration

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

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List of abbreviations and acronyms

AACAEB	Addis Ababa City Administrations Education Bureau
AACAHB	Addis Ababa City Administrations Health bureau
AACWCB	Addis Ababa City Administrations Women's And Children Bureau
AOAC	Association of Official Analytical Chemists
AAS	Atomic absorption spectrophotometer
BAZ	Body Mass for Age Z scores
BMI	Body Mass Index
CI	Confidence interval
DRI	Dietary Recommended Intakes
FAO	Food and Agricultural Organization
EPHI	Ethiopian public health institute
FFE	Food for Education
FMHACA	Food Medicine and Health Authority control Agency
HAZ	Height for Age
Hb	Hemoglobin
HCL	Hydrochloric Acid
GH	Growth Hormone
IGF-I	Insulin like growth factor-I
KCL	Kilo Calories
KOH	Potassium Hydroxide
NBS	United Kingdom's nutrient-based standards
NaOH	Sodium Hydroxide
NTs	Neurotransmitters
RDA	Recommended Dietary allowance
SD	Standard Deviation

SFP	School Feeding Program
SPO	Standard Operating Procedure
SPSS	Statistical Package for the social science
UNICEF	United Nations Children's Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
WAZ	Weight for Age Z score
WFA	Weight for Age
WFH	Weight for height
WHO	World Health Organization
WFP	World Food Program
WHZ	Weight for height Z score

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ABSTRACT

Background:-Malnutrition, temporary hunger, poor health condition and socioeconomic status of parents are among the many reasons for underperformance of children in school. School feeding program has been implemented in many countries in order to make students concentrate in their academic exercise. The government of Ethiopian in collaboration with development partners is piloting school feeding program in selected food insecure areas of the country. The effectiveness of the program is not yet evaluated.

Objective: - The objective of this study was to assess the impact of school feeding program on nutritional status and academic performance of children in the selected schools Arada sub city, Addis Ababa, Ethiopia.

Methods: - A School based cross sectional and comparative perspective cohort study was conducted in 4 randomly selected schools. Over all 234 primary students participated in the study. The students are randomly assigned for intervention (N=117) and control (N=117).

The students were assessed for socio-demographic characteristics, biochemical test, dietary diversity score (DDS), food intake and anthropometric measurements. DDS and adequacy of food intake were determined using meal served for five consecutive days. All other parameters were assessed before and after the intervention as well as at six months for both the intervention and control group. The data were before and after the intervention and against the control group. Nutritional status was calculated using WHO (2007 growth standard.

Result: -. The percentage of anemic students in fed and non-school fed groups before intervention was 35.5% and 38.5% respectively. Anemia has reduced to 18.9% and 35.5% for school fed and non-school fed group respectively after intervention. The reduction of anemia in the intervention group is significant ($p<0.001$).

The overall stunting prevalence was (19.1%). Students who had anemia were less likely to achieve higher academic performance than those who hadn't (OR 0.58, 95% CI 0.41-0.83). The prevalence of underweight (BMI for age below the 5 percentile) in the study group was 15.1% and 21.5% for feeding and non-feeding group respectively. None of students in both groups were overweight. More number of students (55.6%) in school feeding group significantly ($p=0.021$academic score above mean value than non-school feeding group (47.9%).In this study, nutritional status shows significant association with academic performance ($p=0.012$). The mean of the students' grade in the feeding program were 64.6 as compared to 59.5 which was before feeding program started. It is clear that that the school feeding contributed to students score improvement significantly ($p=0.021$). the proportion of students who scored above mean from school feeding program were 55.6% as compared to control group which is 47.9% the study indicate that more number of students from the feeding group score above mean than non-feeding group.

The rate of absenteeism between the control intervention group is not significant ($p=0.123$).There is no significant ($p=0.0875$) difference in dropout and class repetition between school fed and non-school fed group. No significance difference in energy value between the schools ($p=0.155$). All of the four schools` meals contain inadequate level of calcium, zinc and magnesium but adequate level of iron. There was no significant difference in micronutrient

contents between the schools.

Conclusion: -The prevalence of wasting in the school was high it is likely to affect school performance. Although the duration of the study short nutritional status of the students is associated with good academic performance. Hemoglobin level was improved by school feeding program. Living in a large family size, low socio-economic status of the parents or guardian, inadequate amount of nutrient in food supplied, anemia and malnutrition are the cause of poor academic performance. The nutrient content and the energy supplied to the children through school feeding was below the recommended dietary allowance. The program need to consider quality and adequacy of the meal provided. Further longitudinal study may be needed to see the long term benefit of school feeding program.

Key words: Nutrient composition, academic achievement, anemia, dietary diversity, and school feeding.

1. Introduction

1.1. Background of the Study

Malnutrition is a major public health concern affecting a significant number of school age children influencing their health, growth and development, and academic performance. According to the 2007 Food and Agriculture Organization's (FAO) estimate, 923 million people in the world were chronically hungry, which was an increase of about 75 million people from the 2003-05 estimates ((FAO, Hunger statistics, 2007). Many of these are children, and a vast majority of them are in developing countries. The persistence of hunger, malnutrition, and micronutrient deficiencies can have long lasting effects on the health status and productivity of people and their nations. Early malnutrition can adversely affect physical, mental, and social aspects of child health, which in turn leads to underweight, stunted growth, lowered immunity, and mortality. Research has shown that the physical effects of malnutrition as measured by indicators such as body mass index (BMI), have a significant impact on an individual's productivity and wages (Brocas., Stamoulis, 2003).

Malnutrition in school-aged children can result in delayed maturation, deficiencies in muscular strength, work capacity, reduced bone density later in life and school performance. In 2010 according to WHO, the global prevalence of malnutrition among school-age children (5-14 years old) as indicated by the prevalence of stunting, was approximately 28% (171 million children), with Eastern Africa suffering a higher rate of 45% (WHO, Levels and Trendas in child malnutrition , 2012).

Studies from different regions of Ethiopia showed that the prevalence of stunting ranges from 9.8-48.1% and wasting 23.3- 50% among school children Childhood under nutrition imposes significant economic costs on individuals and nations, and that improving children's diets and nutrition can have positive effects on their academic performance and behaviors at school as well as their long-term productivity as adults (Jomma LH., 2011). Policy makers may use a number of interventions to target various groups within a population through social safety nets to address the problem of hunger and malnutrition. One intervention that governments and non-governmental organizations (NGO) have utilized in targeted areas where a significant part of the population faces poverty and chronic hunger is school feeding program.

Anemia is low counts of red blood cells or low levels of hemoglobin in the bloodstream, and reduced capacity for the blood to carry oxygen. It is a health problem with significant economic consequences.

In children, it impairs physical and cognitive development and reduces human capital accumulation via impacts on behaviors like school attendance. In adults, it reduces productivity, and associated with high maternal mortality .Promotion of eating iron rich food is important to improve iron level of children/adolescents and reduce anemia which in turn improve school age children higher school performance and makes them higher academically achieved (WHO, 2006) .

School feeding was introduced in Ethiopia in 1994 with technical and financial support from the WFP (GNFC report, 2012). The objective was to increase equity, access to education, enrollment, and attendance. Additionally it was expected to help students to be able to concentrate on their education and achieve better results. Currently, more than 680,000 students in Ethiopia benefit from school feeding. In addition, more than 125,000 girls benefit from a school feeding program initiative aimed at narrowing gender disparities (WFP, 2009).

Addis Ababa education office in collaboration with other stakeholders has started school feeding program in 10 sub cities and in the 209 government's elementary school (out of 217) in the 2015.The scheme provides breakfast and lunch to19,894 of students who have come from families with low income which was selected by criteria set by Addis Ababa Education Biro with other stakeholders. One thousand six hundred sixty three (1,663) of these students attend Arada Sub City elementary school. The school feeding scheme also provides an income generating job for local women who would be involved in preparing and providing the meals for the students. It also offers a market solution for local producers who would be able to offer their produce for sale and provides the demand. For food producers locally and provides a strong incentive to locally organized women's, community and sellers. It is also consistent with Ethiopia's goal of becoming more self-sufficient in food production and supply (NEPAD, 2012).

The Addis Ababa city administration and Addis Ababa Education office is optimistic about school feeding programs and is committed to expanding school feeding Program because they believe in it as School feeding programs help ensure healthy, productive future generations. School feeding plays an important role in supporting the agricultural sector, local producers, offers an employment opportunity for locally organized women all of which would have a positive impact on the country's overall economy.

According to Addis Ababa Education office, School feeding is targeted at the poor. These criteria of identifying target beneficiaries was decided upon in a process involving all stakeholders so that

multiple opportunities exist to improve the groups and communities involved in the 'school feeding value chain'. This is expected to provide multiple opportunities for all the members of the community (producers, service providers etc) to participate and benefit economically as well as be a part of the improving of children's health and education. It is a societal investment with a clear and significant societal return (AAEDB, 2014).The present study is, therefore, designed to evaluate the nutrient contents of the food supplied, the children nutritional status and the impact of school feeding program on their school performance as well as their academic achievement of children registered in Elementary school, in Arada sub city, Addis Ababa, Ethiopia.

1.2. Statement of the problem

School feeding programs (SFPs) intend to alleviate short-term hunger, improve nutrition and cognition of children, and transfer income to families .The food provided is not designed to address specific energy and nutrient needs at this age. Nutrient needed in order to overcome the problem that the students are facing such as low academic performance, hunger, anemia and wasting were not analyzed.

Therefore, this study focuses on investigating or exploring the nutrient content of the food supplied, nutritional status and school performance of the children. Even though school Feeding Program had many cognitive, physical development and health benefits it is not investigated or explored in the sub city. The food supplied to the children, their nutritional status and school performance is not explored. Moreover the adequacy of food supplied and nutrient requirement of the children is not yet investigated. Therefore, the current study focuses on investigating or exploring the nutrient content of the food supplied, nutritional status and school performance of beneficiary students in the selected school Arada sub city.

1.3. Significance of the Study

School feeding programs help ensure healthy and productive future generations. School feeding should be viewed as a societal investment with clear and significant societal return. In looking at why countries focused on school feeding, the main reasons were: it provides a social safety net, it supports education by increasing enrollment and decreasing absenteeism; and it also helps in providing nutritious food to children. Countries also see benefits in leveraging school nutrition programs to help get more girls into school and keep them enrolled. Therefore, the main concern of this study is to indicate the relevance and adequacy of the food supplied and its importance in

terms of school performance for further decision or intervention plan. Moreover the study will provide the level of significance of the program to the attention of the government and stakeholders in order to establish national standards for scale up. Moreover the study will be used as a base line data for the next researches on school feeding program and to add a value on the impact of school feeding program on educational achievement and malnutrition in Ethiopia. Finally the study will create awareness for public, governments and non-government organization to improve the perception towards school feeding program in relation to educational coverage, health, educational achievements and reducing malnutrition.

1.4. Research question

1. Is the meal served adequate?

2. What is the impact of school feeding program on academic performance before and after? Is there any change? If 'yes' is it significant?

3. What about rate of drop out and absenteeism?

1.5. Objectives of the study

1.5.1. General objective

To assess the adequacy of meal served, nutritional status of the children and the impact of school feeding on school performance.

1.5.2. Specific objectives

- To determine the proximate composition of food served to students.
- Investigate dietary adequacy of the supply
- To determine the nutritional status of the children using anthropometric and hemoglobin level before and after for both beneficiary and non-beneficiary group.
- To assess school performance of school fed students using control groups

2. Literature review

2.1. General characteristics of the school feeding program

School feeding program help children to stay active in order to focus on activities done in the school which in turn help them to overcome hunger and malnutrition .Moreover ,School feeding programs are likely to improve the nutrient intake of participating children. A study in Huaraz, Peru shows that for children who received breakfast at schools, dietary intake of energy increased by 2 percent, protein by 28 percent, and iron by 4 percent compared to the control group (Jacoby E. , 1996).In addition to this we can verifies school feeding program from different prospective by analyzing from different studies conducted and according to an evaluation done on a school feeding program in Jamaica assessed the dietary impact of school breakfast consisting of a bun and half pint of milk. Results show that the program provided 32 percent and 45 percent of daily energy and protein requirements, respectively (Chambers ,C.M,, 1991).Which implies that the school feeding program have potential impact in increasing the daily energy needed in order to attain WHO recommendations .

On the other hand research conducted in Brazil, a study of a large school lunch program examined the impact of the program on consumption of calories and protein by school children in Sao Paulo. Participation in the program was associated with an increased availability of 357 calories and 8.5 grams of protein (Dall'Acqua, 1991).School feeding programs have also proven effective in reducing the education gap between girls and boys. A program evaluation results from Pakistan, Morocco, Niger and Cameroon showed that while food is the initial motivation for sending girls to school, parents of participating girls develop an interest in the education of their daughters. This change in attitudes is an important factor in enhancing parents' commitment to education beyond the duration of food assistance (WHO, 2002).This is also the major reason why school feeding program stared in Addis Ababa government elementary school and it was so effective in attracting girls especially orphaned, vulnerable children and those having food insecurity.

School feeding program can also be important in improving the micronutrient level because inadequate iron intake is common in low and middle-income countries, particularly among infants and young children (Gibson et al. 2010) .Iron and iodine are critical for cognitive development. Iron deficiencies may render children inattentive and uninterested in learning. Iron supplementation was

shown to improve IQ scores of previously iron deficient children (Seshadri and Gopaldas, 1989).So we can say that school feeding was one of the mechanism to reduce malnutrition and the program in Addis Ababa school feeding program also in line with those studies because from different reports organized in education biro there are promising students interests and initiatives in involving school activities observed.

Moreover, there are studies that correlate deficiency of some micronutrients with academic performance and evidence also shows that children who suffer from iodine deficiencies are more likely to perform poorly than those without (dellRosso, 1999). To counter the harmful effects of micronutrient malnutrition, some school feeding programs provide fortified food but this is not practiced in our case because the government and supporting organization in Addis Ababa believe in diversification of diet than fortification even if the provision of such food was shown to increase the dietary intake of micronutrients. For example, in Peru, researchers studied the effect of a breakfast program that included iron-fortified rations. The program significantly increased dietary intakes of iron by 46 percent, besides increasing energy and protein by 25 percent and 28 percent, respectively (Jacoby, E.E, 1996).We can also say that fortification can also reduce the burden of malnutrition if such program in parallel with school feeding program practiced. There are different evidence on the impact of school feeding programs on child nutritional status but it is limited in Ethiopia and in developing countries as whole, due partly to the cost and complexity of obtaining accurate and reliable anthropometric and food intake data, and partly to methodological difficulties in isolating the effect of food intake from other factors affecting nutritional status. Several studies show that food alone does not guarantee improved nutritional status. For example, a study in Ethiopia found that differences in food availability and access had limited effect on the differences observed in child nutritional status (Pelletier et al. 1995). This could be because a child's nutritional status is a function of not only the quality and quantity of the dietary intake but also a function of morbidity, child caring and feeding practices, and household variables such as income and parental education .Some reviews even show that food-based interventions alone have little measurable impact on nutritional status, morbidity or mortality levels except in crisis situations (Clay, E.,O.Stokke, 200).This is also true in our case because starting school feeding program only may not bring significant change on students school performance rather improving teacher effectiveness, supplying on time educational materials ,organizing teaching learning process efficiently and improving school environment may also contribute the school performance of the children.

In most developing countries especially in our case Ethiopia, academic achievement is disappointing, especially at the primary education level. There are numerous causes for this problem, which can be addressed in several ways through both supply-side and demand-side interventions. Health and nutrition inputs have often been included in the strategies because poor health and nutrition are known to affect children's ability to learn so school feeding and other intervention mechanisms have to be implemented in order to overcome the problem. Children who have poor levels of academic attainment often have poor nutritional status (Pollit, 1990; Simeon, and Grantham-McGregor 1989). It is then likely that giving children a daily breakfast or a meal at school may improve their scholastic achievement through several mechanisms: increasing the time spent in school, improving certain cognitive functions and attention to tasks and, perhaps indirectly, improving nutritional status (Grantham-McGregor,S.S, 1998). This is also what is observed in Addis Ababa Education Office report of 2014 indicated.

However, it is hard to infer a causal relationship since other confounding factors are also likely to affect learning. For example, poor social backgrounds and low socio-economic household characteristics are often linked to both poor diet and poor school performance (Chandler, 1995).

There are different evaluations conducted to determine the impact of School feeding programs on academic achievement are sparse and most of them lack scientific rigor. Only a few investigators have examined the effects of school meals on school achievement levels, using quasi-experimental designs with matched treatment and control groups. Even such evaluations did not show consistent results. The inconsistencies may be because of the limited degree of control over experimental conditions, the differences in the analytical approaches and the initial characteristics of the children (Simeon, and Grantham-McGregor, 1989).Moreover, it is so difficult to conclude precisely the effects of school feeding program.

2.2. Objectives and benefits of school feeding programs

The primary assumption of SFPs is that education and learning depend on good nutrition. However, in designing and implementing a school feeding program, a number of options are available, depending on the primary and secondary objectives of the program. SFPs can range from simple snack provision (usually fortified biscuits) to breakfast or lunch programs, to take-home rations. Often, these programs operate in conjunction with other health and nutrition initiatives to increase their success and impact. A number of categories of SFPs exist, linked to the primary objectives of

the program; increase enrollment and attendance and/or decrease gender disparity, alleviate short-term hunger and thereby increasing learning capacity.

In many cases the programs have a strong gender dimension, especially where they target girls' education, and may also be used to benefit specifically the poorest and most vulnerable children. What is less clear is the relative scale of the benefit with the different school feeding modalities, and there is a notable lack of engagement of educators on research around these issues. The clear education benefits of the programs are a strong justification for the education sector to own and implement the programs, while these same education outcomes contribute to the incentive compatibility of the programs for social protection (Levinger, 2002).

Policy analysis also shows that the effectiveness and sustainability of school feeding programs is dependent upon embedding the programs within education sector policy. Hence, the value of school feeding as a safety net and the motivation of the education sector to implement the programs are both enhanced by the extent to which there are education benefits.Well-designed school feeding programs, which include micronutrient fortification and de-worming, can provide nutritional benefits and should complement and not compete with nutrition programs for younger children, which remain a clear priority for targeting malnutrition overall (WFP, 2009).

2.3. Macronutrient Requirements of Children Ages 7 to 14 Years

Proteins

Proteins are macromolecules made up of one or more long chains of amino acids, that make up a good part of the complex organic structures 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) and enzymes. Proteins are found in foods such as meat, fish, milk, cheese, cereals, and legumes. In addition to their structural and enzymatic function, amino acids from these proteins are also used as precursor molecules of neurotransmitters such as serotonin, acetylcholine, dopamine and nor-epinephrine. Adequate amount and variety of food consumption is vital to enable the brain to make the right amount of amino acids based neurotransmitters (Georgief M. , 2007). A deficiency of proteins, also known as protein energy malnutrition (Fazili, 2012) can lead to poor school performance in children, and causes young children to be lethargic, withdrawn and passive, all of which affect social and emotional development (Ross, A.,Anderson,D.L, 2010).

Carbohydrates

All digestible carbohydrates are ultimately broken down into monosaccharaides, 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 the main source of energy for the brain tissue. Fluctuating levels of carbohydrates may cause dizziness and mental confusion, both of which can affect cognitive performance. 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 eating a carbohydrate rich meal can cause one to feel calmer and relaxed because of a brain chemical called serotonin and its effects on mood (Ross, 2010).

Fats &Essential fatty acids

Essential fatty acids and their derivatives, including docosahexaeonic acid and arachidonic acid (part of the Omega – 3 fatty acids) are neurobiological agents that are part of the structure of brain tissue, including cell membranes and are 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, M.A., & scholey,A.B, 2014). Inadequate intake of docosahexaeoinc 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 inadequacy of these nutrients impairs the neuron-development processes (Parado, EL., & Dewey,K.G, 2014)

Table 1: 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	***2,379***	***2,770***
13-14	***2,276***	***2,548***

2.4. Micronutrient Requirements of Children Ages 5 to 13 Years

The period of childhood between ages 5 and 13 years is characterized by continued physical growth and rapid cognitive, emotional, and social developmen (Lucas BL, Feucht SA., 2008). Moreover, many children, especially girls, undergo their pubertal growth spurt between ages 5 and 13. This period of childhood precedes adolescence:-the transitional stage of development between childhood and adulthood. Due to increased growth and metabolism, the nutritional requirements of children are higher in proportion to body weight compared with adults (Lucast BL, 2000). Good nutrition throughout childhood is important not only to support normal growth and cognitive development but also to establish healthy eating patterns that are associated with decreased risk of chronic conditions and diseases in adulthood, including obesity, type 2 diabetes, cardiovascular disease, metabolic syndrome, and osteoporosis.

Calcium plays an important role in muscle contraction and regulation of water balance in cells. Modification of plasma calcium concentration leads to the alteration of blood pressure. Magnesium has been known as an essential co-factor for many enzyme systems. It also plays an important role in neurochemical transmission and peripheral vasodilation (Rude RK, Shils ME., 2006).

Children are most vulnerable to under nutrition due to low dietary intake, inaccessibility to food, inequitable distribution of food within the household, improper food storage and preparation, dietary taboos and infectious diseases (Girma W G. , 2002). Micronutrient deficiencies especially, as a result of inadequate intake of food or inefficient utilization of available micronutrients due to infections and parasitic infestations (Rayhan, 2006). However, information on the serum levels of multiple micronutrients in human biological tissues is scarce. For many essential elements, baseline levels in the general population, and especially in children, are lacking (Bárányet.al, 2002). The levels in children are of particular interest since adequate intake of micronutrients is of great importance for the wellbeing, proper development, and functioning of the body starting from fetal life and throughout childhood. They have been implicated to play important roles in immuno-physiologic functions (Failla Ml, 2003). For example, zinc is an integral part of more than 200 enzymes and has significant task in nucleic acid metabolism, cell replication, tissue repair, and growth (Nicola ML, 2002). The antoxidation functions of selenium in glutathione peroxidase are essential in protecting the biological system from oxidation caused by peroxides. Superoxide dismutase, which usually contain copper and/or zinc, act as antioxidants against super oxides (McKenzie RC, 1998).

2.4.1. Minerals functions for school age children

Calcium

Calcium plays an important role in muscle contraction and regulation of water balance in cells. Modification of plasma calcium concentration leads to the alteration of blood pressure. About 99% of calcium in the body is found in bones and teeth (Abuja JK, 2004). Adequate intake of calcium throughout childhood and adolescence is important for proper mineralization of growing bones, attainment of peak bone mass, and reduction of risk for osteoporosis in adulthood (WHO, 2007).Thus, dietary intake recommendations for calcium in children are established based on the calcium intake needed to support bone accretion and overall calcium retention (i.e., the dietary intake needed to achieve positive calcium balance (Abuja et.al, 2004). The RDA is 1,000 mg/day for children ages 4 to 8 years and 1,300 mg/day for boys and girls ages 9 to 13 years. Calcium intake recommendations are higher in children ages 9 to 13 to account for increased needs of the mineral during puberty (Abujaet.al, 2004)

Iron

Iron is an essential component of hundreds of proteins and enzymes involved in various aspects of metabolism, including oxygen transport and storage, electron transport and energy metabolism, antioxidant and beneficial pro-oxidant functions, oxygen sensing, and DNA synthesis (Fairbanks VF, 1999). Iron is stored in the body as ferritin, and serum level of ferritin is a good clinical indicator of iron status in children (Wood RJ, Ronnenberg AG, 2006). Iron deficiency, which is the most common nutritional deficiency in the world, is a major public health problem, especially in developing nations, but it is also prevalent in industrialized nations. Severe iron deficiency leads to iron-deficiency anemia, which affects more than 30% of the global population (2 billion people) (WHO, 2011). Iron-deficiency anemia results when there is inadequate iron to support normal red blood cell formation. The anemia of iron deficiency is characterized as microcytic and hypochromic, meaning red blood cells are measurably smaller than normal and their hemoglobin content is decreased. At this most severe stage of iron deficiency, symptoms may be a result of inadequate oxygen delivery due to anemia and/or sub-optimal function of iron-dependent enzymes. Low red cell count, low hematocrit, and low hemoglobin concentrations are all used in the clinical diagnosis of iron-deficiency anemia (WHO, 2012).

Most observational studies have found relationships between iron-deficiency anemia in children and poor cognitive development, poor school achievement, and behavior problems. However, it is difficult to separate the effects of iron-deficiency anemia from other types of deprivation in such studies, and confounding factors may contribute to the association between iron deficiency and cognitive deficits (Ahujaet.al, 2004). Yet, several possible mechanisms link iron-deficiency anemia to altered cognition. For example, any cognitive benefit associated with iron supplementation could be possibly due to changes in nerve myelination, which have been observed in iron-deficient animals (Lozoff I. , 2007)and iron has an important role in the development of the cells that produce myelin; as noted above, the myelin sheath is the insulating layer of tissue comprised of lipids and proteins that surrounds nerve fibers. This sheath acts as a conduit in an electrical system, allowing for rapid and efficient transmission of nerve impulses (Maggio, 2013). Iron is also important for enzymes involved in the synthesis of certain neurotransmitters and for DNA synthesis (Lozoff B., 2007).

Zinc

The mineral zinc is essential for growth and development, immune function, neurological function, and reproduction. Zinc plays a number of catalytic, structural, and regulatory roles in cellular metabolism .Zinc deficiency is a major public health concern and has been estimated to affect more than 2 billion people in less developed nations (Abrams SA e. , 1997). Children are at increased risk for zinc deficiency, which can lead to delayed physical growth, impaired immunity, and possibly to delayed mental development. Mild forms of this mineral deficiency, which are common in both developing and developed nations, appear to have negative effects on growth and development (Cole Cr, 2008). However, the lack of a sensitive indicator of mild zinc deficiency hinders the scientific study of its health implications.

Mild zinc deficiency contributes to impaired physical growth in children (MacDonald RS., 2000). Significant delays in linear growth and weight gain, known as growth retardation or failure to thrive, are common features of mild zinc deficiency in children. More recently, a number of larger studies in developing countries observed results with modest zinc supplementation. A meta-analysis of growth data from zinc intervention trials recently confirmed the widespread occurrence of growth-limiting zinc deficiency in young children, especially in developing countries (Cole CR, 2008). Although the exact mechanism for the growth-limiting effects of zinc deficiency are not known, recent research indicates that zinc availability affects cell-signaling systems that coordinate the response to the growth-regulating hormone, insulin-like growth factor-1 (IGF-1)

Adequate zinc intake in children is essential in maintaining the integrity of the immune system (MacDonald RS, 2000) and zinc deficiency is associated with increased susceptibility to a variety of infectious agents. The adverse effects of zinc deficiency on immune system function are likely to increase the susceptibility of children to infectious diarrhea, and persistent diarrhea contributes to zinc deficiency and malnutrition. Zinc deficiency has been associated with poor growth in childhood, reduced immuno-competence, and increased infectious disease related morbidity

Magnesium

Magnesium has been known as an essential co-factor for many enzyme systems. It also plays an important role in neurochemical transmission and peripheral vasodilation (Rude RK, 1996). The mineral magnesium is involved in more than 300 essential metabolic reactions that are generally involved in energy production and the synthesis of nucleic acids (DNA and RNA), proteins,

carbohydrates, and lipids(Rude and Shils,2006). Magnesium also plays structural roles in bone, cell membranes, and chromosomes and is also required for various cellular processes, including ion transport across cell membranes, cell signaling, and cell migratio (Rude RK, & Shils M., 2006).The RDA of magnesium for children ages 4 to 8 years, which is 130 mg/day, was derived by extrapolating data from magnesium balance studies in older children (Abrams SA G. M., 1997).

The RDA for boys and girls ages 9 to 13 years is 240 mg/day. This recommendation was based on data from magnesium balance studies in children of this age (Rude and Shils, 2006). Good dietary sources of magnesium include nuts and green leafy vegetables because magnesium is part of chlorophyll — the green pigment in plants. Meats and milk have intermediate magnesium content, with milk providing 24-39 mg per cup (Rude RK, 2006) and refined foods generally have the lowest magnesium content.

2.5. Children school performance and Potential uses of school feeding program

School feeding programs are designed to provide food to hungry children and to improve their physical, mental and psychosocial health. Malnutrition is one of the major obstacles to human well-being and economic prosperity in developing countries (Ecker&Nene, 2012). The most recent report from Save the Children stated that adults who were malnourished as children earn twenty percent less in academic performance, on average, than those who were not (Save The Childern, 2012). Majority of the children interviewed highlighted that they came to school without having any breakfast. Most of the respondents narrated that their lack of food and basic meals was a contributing factor in dropping out of school. It was a major issue as they narrated: ‘Sometimes we go to school without a meal’. Some learners have dropped out of school because of not having any food at home “We sometimes only have one meal a day and sometimes sleep without taking in any food”; “We eat low calorie and less nutritious food like black tea in the morning and half bread and ’Shirowote with enjra’ sometimes at lunch and /or supper”. From different reports, one can conclude that the majority of children in the schools ate virtually nothing at all when they woke up in the morning and most of the time when they were at school.

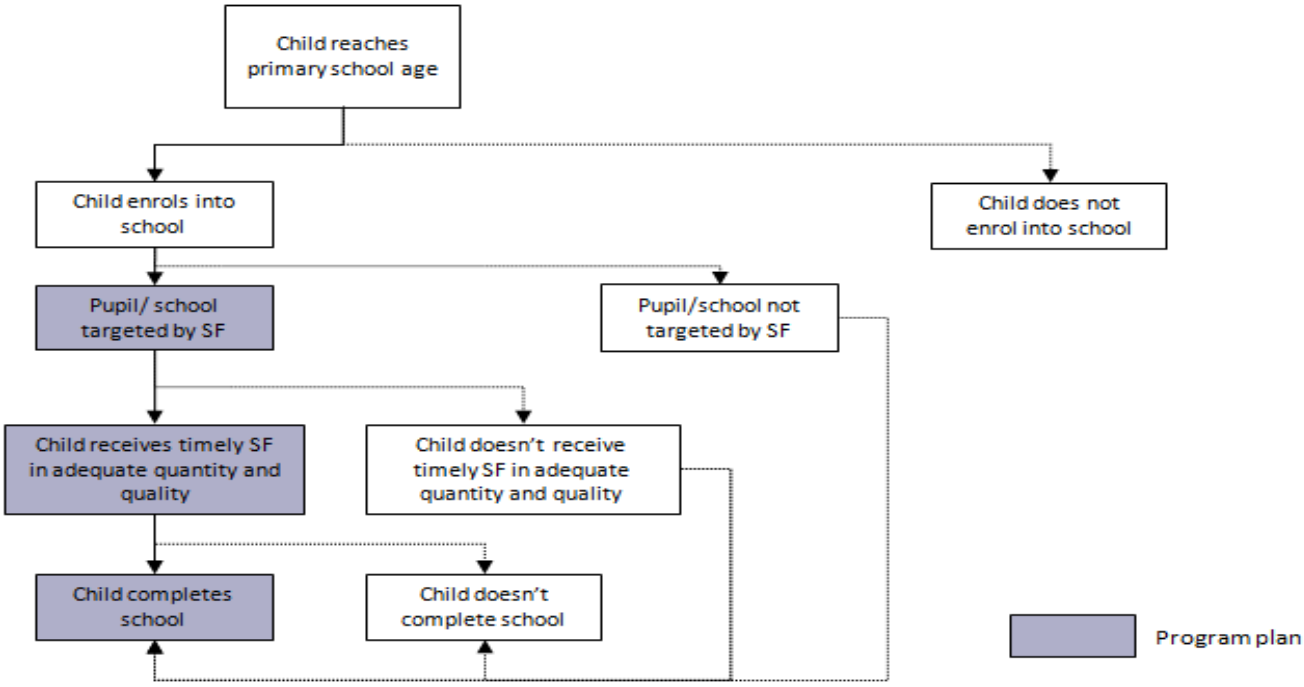


Figure 1: Proposed school feeding program schema/plan

2.5. School Feeding Program expected mechanism of impact on Educational Achievements

We can draw general idea about the potential of school feeding program as the potential impact goal of targeting children through school feeding programs is to increase their educational achievement so as to improve their potential future productivity and earnings. However, improvement in educational achievement due to serving food in SFPs is thought to occur through three pathways, as demonstrated in Figure 1. First, SF programs increase school attendance by lowering the opportunity costs of attending school and providing additional incentives to engage in formal education. This leads to more time spent in school and more time spent towards learning. The second is through the alleviation of short term hunger which improves children's cognitive functioning and attention span. The third path is through the improved nutritional status of children by providing them calories and nutrients in addition to their regular diet. This leads to better health and better resistance to infectious diseases and illnesses that would keep children from attending school (Buttenheim, 2011).So that children stay health and focuses on educational activities in order to perform better in school as we observed from the program evaluation by stakeholders in the program coordination.

Thus, better nutrition indirectly improves educational achievement by increasing school attendance by children. And also reduce their anemic problem by increasing their hemoglobin level because Anemia is low counts of red blood cells or low levels of hemoglobin in the bloodstream, and reduced capacity for the blood to carry oxygen. Anemia is a health problem with significant economic consequences. In children, it impairs physical and cognitive development and reduces human capital accumulation via impacts on behaviors like school attendance. In adults, it reduces productivity, and associated with high maternal mortality. Nutritional intake is a behavior with purely private benefits; poor sanitation primarily constitutes an external harm. Promotion of eating iron rich food is important to improve iron level of children/adolescents and reduce anemia which in turn improve school age children higher school performance and makes them higher academically achieved (Buttenheim et al. 2011)

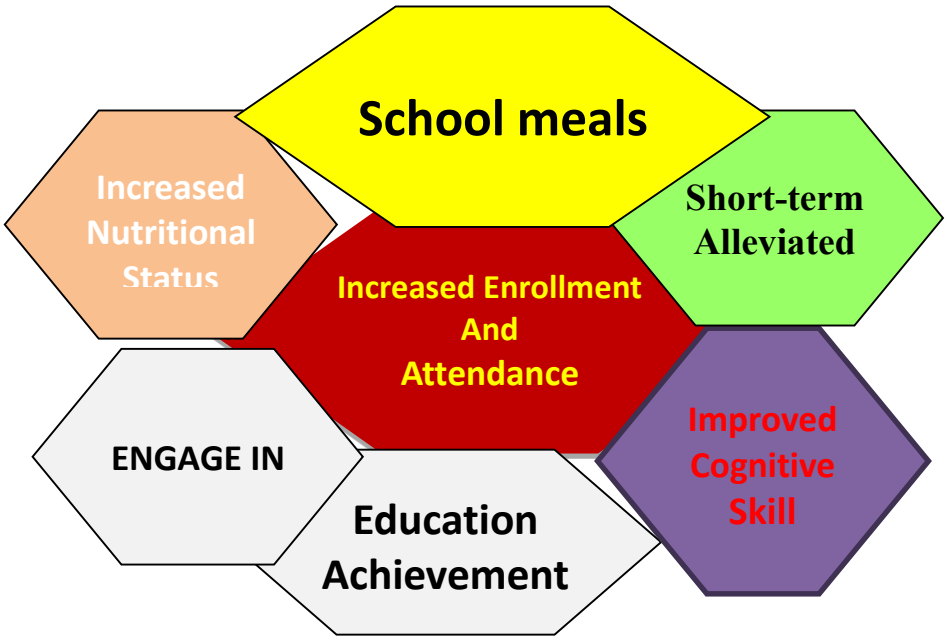


Figure 2: Relationship between SFP and potential outcomes and impacts on school children

Source: Adapted from Grantham-McGregor et al. (1998) and Jacoby et al. (1998).

However, there are some possible negative attributes to the first and the third paths that should be considered as well that may take away from improvements in educational achievement. For example, increases in enrollment may lead to overcrowding and lowering the effectiveness of classroom time or stretch the limited amount of school resources such as books. Depending on how the SFP is set up, teaching time may be reduced if teachers are used in overseeing the meal time (Grantham-McGregor S. , 1998).

2.6. Usefulness of school feeding program in Educational system and Health

School feeding were so useful in order to overcome different problem because Poor nutrition and health among schoolchildren contributes to the inefficiency of the educational system (Pollitt, 1989). School feeding is a very popular program that has been used to support the education, health and nutrition of children living in vulnerable food-insecure areas. Anemia diminishes oxygen transport in the body, resulting in potentially irreversible growth and developmental consequences for children. The burdens of hunger, malnutrition and ill-health on school-age children are major constraints in achieving the Education for All and the Millennium Development Goals (MDGs) on education (WFP, 2006).

Nutritionists and social scientists have widely recognized the causal relationship between nutritional status and the learning ability of children. Which can be correlated and have impact on children which were characterized by children with diminished cognitive abilities naturally perform less well and are more likely to repeat grades and to drop out of school; they also enroll in school at a later age, if at all, and finish fewer years of schooling (Jukes MCH, 2008). The irregular school attendance of malnourished and unhealthy children is one of the key factors in poor performance. Even short-term hunger, common in children who are not fed before going to school, can have an adverse effect on learning (Jacoby E. a., 1998). Children who are hungry have more difficulty concentrating and performing complex tasks (Powell C. W.-M., 1998).This is also in line with the performance of government elementary school children in Addis Ababa.

Studies have shown that undernourished children are more likely to have behavioral problems such as attention deficit, depression and aggression which in turn inhibit educational attainment (Kleinman, 1998). School meals could provide immediate alleviation from hunger reducing distraction and increasing concentration among students (Politt et al., 1981; Murphy et al., 1998). In

the long-term, therefore, school meals could improve classroom effort and there by the educational attainment of students by improving their nutritional status.

2.7. Potential impacts of school feeding Programs

The potential impact goal of targeting children through school feeding programs is to increase their educational achievement so as to improve their potential future productivity and earnings. However, improvement in educational achievement due to serving food in SFPs is thought to occur through three ways. First, school feeding programs increase school attendance by lowering the opportunity costs of attending school and providing additional incentives to engage in formal education. This leads to more time spent in school and more time spent towards learning. The second is through the alleviation of short term hunger which improves children's cognitive functioning and attention span. The third path is through the improved nutritional status of children by providing them calories and nutrients in addition to their regular diet. This leads to better health and better resistance to infectious diseases and illnesses that would keep children from attending school (Buttenheim, A.M.,et.a; ., 2011).Thus, better nutrition indirectly improves educational achievement by increasing school attendance by Children.

2.8. School feeding program impact on behavior

School feeding programs are premised on the expectation that serving food at school will increase enrollment and daily attendance of students. Thus, school feeding programs are hypothesized to alter the schooling decision for families who would not have sent their children to school otherwise (Adelman, Gilligan, and Lehrer 2008). This behavioral change by both the parents and the children is reflected in the rates of increase in such outcomes as enrollment, attendance, and length of schooling, and decrease in dropout rate, tardiness, and absenteeism.

2.9. School feeding and nutrition

Enhanced nutrition and health of primary schoolchildren leads to improved learning and decreased morbidity, paving the way for healthier lives. School feeding programs not only alleviate child hunger in school, but also enhance nutrition, particularly when the food is fortified with micronutrients. This raises the potential to improve a child's health, school performance and educational attainment. School feeding enhances the diet and increases the energy and kilocalories available to a child. It targets micronutrient deficiencies, which are widespread among school-age children in developing

countries and which increase susceptibility to infection, leading to absenteeism and impairing learning capacity and cognition (Latham et al., 2003; Van Stuijvenberg, 2005; Solon et al., 2003; Grillenberger et al., 2003). There is compelling evidence that poor nutrition in early childhood affects cognitive development and learning potential; poor health is an additional barrier to education (Jukes, Drake and Bundy, 2008).

2.10. School feeding improving learning and cognition

Providing food for consumption at school can be beneficial for learning because it relieves immediate short-term hunger. Children who are not hungry are more attentive and have higher cognitive abilities (Simeon D. a.-M., 1998). The food should be served as early as possible during the school day, for maximum benefit while the child is in school. Thus, timing of the meal or snack is important for addressing hunger and reaping cognitive benefits. Alleviating short-term hunger among children at school may contribute to improved performance in school tests and promote normal progression from grade to grade in completing a basic education. From Addis Ababa Education bureau reports indicates those students involved in school feeding program their reaction towards learning and participation on activity increased

2.11. School feeding as value transfer

During periods of shock and reduced purchasing power, families often resort to negative coping mechanisms, including taking children out of school to save on school fees and related expenses (World Bank, 2009.). School feeding program can help to safeguard households' investments in education by defraying some of the costs of schooling and encouraging parents to enroll their children in school and ensure that they attend class regularly throughout the complete cycle. This helps protect children from the risk of both formal and informal child labor and facilitates social integration (Paruzzolo, 2009). School feeding is a well-recognized safety net that transfers significant value to households with children enrolled in school or with school-age children (Bundy D, 2009). The value transfer from school feeding frees up resources within households, allowing families to buy food and invest in productive assets, and ultimately improving their livelihoods, nutrition and education. The value transferred is equivalent to the value of the food transfer delivered to the child at school.

2.12. Benefits of school feeding program

The benefits of SFPs are, arguably, very large (Ahmed., 2004). First, nutritional and health statuses have powerful influences on a child's learning and on how well a child performs in school. In particular,poor nutrition among school-age children impacts their cognitive functions and reduces their ability to participate in learning experiences in the classroom. Second, malnourished or unhealthy childrenare likely to attend school irregularly leading to poor academic performances. Third, it has beenshown in the nutrition literature that even short-term hunger (common in children who do no teat before going to school), can have severe adverse effects on learning and academic performances in general. Simply stated, children who are hungry have more difficulties concentrating and performing complex tasks, even if otherwise well nourished. Overall, beyond getting parents to enroll their children, SFPs can have a far reaching impact on children nutritional and health status and how they perform in school.

2.13. School feeding programs enhance children's education

Education systems are undermined when children who do attend school are unable to get the full benefit of doing so due to being malnourished. School feeding programs are not only useful in encouraging children to enroll and stay in school but also for enhancing their learning. An estimated 23 million children in sub-Saharan Africa attend school in a state of malnutrition, a situation which has far-reaching consequences for their education (WFP. , 2010).

Research has shown that malnourished children lack the capacity for learning possessed by their well-nourished peers. Poor school achievement among primary school and adolescent children has also been linked to consequences of malnutrition such as iron deficiency. Overall malnutrition undermines cognitive development, resulting in irreversible losses for learning opportunities for the future (WFP, 2007.).

According to (UNICEF ,2006), the depletion of human intelligence on such a scale for reasons that are almost entirely preventable is a profligate, even criminal and waste. Well-designed food programs which include micronutrient fortification can provide vast nutritional benefits, thus mitigating the undermining effect that malnutrition has on children's education. Comprehensive school feeding is near universal in high and middle-income countries but countries with the greatest need are those where the school feeding programs are currently least adequate. The near universality of school feeding, and the inadequacy of program where the need is greatest, suggests the need for development

partners to assist governments to roll out safety nets in response to the current global crises (World Bank , 2009). Slower economic growth resulting from the global financial crisis can trap a further 90 million people worldwide in poverty and more children will face the threat of malnutrition (UNESCO, 2009b).

The vast human development potential of basic education renders the achievement of universal primary education invaluable for developing nations. A large number of children, however, do receive the benefits of primary education because rising poverty, unemployment and decreasing remittances during the economic downturn force people from poor or vulnerable households to cut back on education spending or to withdraw their children from school altogether (World Bank, 2009).

School feeding program are not nutrition interventions to tackle malnutrition at its roots or to compensate for nutritional shortcomings during early childhood. Malnutrition has multiple causes, including poor food consumption patterns, illness, lack of sanitation and poor health and hygiene practices. Serious mental damage, such as reduced intelligence and lower physical capacity is predominantly a result of poor nutrition during earlier periods in life, before children start going to school. School feeding program therefore cannot be considered to be pure nutrition program, and should not be prioritized at the expense of efforts to reach pre-school children with effective nutrition interventions.

Strategically, school feeding programs cannot replace nutrition programs that target vulnerable groups, such as pregnant and lactating mothers or children under two years of age. The comparative advantage of school feeding programs therefore lies in their ability to play a supportive role with regard to children's education in that they can help to bring children to school. The added nutrition from school meals also can help students to be more attentive and to increase their concentration span during lessons, ultimately enabling children to learn better. This is particularly relevant in areas where malnutrition is a severe and acute problem (WHO, 2007).

3. Materials and Methods

3.1. Description of the study area

The study was carried out in Arada sub city at four elementary school, Addis Ababa Ethiopia.

Addis Ababa lies between9°1′48″N latitude and 38°44′24″E longitude. The city is located at the heart of the country at an altitude ranging from 2,100 meters at Akaki in the south to 3,000 meters at Entoto Hill in the North. The average altitude of the city is 2400 meter above sea level. This makes Addis Ababa the third from the high elevation city of the world following La Paz and Quito in Latin America. Its time zone is categorized in east Africa time (UTC+3). The city occupies a total area of 540.Km2. According to CSA, the projected population of Addis Ababa was 3,048,631(CSA, 2011/12, projected population). There are 23 government elementary school involved in school feeding program in Arada sub city.

3.2. Study design

School based cross sectional and comparative perspective cohort study was conducted to cover the stated objective. The study uses a combination of cross sectional for taking a sample of one meal served for a single student at a time and prospective cohort study design for taking a base line data before feeding for fed group and non-fed group and also after six months of intervention for both group in which students are randomly assigned to treatment and control groups and data are collected before the interventions are rolled out and after the interventions have been implemented. Then the data were compared between the fed group and also between the fed and non-fed group .Our identification strategy relies entirely on the random assignment of the students to treatment and control groups based on similarity in socio-demographic characteristic between the groups. Because of this random assignment the estimated program impact has a causal interpretation because both group have similar socio-demographic characteristics problem.

Study Population

The study subjects were 234 students were selected by randomly from four schools who have the same problem in socio economic status by purposive assigning 117 students involved in school feeding program and 117 in non-school feeding and 4 schools were selected from the schools participating in the program by random sampling using lottery technique from 23 Government primary schools in Arada Sub city Addis Ababa, Ethiopia.

Exclusion Criteria

Students with mental and chronic heart problem and those who are not willing were not included in the study

3.3. Sample size determination and sampling

Since the study was on the nutrient composition of the food supplied ,children nutritional status and their school performance in Government primary schools in Arada Sub city ,equal number of students by purposive random sampling were taken proportionally from each grade level and from 4 schools were classified into those in the school feeding program(n=117) and non-school feeding program(n=117). Addis Ababa , Ethiopia , data is available for stunting accordingly , stunting proportion of Addis Ababa which is 23% (with 95% CI) were used.

$$\mathbf{n = [z^{2}_{\alpha/2} * p\ (1\text{-}q)]\ /ME^{2}}$$

Where: n= sample size

$Z\propto_{/2}$= critical value of 95% confidence level of certainty (1.96)

ME= marginal error =0.05

P=proportion=0.23

$$n = \frac{(1.96)^2 * 0.23(1-0.67)}{(0.05)^2} = 236$$

3.4. Sampling procedure

Out of 234 students, the Control groups (non-school feeding) are 117 students were considered from each selected school proportionally form each grade level and the remaining students 117 are from the target group those students who are involved in the feeding program. A total of 234 registered students were recruited. Students were then classified into in the school feeding program (n=117) verses non-school feeding program (n=117) based on students involvements in the school feeding or non-school feeding having the same problem.

3.5. Data analysis

Data were entered using Epi version 3.5.3 and WHO 2007 Althro plus version 2.0.4 software. Both bivariate and multivariate logistic regression analysis was done to identify associated factors. One

sample independent t-test ,paired sample t-test data analysis was also used .Odds ratio with 95%confidence level were used to report significant factors. In this cross sectional and comparative perspective cohort study, anthropometric data, hemoglobin level , homogenized food samples were collected from 4 Elementary School in Arada Sub city by purposive random sampling and 234 students are selected using stunting as population proportion from the students participating in the program and their anthropometric indices of weight-for-age, height-for-age, hemoglobin and BMI-for-age were used to estimate the children's nutritional status. The Experiment was carried out from November 2015 to Jan 2017 in Addis Ababa University center for food science and nutrition laboratory, Arada Health centers and EPHI, Addis Ababa.

3.6. Data Collection Method

Data were collected using structured interview administered questionnaire, proximate composition of the food supplied/provided ,capillary blood finger prick using Hemacure301^{+}(Agalen ,Sweden) for hemoglobin level, Anthropometric measurements and students average score at baseline and after six months of intervention for both arms .

Questionnaire translated into the local language (*Amharic*) for demographic information purpose , Anthropometric measurements: according to WHO standard procedures, students result from student record book, Hemoglobin determination was done by taking a finger-prick blood sample using a Hemocue, haemoglobinometer (Hemocue301+, angelholm, Sweden), Dietary assessment was done using food frequency questionnaire and proximate composition analysis ,Data collectors (Nurses, lab technicians and experienced health professional staff) and Data quality was assured.

Nutritional assessment/ Anthropometric data

Body weight was measured to the nearest 0.1 kg on an electronic digital scale and height was measured to the nearest 0.1 cm using measuring instrument **(**Stadiometer, CE 0123, Germany,). Overweight (> + 1SD BMI-for-age z score), obesity (> + 2SD BMI-for-age z score), thinness/ wasting (< −2SD of BMI-for-age z score), underweight (< −2SD of weight-for-age z score) and stunting (< −2SD of height-for-age (HAZ) z score) were defined according to the WHO references. Since weight-for- age (WAZ) is inadequate indicator for monitoring child growth beyond pre-school years

due to its inability to distinguish between relative height and body mass, therefore, BMI-for-age is recommended by the WHO to assess thinness/wasting in registered school-aged children.

Hemoglobin test

Hemoglobin determination was done by taking a finger-prick blood sample using a Hemocue haemoglobinometer (Hemocue301^{+}, angelholm, Sweden). After analysis, hemoglobin values were adjusted for altitude according WHO Hgb adjustment formula (Sullvan et al., 2008)

Hgb adjustment = -0.032 x (Altitude x 0.0032808) + 0.022 x (Altitude x 0.0032808)2

Hgb adjustment = -0.032 x (2400 x 0.0032808) + 0.022 x (2400 x 0.0032808)2 = 1.11

Hemoglobin determination was done by laboratory technicians for the selected students in the health center compound. The hemoglobin level of each student was measured by taking a finger-prick blood sample using a Hemocue haemoglobinometer (Hemocue, angelholm, Sweden). A prick was made on the tip of the middle finger after the site was cleaned with disinfectant. The first drop of blood was cleaned off and the second drop (0.05ml) was collected to fill the micro cuvette which is then placed in the cuvette holder of the device (HemoCue Hb 301+) for measuring hemoglobin concentration. The displayed hemoglobin value was then recorded. The technique is recommended by WHO. Data collection was supervised daily by trained field supervisors and the principal researcher. Hemoglobin level was divided into four for two age categories. For children 5 to 11 year; 11.5 g/dl normal, 11.0–11.4 g/dl mild anemia, 8.0–10.9 moderate, and < 8.0 g/dl severe anemia. For children 12 to 14 year; 12 g/dl normal, 11.0–11.9 g/dl mild anemia, 8.0– 10.9 moderate, and < 8.0 g/dl severe anemia . Hemoglobin concentrations were corrected for altitude as proposed by the WHO .The adjustment value (1.11) was subtracted from each Hgb value.

Trained senior nurses (8) laboratory technicians were recruited from the health Centre for collecting figure prick blood samples and performing the laboratory analysis and Hemoglobin levels of the students were measured before the feeding program and after the feeding (after 4 months) and analyzed using Hem cure .Children were accompanied by the principal and supporting teachers involved as school feeding program coordinators during hemoglobin, socio-demographic characteristics and anthropometric measurements .

Representative food samples were collected from 4 schools random sampling from schools that were beneficiaries of the SFP in Arada Sub city Government primary schools, Addis Ababa Ethiopia. The

SFP representative or school principal was notified prior to the visit and arrangements was made to collect food samples which would be collected during serving times (between 2:30 and 6:00 local time), during the School time breakfast and lunch food sample were collected separately for five days in a week for each school separately because serving time is during class time only. This notification was necessary because schools may not always adhere to the serving time stipulated by the AAEDB as they operate differently in terms of the duration of classes and general attendance. The samples consist of representative portions of food that were served to children under normal serving practices

In an attempt to collect a variety of food and obtain a wider perspective on the nutritional benefits of the meals, the samples were collected on specific days with guidance regarding menus provided by the schools. A school uses the menu provided by the AAEDB which would have detail descriptions of meals to be served each day, as a guideline.

Meal size of one child was collected per day for the five school time in all those four school consequently. The Schools were alphabetically coded to maintain confidentiality. The food handlers followed recommendations of the Addis Ababa Education Bureau in preparing the meals with some modifications according to availability of ingredients. All meals were prepared on the day they were sampled. The average score at baseline data before school feeding program started and after a years, school performance of the students in feeding program and non-school feeding program and demographic data were collected.

3.7. Proximate Analysis of the sample

The samples was transported to Addis Ababa university center for food science and nutrition laboratory on ice and homogenized upon arrival at the laboratory. Sampling and analyses were performed in duplicate.

3.7.1. Proximate analysis (Determination of nutrition value of the food supplied)

Proximate analysis (moisture, ash, crude protein, crude fat, crude fiber and carbohydrate) were done at food science and nutrition laboratory of AAU and EPRI.

3.7.1.1. Moisture content determination

Metal dishes with their covers used for the moisture determination was washed with water and dried at 130 o c for 1 hr. to a constant weight in drying oven provided with a motor fan (model DHG 9055A). The dishes were uncovered during drying in the oven but at the end of the drying immediately before transferring to desiccators. Then the dishes provided with cover placed in the desiccators were cooled for 30 minute to room temperature. Using digital balance, the weight of each covered dishes was weighed (w1) after tarring and about 2 g of sample was weighed (W2) in to each of the dishes. The dishes with loosen cove together with the sample taken were then transferred into an oven set at 130o c for 6 hrs. to dry until a constant weight reading would be achieved . At the end of the drying the dishes (were covered while it is in the oven)plus sample were removed from the oven transferred to desiccators , cooled and the mass is weighed soon after (W3) loss in weight was reported as moisture content (AoAC 2000,925.10) the moisture content were calculated from the subsequent formulas

$$\textbf{Moisture (\%)} = \frac{W2 - W3}{W2 - W1} \times 100$$

Where,

W1 = weight of empty dish

W2= weight and sample together before drying

W3= weight of dish and sample after drying

3.7.1.2. Ash content determination (direct method)

Porcelain crucibles were washed with water and HCL and dried at 130c for 30 minutes in drying oven. The crucible was ignited at 550oc in furnace to a constant weight 2hr placed in the desiccators for 1 hr to cool in to room temperature and their mass were weighed W1 soon after reaching room temperature using digital balance. About 5g of each sample were measured W2 and transferred in to the crucible. The crucible with the sample was placed on the hot plate at low temperature, to char the sample until it turned black. Then the charred sample were placed in the furnace at 550 until light gray ash was obtained (6 hours), then the crucible were cooled (hour) and finally the ash and crucibles were measured together.(W3)

The amount of ash were calculated from the following formula

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

Where,

W1 = mass of empty crucible

W2= mass of crucible and sample before ash

W3= mass of crucible and ash

3.7.1.3. Crude fat content determination (Soxhlet -ether extract method)

The cleaned aluminum cups , were used for the extraction of fat , with boiling chips was placed in drying oven at 130 for 1 hr and cooled to room temperature in a desiccator for 30 minutes then about 2 g of samples were measured (w1) in to an extraction thimble , with porosity permitting rapid passage of ether lined with fat free cotton and 50 ml of diethyl ether was added to in to each weighed aluminum cups with boiling chips . Then the thimbles with the samples were attached to soxhlet extraction apparatus and set up of the extraction apparatus are done for 3 hrs. Which is started when the hot plat temperature were reached at 55 ^{o}c after soaking the thimbles were lifted up and extraction process is taken place for 4 hrs. Then the recycling the process made by the diethyl ether were stopped to let the solvent to evaporate from the aluminum cup with the extract , in the process the evaporated solvent were recovered in the apparatus . The aluminum cup and the content were dried in the oven for 30 min at 100c to evaporate the reaming cup and the content were dried in the oven for 30 min at 100^{o}c to evaporate the remaining solvent in the cup. Finally, the aluminum cups and the content were dried in the oven for min at 100^{0}c to evaporate the remaining solvent in the cup, cooled in desiccators for 30 minutes, and weighed (w3) using digital balance AOAC 2009, 920.39)

$$\textbf{Fat (\%)} = \frac{W3 - W2}{W1} \times 100$$

Where,

W1 = weight of sample

W2= weight of cup and its content before extraction

W3= weight of cup and it content after extraction

3.7.1.4. Crude protein content determination (kjedahl method)

Crude protein content was determined based on the method described by AOAC92000, 955.04) about 0.5 g of sample was weighted and sulphuric acid and 3.5 ml of 30% hydrogen peroxide solution as oxidizing agent , were added in to the digestion flask . The tubes were shacked until the violent reaction disappeared. Then about 3 g of the catalyst mixture made of 10 g of $CuSO_4$, to facilitate digestion, and 150 g of the catalyst mixture made of 10 g of $CuSO_4$, to facilitate digestion, flask. The tubes were shacked until the violent reaction disappeared. The same procedure was followed for blank sample too, and then the mixtures were digested in the digester at a temperature of 370^{o}c for 4 hrs. and allowed to cool in the digester for 30 min therefore , digestion were the first reaction that occurred during protein determination that converts any nitrogen in the sample in to ammonia and other organic matter to CO_2 and H_2O in acidic solution , ammonia is not liberated as gas because it exists as ammonium sulphate salt.

N. (in a food) + H_2SO_4 ⟶ $(NH4)_2SO_4$

After digestions were completed, distilled water (25m1) and NaOH (25ml) was added to the digested sample in order to neutralize the acid and to make the solution slightly alkaline. $(NH_4)_2SO4$ +2NaOH ⟶ $2NH_3$ +$2H_2O$ +Na_2SO_4

Distillation is the next step followed by titration. Therefore , the ammonia were distilled in to receiving conical flask that consist solution of 25 m1 H_3BO_3 (4%) 25ml distilled H_2O and indicator (methyl red .) distillation were stopped when the volume of liquid reached 250 ml

NH_3+ H_3BO_3 (boric acid) ⟶ NH_4+ H_2BO_3- (Borate ion)

Then the borate ion is directly titrated with standard acid (0.1N HCl) and the volume of consumed HClat the end of titration (color change)was recorded for all samples including blank sample.

H_2BO_3+ H+ ⟶ H_3BO_3

The nitrogen content is calculated form the following equation

$$\textbf{Nitrogen (\%)} = \frac{V \times N \times 14}{W} \times 10$$

Where

V (M1) = volume of HCl consumed to the end point of titration

N(0.1) = the normality of HCl used often is about (0.1N

14= the atomic weight of nitrogen

W (g) = sample weight

The protein content were calculated form the following equation

Nitrogen (%) = N × F

Where, **F** the conversion factor which is 6.25

3.7.1.5. Crude fiber content determination

Crude fiber analysis were conducted using the method of AOAC (2000, 962.09)) about 2 g of samples were measured and transferred analytically in the 6 00ml beaker. Then 200 ml of H_2SO_4 (1.25%) Were added in to the beaker the level of the volume was marked on the beaker, and then it was boiled for 30 min on the hot plate by stirring periodically. During boiling the level were kept constant by addition of hot distilled water. After exactly 30 mints of boiling 20 ml of 28 % KOH is added with occasional starring using glass rod for additional 30 min of boiling. The level of the mixture was still kept constant by adding hot distilled water. After billing was completed the solution was poured in to the wetted sintered glass crucible which is filled with 10 mm a sand and the mixture was filtered by turning the vacuum pump on . The beaker wall saw rinsed several times with hot distilled water and transfer to crucible. Then the residue in crucible was washed , with hot distilled water andH_2SO_4 (1%) and again with hot distilled water , then with NaOH (1%) , and aging with hot water , thane wit 1%H_2SO_4 , then with hot water filtration was there in every washing process . finally it was washed using water free acetone . the solution in each beaker will be then filtered through crucible containing sand by placing each of them on cruncher funnel fitted with No.9 tuber stopper . during filtration the sample was washed with hot distilled water . the final residue were washed with acetone . each of the crucibles with their contents were dried for 2 hr at 130 OC in furnace and

was cooled in desiccators finally then mass of each crucible were weighed (M2) the washed crucible with the digested sample were dried for 2 hr in the oven at temperature of 130Oc . then it was cooled in the desiccators for 30 min then it was weighted immediately after taking out from the desiccators and mass were taken as W1(crucible + fiber +ash) . after that the crucible were transferred to the furnace for 30 min at temperature of about 550c for ashing then it will be cooled in the desiccators and weighed , the mass were taken as W2 (crucible + ash) were cooled in the desiccators and weighed the mass were taken as W2 (crucible+ ash) .

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

Where;

W1 crucible Wt. after drying **W2** crucible weight after ashing

3.7.1.6. Carbohydrate content determination (by difference)

The carbohydrate content of the homogenized food sample were determined by difference method, by subtracting the sum of to the components of proximate composition from 100.

3.7.1.7. Energy value determination

Energy value were calculated by applying factors of 4, 9 and 4 for each gram of crude protein, crude fat and carbohydrate respectively (Shreshta and Noomhorm, 2002)

Energy value = protein × 4 + carbohydrate × 4 +fat × 9

3.7.2. Minerals Analysis

Iron, Magnesium, calcium, and zinc were determined using flame atomic absorption spectroscopy(AAS) The samples were ashed at 525 C and are treated with 7ml of 6N of HCI for wedge section and the deist is recovered with 7ml of 3N of HCI by heating on a hot plate until boiling. The ash solution is cooled to room temperature in a hood and is going to be filtered in to a 50 ml graduated flask using a filter paper(Whitman 42, 125mm)five ml of 3N of HCl is added into each crucible are rinsed three times with deionizer water; the washings is filtered into the flask (Osborne and Voogt, 1978).A2.5ml of 10% lanthanum chloride solution is going to be added into each

graduated flask .Then .the solution is cooled and diluted to 50 ml with deionizer water A blank which contains 12ml 3M of HCl and deionizer water in 50 Volumetric flasks is also prepared.

Standard solutions: Four series of Working standard metal solutions are going to be prepared by appropriate dilution of the metal stock solutions (nitrate of the metal) with deionizer water after manipulating the instrument operation procedure, calibration graph (concentration versus absorbance)for each element using the prepared standard solutions is foxing to prepared .The sample concentrations are going to be analysed using flame atomic Absorption aspirating deionizer water. Sample blank solution is run with the sample solution.

Metal content (mg/100g) = [(a-b) xV]/10 W

Where, W= Weight of sample in (g), V= Volume of extract (ml),a = Concentration of sample solution (μ-g/ml) and b= Concentration of blank solution (μg/ml).

3.8. Statistical analysis

The results of this study were analyzed according to the WHO, 2007 standards, which are derived from the Dietary Reference Values, for an average school lunch. It was deemed necessary to compare schools that served the same meal in order to explore the possible impact of the preparation methods on the nutritional quality. The results were expressed as grams/ day for macro and as kilocalories/day for energy. All descriptive and inferential statistical analyses were performed using Sigma Plot 10.0.1, SPSS software. In the cases of determination of significance, the *t*-test was used with a significance level of 0.05. Means of duplicated values ± standard deviations and percentages were used to present the results.

Average score result before school feeding program started and after a year , Scio- demographic characteristics and Hemoglobin level of the students in the school feeding program were compared with the students in the control group(these students not in the school feeding program) .

Data were analyzed using SPSS version 20 statistical package (SPSS, Inc., Chicago, IL, USA). A one-sample Kolmogorov-Smirnov test was used to assess whether the data was normally distributed. Pearson's t-test was used to assess the correlation between two continuous variables control and *beneficiaries of* the school feeding program. Statistical significance was assigned for p values less than 0.05. Anthropometric data were analyzed using WH O Anthro Plus software .The Z score values for height-for, weight- and BMI-for-age were calculated using the WHO, 2007 reference. The Z score values relative to the WHO reference were calculated by the SPSS files provided by the WHO.

Ethical consideration

The study were carried out after getting permission from the institutional review board (IRB) of Addis Ababa university center of food science and nutrition. Verbal informed consent was obtained from the parents /caregivers. Confidentiality of the participants consent form were prepared before conducting the data collection. The participants were promised to keep confidentiality regarding their details.

4. Result and discussion

A total of 236 study subject, from grade 1 to grade 8 were enrolled in the study. The response rate was 99.2%. The results of the survey obtained from 234 students is presented as follows.

4.1. Socio demographic characteristics of the study participants

All the study participants were from Arada sub city school. The participants were grade 1^{th}-8^{th} (Table 1) Out of 234 Fifty percent of the participants (117) were male. The majority of the students were between 9-13 years of age 187(79.9%).

Half of the students (117) were enrolled in the SFP School (Treatment Group) of which, 59 students were male (50.4 %,). Similarly out of 117participants in the non-SFP group (control Group), 58 (49.6%) were males. The family size of those children in the school feeding program is not significantly different from the family size of those in the non-feeding ones. Family size does not have a significant difference in both groups (p-value=0.0856). Students who had lived in the family of ≤ 3 persons per home showed good academic performance 1.4 times than those who had lived in the family of >4 persons (OR 1.39, 95% CI 1.37-1.67). Orthodox Christianity (76.9%) was the most Common religion among them. The majority of household size was 4 ± 2 members comprising of a mean of 2± 1 adults and 3 ± 1 children (<15yrs).

Table 2: Demographic characteristics of students of Arada sub city elementary schools children Jan 2017

		N	%	SFP	%	Non-SFP	%	p-value
Grade	1th to 4th grade	127	54.3	67	57.3	59	50.4	0.388
	5th to 8th	107	45.7	50	42.7	58	49.6	0.708
Sex	Male	117	50	59	49.6	58	49.6	0.145
	Female	117	50	58	50.4	59	50.4	0.312
Age Category	7-8 Years	26	11.1	9	7.7	17	14.5	0.313
	9 – 13 years	164	70.1	88	75.2	76	65	0.165
	≥ 14 years	44	18.8	20	17.1	24	20.5	0.551
Religion	Orthodox	180	76.9	95	81.2	85	72.6	0.551
	Muslim	37	15.8	17	14.5	20	17.1	0.888
	Protestant	13	5.5	3	2.6	10	8.6	0.323
	Others	4	1.7	2	1.7	2	1.7	
Residence	Own home	45	19.2	28	23.9	17	14.5	0.09
	Rent home	189	80.8	89	76.1	100	85.5	0.081
Family Size	≤ 3 person	181	77.4	89	76.1	93	79.9	0.085
	3-4 person	33	14.1	17	14.5	15	20.5	0.525
	>4 person	20	8.5	11	9.4	9	7.7	0.097
School attendance /performance								
Do not repeat or drop out		150	64.1	70	59.8	80	68.4	0.023
Drop out class		32	13.7	17	14.5	15	13.7	0.084
Repeat class		51	21.8	28	23.9	23	19.7	0.094
Drop out and repeat class		21	8.9	12	10.3	9	7.6	0.087
Time rounded traveling to school								
	≤ 15 minutes	152	65	77	65.8	71	60.7	0.969
	> 15 minutes	82	35	36	30.8	46	39.3	0.649

4.2. Socio demographic status of parents of the study participants.

Among the 234 caregivers 168(71.8 %) and 66 (28.2%) were literate and illiterate respectively (Table 2).Ninety three of 234 caregivers (39.7 %) were government employees, and 71 (30.3 %) of them were private-employed while the rest of them 70(29.9%) had no permanent income generating work. Most of the caregivers educational level (41.9%)were classified in primary school level. A majority (56.8%) of caregivers reported a household income of between 300-900 birr. Caregivers of school age children in the SFP and NSFP had

Similar socio-demographic characteristics except that the majority (39.7%) of Caregivers of the SAC in the SFP and NSFP were in government employed whereas the others caregivers of the SFP children were engaged in private and non-permanent employed (p=0.856).

Table 3. Educational and Socioeconomic status of parents / guardians of Arada Sub city elementary school Children, Jan, 2017 (n=234)

Socio Economic status		Total number	%	Target group	%	Control group	%	p-value
Caregivers Educatio	illiterate	66	28.2	32	27.4	34	29.1	0.856
	Literate	168	71.8	85	72.6	83	70.9	0.721
Caregiver education level	Primary education	98	41.9	56	47.9	42	35.9	0.034
	Secondary education	34	15.5	17	14.5	17	14.5	0.912
	Tertiary	47	19.2	24	20.5	23	19.7	0.652
	No formal education level	57	24.4	22	18.8	35	29.9	0.041
	Mother primary father secondary	96	41	47	40.2	49	41.9	0.756
	Mother secondary Father primary	69	29.5	42	35.9	27	23	0.031
	Mother illiterate Father primary	37	15.8	22	18.8	15	12.8	0.042
	Mother primary Father Illiterate	36	15.4	20	17.1	16	13.7	0.752
	Gov't employee	93	39.7	41	35	52	44.4	0.041
Caregiver Occupatio	private-employee	71	30.3	41	35.1	32	27.4	0.043
	No permanent work	70	29.9	35	29.9	33	28.2	0.856
Care giver month income	<300	71	30.3	35	29.9	36	30.8	0.951
	300-900	133	56.8	66	56.4	69	59	0.881
	>900	30	25.6	18	15.4	12	10.2	0.542

4.3. Socio Economic status of parents and guardians of the study participants.

Out of 234 study participants192 (82.1%),51 (21.6 %),48 (20.3%),158 (67%) and 174(73.7%) had access to mobile phone, wired phone, refrigerator ,Radio and TV set respectively (Table 3).One hundred ninety three 193 (82 %) lived in rented houses from private or government(kebele/woreda). One hundred ninety three 193 (82.5%) and 41(17.5 %) of the participants lived with the family of <4 and >=4 persons per house, respectively. The major sources of fuels used during the cooking were charcoal 125 (53.4%). The majority of the study households 174(73.7 %) cook in their living room (not separate).

In school feeding program ,the number of students who had access to mobile phone, wired phone, refrigerator, Radio and TV set were 99(84.6%),28(23.9%),28(23.9%),80(68.4%) and 92(78.6%),respectively. Almost more than half of the children parents /guardian of school feeding children 63(53.4%) were use charcoal for cooking, 92(78.6%) of them were cooking in their living house, 95(81.2%) of them were lived in rent house and more than half 97(82.9%) of them were had less than 4 family members per house.

While children who are not involved in school feeding program parents/guardian who had access to mobile phone, wired phone, refrigerator ,Radio and TV set were 93(79.5%),23(19.7%),20(17.1%),78(6.6%) and 82(70.1%),respectively. Almost more than half of the children parents /guardian of school feeding children 62(53%) were use charcoal for cooking, 80(68.4%) of them were cooking in their living house, 98(83.8%) of them were lived in rent house and more than half 95(81.2%) of them were had greater than or equal to 4 family members per house.

This indicates that the socioeconomic status of parents/guardians of children in school feeding program proportionally is not significant different from those in non-school feeding program.

Table 4. Socioeconomic status of parents / guardians of Arada Sub city elementary school Children, Jan, 2017(n=234)

Socioeconomic variables. % HHs have		Total]	%	Target group	%	Control group	%	p-value
Availability of Radio	Yes	158	67.5	80	68.4	78	66.6	0.951
Availability of TV	Yes	174	74.4	92	78.6	82	70.1	0.083
Availability of Radio and TV	Yes	90	38.5	24	23.1	56	47.9	0.034
Availability of Mobile only	Yes	192	82.1	99	84.6	93	79.5	0.883
Availability of wired phone only	Yes	51	21.8	28	23.9	23	19.7	0.756
Availability of Refrigerator	Yes	48	20.5	28	23.9	20	17.1	0.451
House Owner Ship	Our house	41	17.5	22	18.8	19	16.2	0.879
	Rent	193	82.5	95	81.2	98	83.8	0.987
Family Size	≤ 3 person	181	77.4	89	76.1	92	78.6	0.856
	3-4 person	33	14.1	20	17.1	13	11.1	0.479
	>4 person	20	8.5	10	8.6	10	8.6	0.913
Type of fuel sources	Charcoal	125	53.4	63	53.9	62	53	0.956
	Electricity	61	26.1	25	21.4	36	30.8	0.03
	Kerosene	22	9.4	15	6.4	7	6	0.04
	Wood	23	9.8	13	5.6	12	10.3	0.857
	Cylinder	3	1.3	3	1.3	0	0	0.001
place where they cook food	In the Living	172	73.5	92	78.6	80	68.4	0.007
	In Separated house	62	26.5	25	10.7	37	31.6	0.051

4.4. Nutritional status of the study subject for BMI for Age value

The body mass index (BMI)for age of the students was calculated according to the Quenelle's Index nutritional evaluation tools used for adults that were adopted to adolescents by CDC,2000(33). According to the Quenelle's Index, the mean and standard deviation of the BMI–for-age were calculated as 16.57 and 2.37 respectively for the non-feeding group while for the feeding group were 16.66 and 2.73 respectively. The difference in the mean BMI for feeding and non-feeding group were not significantly different at (p-vale=0.134).

The prevalence of underweight (BMI value below the 5thpercentile)for Arada sub city schools were 43(18.4%) in all age value and out of total participant,160(67.8%) of them had normal weight (BMI

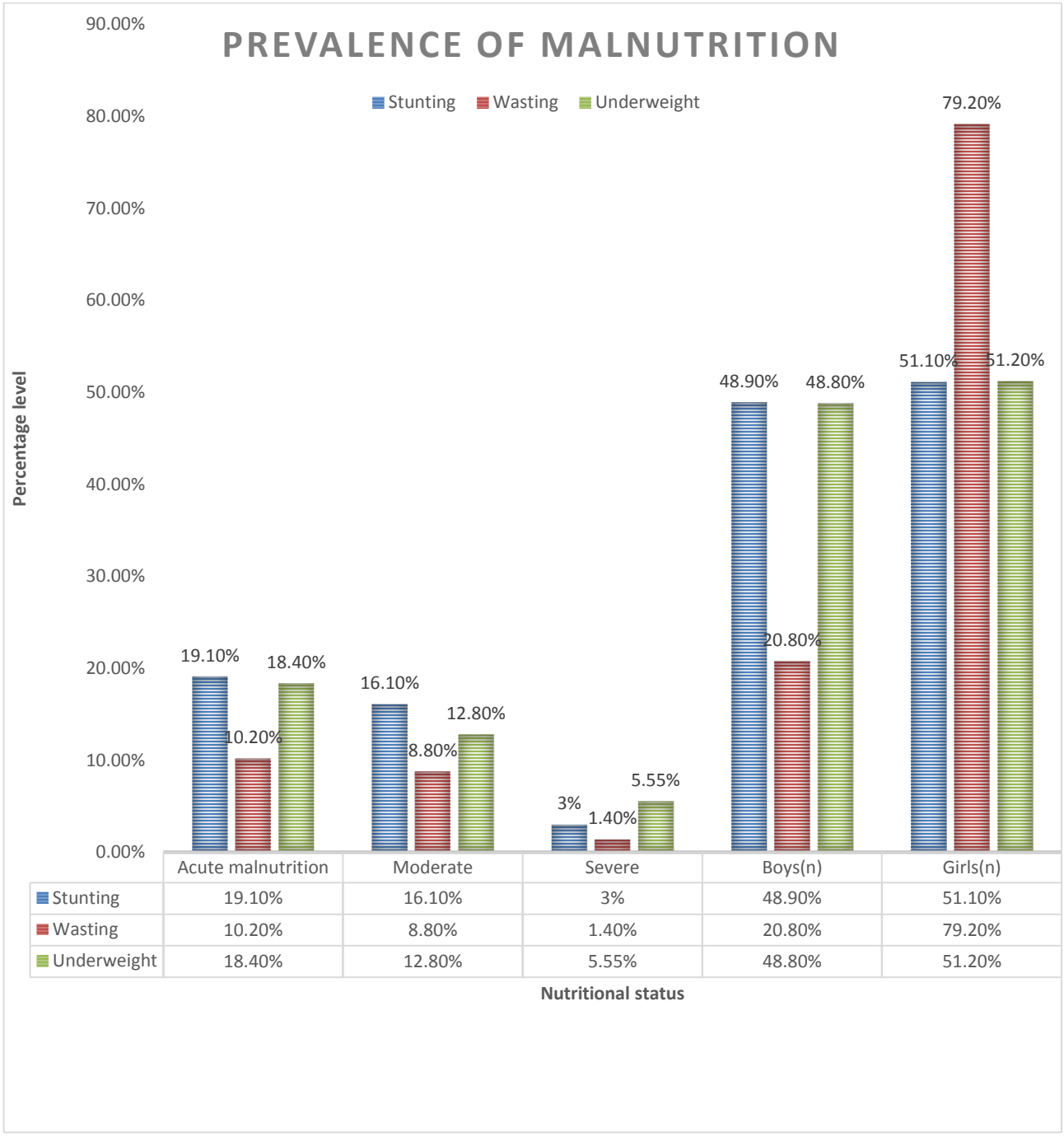
between 5th and 85th percentile) and there were 31(13.3) students who were overweight(BMI between 85th and 95th percentile) while there is no obese,(BMI above 95thpercentile).When we consider the non-feeding group for underweight and risk–of-over weight percentile in the area was 25(21.4%) and 26(22.2%)respectively which is significant difference(P-value=0.014) than the feeding group(underweight 18(15.1%) and risk-of-overweight 8(6.7%)) in all age group(p=0.013). On the other hand there is no overweight or obese case (BMI above95th) in both groups. When we see the normal weight (BMI between 5th and 85thpercentile) for the feeding group were 94(39%) which was higher than the non-feeding group 66(28%) at p-value=0.031 which indicates that feeding help significant difference in normality of BMI for age. There was no significant difference(p-value=0.623) for underweight between male and females and most of the underweight students were between the age 9-13 years old . But females were more overweight (9.3%)(p-value=0.011) than male (5.1%) in all age group and for both feeding and non-feeding group.

4.4.1. Nutritional status of all the school age children

From the total study population, the nutritional status of the school age children (age in years) was calculated using WHO (2007) and based on this 10.2%were wasted (1.3% severely and 8.9% moderately wasted).Prevalence of underweight was 18.4%(12.8% moderate and 5.5% severe)1.7%. Stunting was 19.1 %(3% severely,16.1%moderately stunted and 0.5 % 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 5.Overall acute malnutrition status of children

Prevalence as a whole										
Variable	Acute malnutrition		Moderate		Severe		Boys(n)		Girls(n)	
	N	%	n	%	n	%	n	%	n	%
Stunting	45	19.1	38	16.1	7	3	22	48.9	23	51.1
Wasting	24	10.2	21	8.8	3	1.4	5	20.8	19	79.2
Underweight	43	18.4	30	12.8	13	5.5	21	48.8	22	51.2



	Acute malnutrition	Moderate	Severe	Boys(n)	Girls(n)
Stunting	19.10%	16.10%	3%	48.90%	51.10%
Wasting	10.20%	8.80%	1.40%	20.80%	79.20%
Underweight	18.40%	12.80%	5.55%	48.80%	51.20%

Table 6.Acute malnutrition status of children involved in SFP

Prevalence for school feeding group										
Variable	Acute malnutrition		Moderate		Severe		Boys(n)		Girls(n)	
	N	%	n	%	n	%	n	%	n	%
Stunting	19	16.2	15	12.8	4	3.4	10	52.6	9	47.4
Wasting	9	7.6	7	5.9	2	1.7	4	44.4	5	55.6
Underweight	12	10.2	9	7.7	3	2.5	8	66.7	4	33.3

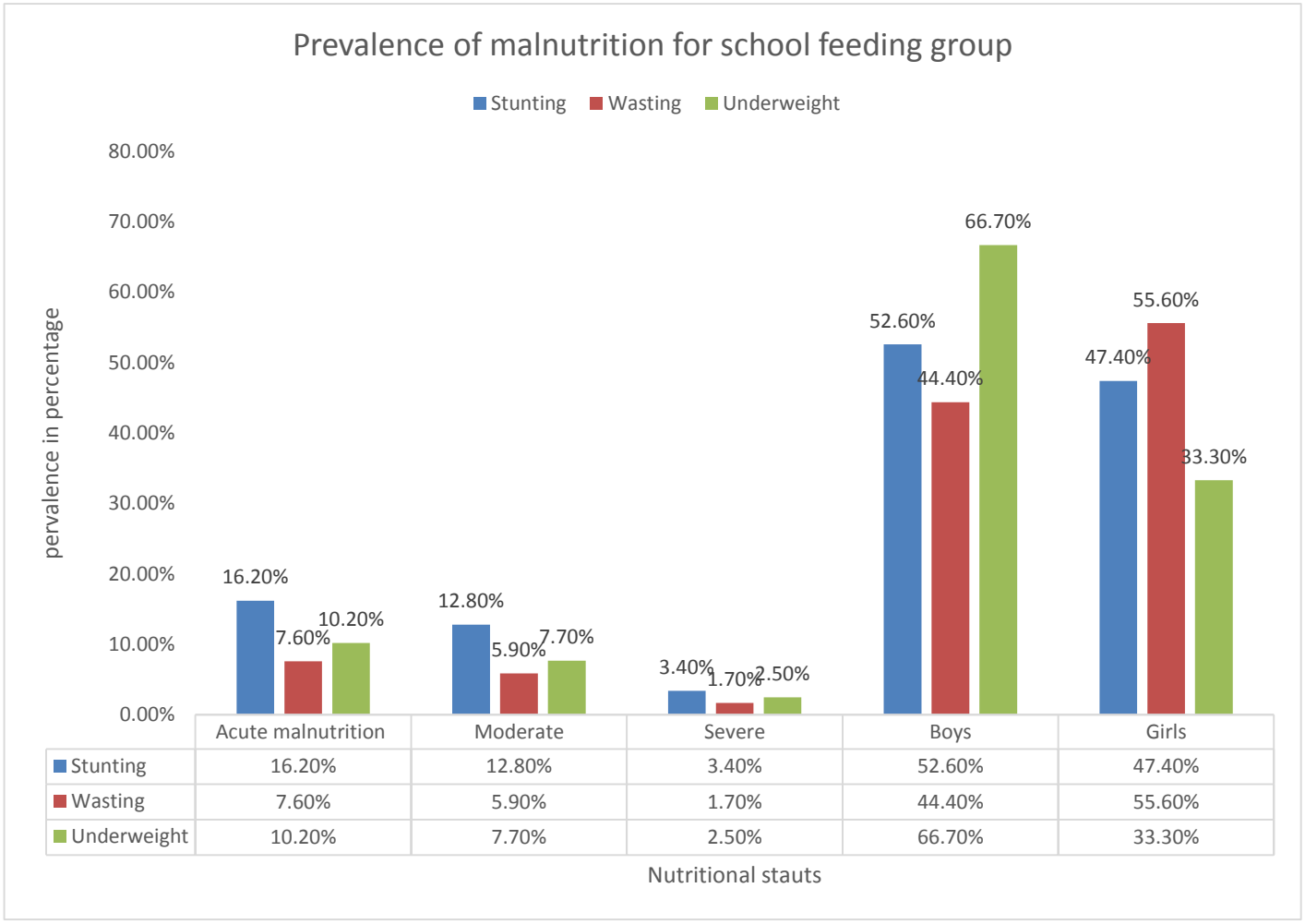
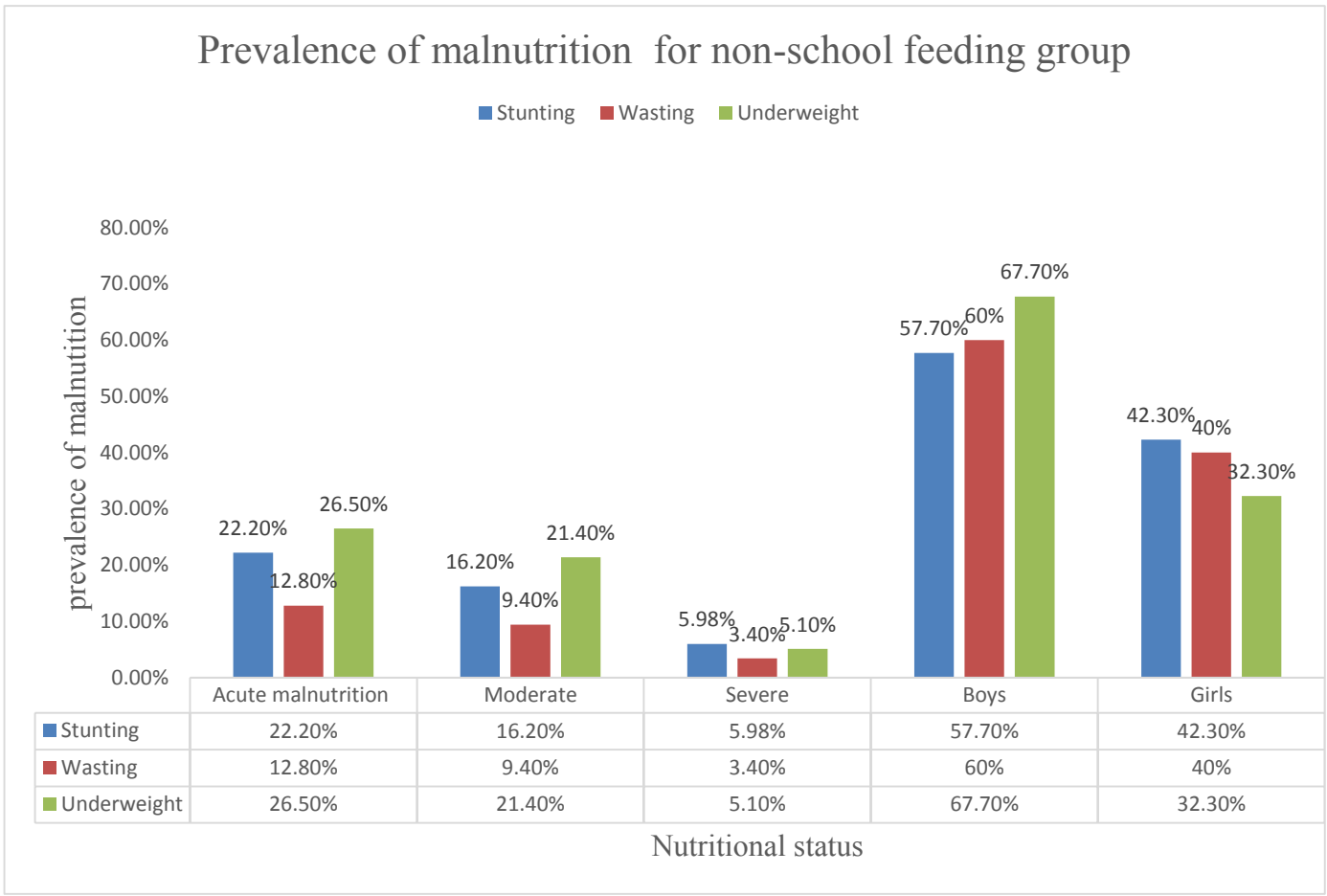


Table 7:Acute malnutrition status of children not involved in SFP

Prevalence for non-school feeding group										
Variable	Acute malnutrition		Moderate		Severe		Boys(n)		Girls(n)	
	N	%	n	%	n	%	n	%	n	%
Stunting	26	22.2	19	16.2	7	5.98	15	57.7	11	42.3
Wasting	15	12.8	11	9.4	4	3.4	9	60	6	40
Underweight	31	26.5	25	21.4	6	5.1	21	67.7	10	32.3



Overall=z-score<-2

Moderate=z-score between -2 and -3

Severe=z-score <-3

4.5. Nutritional status for the control group (Non-feeding group)

The prevalence of wasting for children who are not involved in the feeding was 12.8%(3.4% severely and 9.4% moderately) which is greater than the prevalence of wasting(8.9%) found in Gondar town school children by Amare et al.(2013).The prevalence of underweight for non-feeding group was found to be 26.5%(5.1% severely and 21.4% moderately)) which was greater 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 22.2%(5.98%severely and 16.2% % moderately).

4.6. Nutritional status for the feeding group (Target group)

When the data was analyzed independently for the two groups nutritional status, prevalence of wasting among the feeding group(out of 117 students) was found to be 7.6%(1.7 severe thinness and 5.9% were moderately) and 0.8% were overweight and they had low prevalence of wasting than those who were not in the feeding program. This result might show the contribution of the school feeding program as intervention to reduce prevalence of acute malnutrition.

The prevalence of underweight was 10.2%(7.7% moderately and 2.5% severe) there were no overweight for the feeding group. The prevalence of stunting for the feeding group was found to be 16.2%(3.4 severely and 12.8% moderately) among the group there were no tall stature. The prevalence of stunting of this study was less than the prevalence of stunting (25.2%) found from the previous study (Amare, B.et.al, 2012) in Gondar.

The prevalence of stunting ,wasting and underweight were lower in the school feeding group than the prevalence of stunting, wasting and underweight in the non-school feeding group and the difference was statistically significant (p=0.031).

In general the prevalence of stunting19.1%(3% severe and 10.2% moderate),wasting10.2%(1.4%severe and 8.8% moderate) and underweight18.4%(0.8% sever and 1.7% moderate)of this study were less than the prevalence of stunting 43.2% (15% sever thinness and 28.2% moderately) ,wasting 6.8%(0% sever and 6.8% moderately) and underweight 29.6%(6.2%sever and 23.4% moderately)found from the previous study (Gashu, 2016) in resource-poor rural households of the Amhara region, Ethiopia.

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

Although earlier malnutrition cannot be reversed by school Feeding (Bundy et al., 2009 and Kristjanson et al., 2007), there is evidence to suggest that meals provided in school improve nutritional status. Whiles evaluating the impact of school feeding on nutritional status of school children, it was reported that Body Mass Index increased by 0.62points of participants than controls (Ahmed, 2004). A study among Kenyan primary 5 and 6 pupils in schools with or without SFP, revealed that participants were less likely to be undernourished (8.1% BAZ scores of participants verses 16.3% of non-participants and 30% stunted participants against 53.1% of non-participants (Musamali et al., 2007).

4.7. Hemoglobin level of the study subject

The hemoglobin level of the students was calculated according to the Quenelle's Index nutritional evaluation tools used for adults that were adopted to adolescents by CDC, 2000. According to the Quenelle's Index, the mean and standard deviation of the hemoglobin level were calculated as for male 13.4±1.4 and female 13.6±1.5 in the non-feeding group respectively while in the feeding group 14.12±1.03 and 13.83±1.07 for male and female, respectively.

This result shows that hemoglobin level after feeding between the group significantly different at (p-value=0.007) which indicates that feeding helps hemoglobin level change for students involved in the school feeding group than in the non-feeding group. Before the intervention there is no significant (p=0.085) hemoglobin level difference between the group (school feeding and non-school feeding group).

The prevalence of anemia in the study subject for the school feeding group before feeding program started was 35.5% while the prevalence significantly(p-value<0.001) reduced into 18.9% for students involved in the school feeding program .The majority of students in the school feeding program were in mild and moderate anemia range.

On the other hand, the prevalence of anemic children in the study subject for the non-school feeding group before started was 38.5% while the prevalence after the intervention was 35% which is not

significantly (p-value=0.451) reduced for those students not involved in the school feeding program .The majority of students in the non-school feeding program were in mild and moderate anemia range

Moreover ,the prevalence of anemia for those students involved in the school feeding program after the program implementation was 18.5% which was significantly different(p-value<0.001) from for those students not involved in the school feeding program (35% of them were in anemic).

There was significant difference (p-value<0.001) for being anemic in the feeding and non-feeding group after the intervention. Only 26.9% of the students were found anemic in both groups while the remaining 73.1% of them were in normal hemoglobin level.

Even though each hemoglobin level alone did not show any significant association with academic performance, the state of being anemic together with low protein energy malnutrition can affects school performance. With the current study it is difficult to compare with others as they used different age range. School-age children with Hb levels lower than 11.5 g/dl and 12 g/dl were considered as anemic for age ranges from 5–11 and 12–15 years old, respectively. Mild anemia was defined as the Hb concentration between 10–11.9 g/dl for 12–15years and Hb concentration of 10–11.4 g/dl for 5–11yearsold school children. Moderate anemia was defined as the Hb concentration between 7–9.9 g/dl and severe anemia was defined as Hb concentration lower than 7 g/dl.

4.8. Dietary intake

Dietary intake of the school children is indicated in Table 8 .The dietary intake of school children was mostly cereals, pules, legumes and nutes and roots and tubers than vegetables, animals source food and green leafy vegetables. Majority of the school meals were from plant origin and there is insufficient serving of quality proteins which is most found in animal food sources. Consistent with typical African diets, all students involved in the study interviewed reported eating food belonging to grains, roots and tubers groups. Food groups that were less consumed by the students in feed and non-fed group included organ meats, dairy products, eggs and dark green leafy vegetables. Olumakaiye, (2013) also found a similar results among 600 school age children in the study at South Western Nigeria. Students involved in SFP and non-school feeding program in the study were less likely to consume food groups such as organ meats, milk and milk products, eggs, and vitamin A rich fruits and vegetables (Olumakaiye M. , 2013).

Lack of diversity is severe problem among poor population 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). It has been well documented that children are less likely to eat fruits and vegetables as part of their diet .In this study most of Children who are in the feeding program had better dietary intake than those who were not in the feeding program.

Table 8.Percentage distribution of dietary intake of different food items in the 24h preceding the survey by school children (n 234) both in the school feeding program and non-feeding group of Arada sub city elementary school, Jan 2017.

Food item		School feeding group		Non-school feeding		p-value
		n	%	n	%	
Cereals	Teff	94	78.9	74	63.2	0.042
	Maize	55	46.2	76	65	0.003
	Millet	79	66.4	49	41.9	0.001
	Wheat	43	36.1	57	48.7	0.002
	Barely	117	100	117	100	0.981
	Sorghum	51	42.9	60	51.3	0.065
	Rice	27	22.7	31	26.5	0.871
Pulses, Legumes and nuts	Lentils	93	78.2	81	69.2	0.072
	Beans	22	18.5	15	12.8	0.012
Roots and tubers	Sweet	25	21	18	15.4	0.043
	Potato	88	74	78	66.7	0.041
	Carrot	24	20.2	13	11.1	0.03
Vegetables	Papaya	33	27.7	22	18.8	0.042
	Mango	11	9.2	16	13.7	0.043
	Tomato	7	5.9	5	4.2	0.081
Green leafy vegetables		19	16	14	12	0.052

Animals –source foods	Eggs	6	5	2	1.7	0.002
	Milk	2	1.7	1	0.8	0.05
	Beef	5	4.2	3	2.6	0.061
	Lamb	0	0	0	0	
	Fish	3	2.5	1	0.9	0.002
	Chickens	9	7.6	5	4.3	0.051
Fruits	Lemon	14	11.7	8	6.8	0.003
	Mango	11	9.2	16	13.7	0.45
	Banana	39	32.8	21	18	0.452
	Guava	1	0.8	0	0	0.001
	Orange	4	3.4	3	2.6	0.652
	Avocado	2	1.7	1	0.9	0.05
	Papaya	33	27.7	22	18.8	0.035

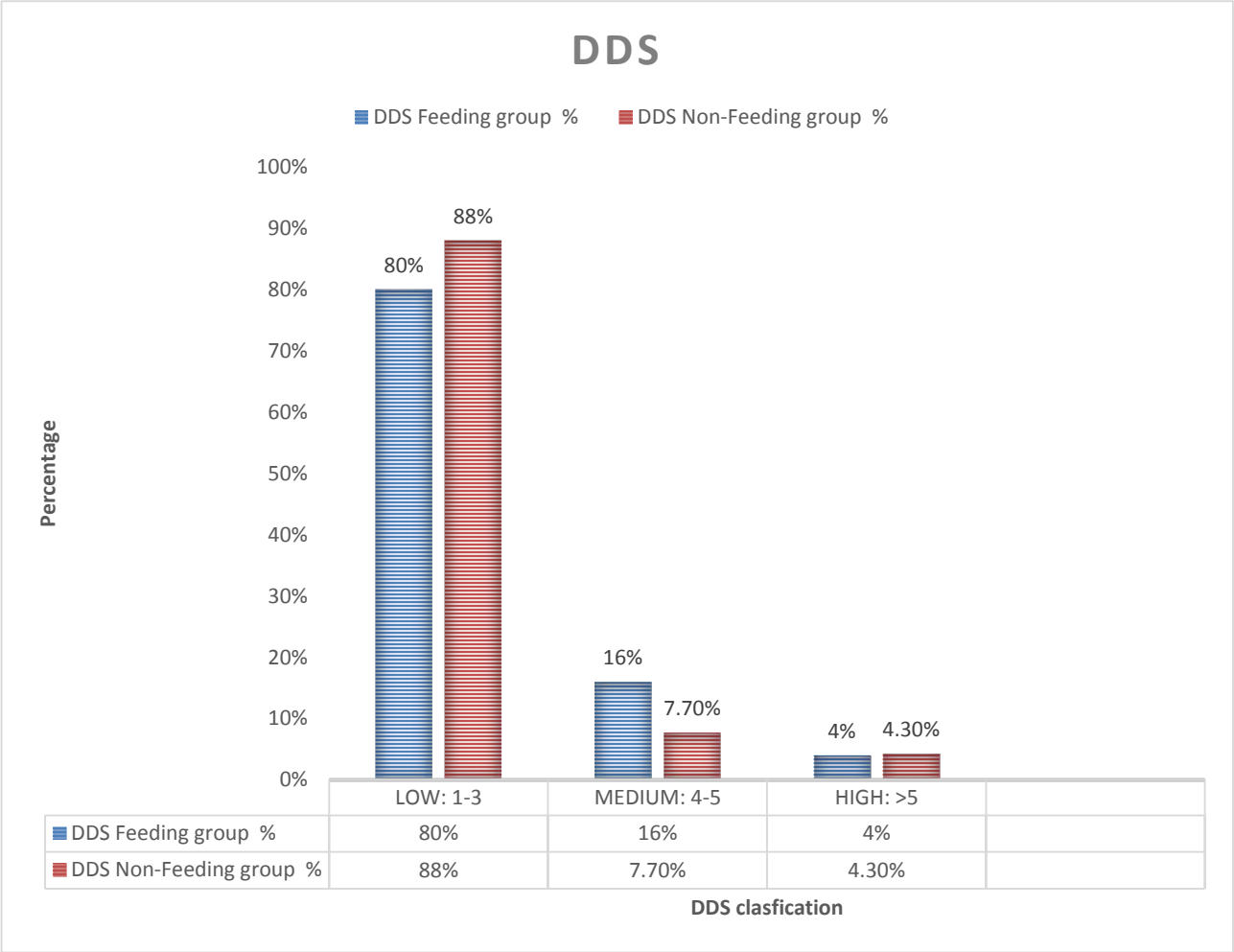
4.9. Dietary diversity score

The dietary diversity score assessment of both study and comparison group was conducted following the method of FAO (2006/7). Dietary intake of the school children is indicated in Table 9. The dietary diversity of school children was in the range of 2-5, with a mean value of 2.3(± 0.95). Most children, 80 %(n 78.6) in the school feeding program and 80.3 %(n 94) in the non-feeding group, were in the lowest dietary diversity group consuming 1-2 food group. Medium dietary diversity (4-5 food groups) and high dietary diversity (5-8 food groups) scores were attained 16% (N= 19) and 4%(n= 6) for children in the feeding group while 17.8%(n= 15) and 6.9%(n=8) in the non-feeding group respectively .

Children with four or more food group are considered to have a good dietary diversity as compared to children who have less than four food groups. According to this study, Children who are in the feeding program had better dietary diversity score than those who were not in the feeding program. This indicates the contribution of the school feeding program for diet diversity by increasing the number of food group.

Table 9: Dietary diversity score

DD Category	Student's category			
	School Feeding group		Non-school feeding group	
	N	%	N	%
Low: 1-3	92	80	103	88
Medium: 4-5	19	16	9	7.7
High: >5	6	4	5	4.3



4.10. Nutrient composition of the food supplied

Macronutrient especially proteins are essential component for children because it is necessary for growth and development. In the study, majority of the school meals (table 11) contain more than 10.5% protein energy contribution which is adequate in terms of fulfilling the requirement for age 5-11 but not for age 12-15. The majority of the analyzed school meals contained inadequate amount of carbohydrate compared to suggested amount as indicated by (Yasmin G. a., 2014).

The brain is dependent on circulating blood glucose since glucose is the brain primary fuel. Carbohydrate timely 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 its own impact on the learning teaching process (D'Anci, 2009).

The meal from all schools was found to contain inadequate amount of zinc, magnesium and calcium, when compared to WHO, 2007 recommended dietary allowance value, but the amount of iron in the food was adequate and this may be one reason for normality of hemoglobin in most of the school children in both feeding and non-feeding group but we cannot conclude that the iron they obtained is adequate because it not bioavailable as it is not from animal source food.

Nutrient deficiencies may contribute to growth retardation indirectly by reducing the intake of other growth-limiting factors, such as energy and protein. Mild to moderate zinc and severe iron deficiency may affect growth and can result in anorexia. Deficiency of iron leads to Anemia. Hemoglobin level goes down due to a number of factors but the most important one is deficiency of iron. Deficiencies of these micronutrients are associated with impairment of immune function and risk of morbidity, which in turn affects 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).

From this study result, energy from protein on average was 29.24%, from fat 0.78% and from carbohydrate 69.79%. Which indicate that insufficient for carbohydrate, fat and but sufficient from protein in terms of fulfilling the requirements **.**The energy was found to be very low in terms of fulfilling two third of the daily requirements assuming that most of the children have three meals per day. Majority of the schools meals in table 8, contain inadequate level of calcium, zinc and magnesium, which is a potential indicator for poor dietary diversity of the school meal

Table: 10 Distribution of nutrient composition of the food supplied to school children in Arada sub city elementary school. Jan, 2017.

School name ID	Sample wt(g)	%moisture	Protein g/100g	Fat g/100g	Fiber g/100g	CHO g/100g	Ash g/100g	Kcal /100g	Total energy Kcal /100g	WHO standard (2/3)
ME	220.7	59.4(6.55$^{a)}$	10.2(1.1$^{b)}$	0.22(0.13$^{c)}$	1.72±(1.2$^{d)}$	28.4(1.73$^{e)}$	0.09(0.02f)	156.17±1.45^{x}	344.67±1.45^{x}	In the range of :- Minimum 1036 to maximum 1846.6
BE	222.9	63.4(6.48$^{a)}$	11.04(1.58$^{b)}$	0.09(0.02$^{c)}$	1.9(1.3d)	23.46(1.61$^{e)}$	0.13(0.13f)	138.79±2.5^{x}	309.36±2.5^{x}	
AL	217.8	60.6(12.2$^{a)}$	11.04(1.58b)	0.15(0.05$^{c)}$	2.2(1.4d)	25.92(±1.53$^{e)}$	0.04(0.04f)	149.15±3.22^{x}	324.85±3.22^{x}	
KEK	235.4	62.96(9.14$^{a)}$	10.6(1.2$^{b)}$	0.18(0.11$^{c)}$	1.67(0.47)	24.37(1.50$^{e)}$	0.24(0.02f)	141.36±1.01^{x}	332.76±2.05^{x}	
p-value	0.095	0.687	0.106	0.617	0.302	0.723	0.06	0.155	0.155	0.002

**There is no significant difference between moisture, fiber ,ash ,protein, fat, carbohydrate ,energy and mineral (iron ,zinc, calcium and magnesium)between the schools **

Energy from protein on average 42.81kacl/100g (29.25%), from fat 1.41kacl/100g (0.96%) and from carbohydrate 102.15kacl/100g (69.8%). Which is over from carbohydrate, and sufficient from protein but insufficient from fat out of total energy. Average total energy intake was 327.9Kcal.

Values with the same letter is not significantly different (Significance based on independent t-test, mean±SD

School name	**Sample**	Iron mg/100g	Zinc mg/100g	Calcium mg/100g	magnesium mg/100g
ME*	220.7	12.78±2.92^{a}	0.94±0.16^{b}	87.62±25.25^{c}	4.86±0.14^{d}
BE*	222.9	11.41±4.10^{a}	1.00±0.23^{b}	108.13±25.72^{c}	4.86±0.10^{d}
AL*	217.8	11.04±3.68^{a}	1.22±0.24^{b}	108.03±25.68^{c}	4.79±0.16^{d}
KEK*	235.4	9.45±0.97^{a}	1.10±0.19^{b}	88.77±19.56^{c}	4.88±0.05^{d}
p-value		0.717	0.158	0.309	0.155

Table 11:Daily recommended dietary allowances for micronutrient

Age	Iron		**Zinc in (mg)**		**Calcium in (mg)**		**Magnesium In (mg)**	
	Males In (mg)	**Females In (mg)**	**Males**	**Females**	Males	**Females**	Males	**Females**
4 to 8 years	10	10	5	5	1,000	1,000	130	130
9 to 13 years	8	8	8	8	1,300	1,300	240	240
14 to 18 years	11	15	11	9	1,300	1,300	410	360

(ADAPTED FROM The Institute of Medicine of the National Academy of Sciences)

The impact of SFP is not only macronutrients but also micronutrients. Micronutrient deficiency can be reversed rapidly if SFP targets it **(Buhl, Meeting Nutritional Needs Through School Feeding: , 2010)**. Children who have been supplemented with vitamin C rich foods and other micronutrient dense foods have been reported to have an increase in these micronutrients after some time. In this study the micronutrient contents of the food significantly ($p<0.001$) below two third of WHO/FAO recommended amount. All of the school meals in table 10,contains inadequate level of zinc, iron, calcium and magnesium which is a potential indicator for poor dietary diversity of the school meal.

4.11. Academic performance of the study subject

One hundred fifty six 156 (66.1 %) of the students had ≤ 5 days of absenteeism from their school and 80 (33.9%) had >6 days absenteeism within the last semester. Those who had repeated last academic year were 85 (36%). The students last semester average grade score was a minimum of 38.2 and a maximum of 95.8. The mean and standard deviation of the students' grade in the feeding program were 64.6 and 11.9respectively after feeding which is higher than 59.5 and 8.8 before feeding program started which indicates that feeding contribute students score improvement significantly(p=0.021).

Generally students who had below and above mean score from school feeding program were 44.5% and 55.6% respectively while from non-school feeding group, only 47.9% of them score above mean score and more number of students score below mean score 52.1% which also indicate that more number of students from the feeding group score above mean score than non-feeding group. School Feeding program helps students academic performance significantly (p-value=0.02) than non-school feeding program after program implementation.

More rate of absenteeism from the control group than feeding group but the difference is not significant (p=0.123).In Ethiopia, food insecure children were found to absent themselves from school about twice(33%)more than their colleagues who were food secured (17.8%) at P < 0.001(Belachew et al., 2011).

In the systematic review of SFP's, (Kristjansson B, 2007), stated that hunger affects attention and interest. This may account for the inability of the child to learn. Children who are chronically undernourished are irritable and have a reduced attention span (Abudayya et al., 2011). These can affect their ability to learn well (Abudayya A. e., 2011) and subsequently lead to poor academic performance.

In Kenya, Vermeersch (2003) examined the effects of subsidized school meals on school participation, educational achievement, and school finance in a developing country setting. The findings revealed a 30 per cent higher participation of children in the treatment group than in the comparison group leading to higher test scores (0.4 of a standard deviation). In general, Kamlongera (2009) after assessing works of others on school feeding and equitable access to education in Malawi, revealed that, schools with school feeding program had higher enrolment, improved student`s performance in class, a gender ratio of more than one in favor of girls, reduced absenteeism and parents encouraged to send their kids to schools than schools that were not enjoying from the program

under the same circumstance. Our result also indicates that school performance and hemoglobin level was higher for children who were in the school feeding program than who are not which indicates that feeding helped them to concentrate on school activities .

Table 12.School performance related variables of the students among Arada sub city elementary School children Jan 2017.

	N	%	Target group	%	Control group	%	Adjusted OR (95% CI) for both group
Academic Performance Variables							
Absenteeism from the school							
≤ 5 days	154	65.8	94	80.3	66	56.4	1.09(0.70-1.72)
> 6 days	80	33.9	23	19.3	57	48.7	1.23(1.01-1.85)
Class repeated last once and more							
Yes	85	36	38	32.5	47	40.2	1.21(1.03-1.51)
No	149	64	72	61.5	77	65.8	1.00
Grade Score							
Below mean	113	48.3	52	44.4	61	52.1	1.04(1.03-1.11)
Above	121	51.3	65	55.6	56	47.9	1.19(1.11-1.27)

4.12. Relation of socio-demographic characteristics with school performance.

The effects of different variables were tested for their association with academic performance using Binary Logistics analysis. Female students had better performance (1.5times ODDS RATIO?) than males. Students who had lived in own house performed better than those who are living in rented houses (OR 1.21,95% CI 1.7-1.27.Better academic performance was seen in students who had access to radio and TV. Students who had lived in the family of less than or equal to three persons in their home had achieved better performance 1.42 times greater than those who had greater than four families in their house (OR 1.42,95% CI 1.39-1.77). Father's and Mother's educational status had no association with academic performance. Students who had ≤ 5 days of absenteeism from the school were 1.53 times higher in their academic performance than those with > 5 days. Presence of low level of hemoglobin affected academic performance. Those who had normal level of hemoglobin affected less than who had low hemoglobin level. The presence of each anemia and low nutritional status had association with academic performance. Students who had lived in the family of ≤ 3 persons per home showed good performance 1.2 times than who had lived in the family of >4 persons (OR 1.39,95% CI 1.37-1.97). The finding in Arada sub city elementary school children was similar to study conducted in China to determine whether the academic outcomes with school feeding program and without school feeding program. The results of the survey was in 1987 of 1,460 school children involved in the feeding program. Among urban children in china, show that those in school feeding program had higher academic scores than students not enrolled in school feeding program(Dudeley L. Poston,1990 Vol. 96(2).

Adjustment of the confounding variables such as gender residence, availability of Radio, family size, number of days of absenteeism, distance of home from the school, presence of anemia and hemoglobin and fever was done using multivariate logistics analysis. Females (mean 66.7) had a better school performance score than males(mean 62.5). Students who had TV access were (1.5) times higher in their academic performance than those who hadn't.

The number of days of absenteeism from the school was associated with academic performance, with better performance seen in students who had less than five days of absenteeism. Students with low hemoglobin level were less likely to achieve higher academic performance than those normal hemoglobin level. Even thought, presence of anemia was significantly associated with academic

performance none of the food composition investigated were specifically associated with performance.

In general, Kamlongera (2009) after assessing works of others on school feeding and equitable access to education in Malawi, revealed that, schools with school feeding program had higher enrolment, improved student`s performance in class, a gender ratio of more than one in favor of girls, reduced absenteeism and parents encouraged to send their kids to schools than schools that were not enjoying from the program under the same circumstance.

In Kenya, Vermeersch (2003) examined the effects of subsidized school meals on school participation, educational achievement, and school finance in a developing country setting. The findings revealed a 30 per cent higher participation of children in the treatment group than in the comparison group leading to higher test scores.

4.13. Relationship of hemoglobin level, the food supplied composition and its nutrient adequacy

There were significant hemoglobin difference at (p-value of 0.007) between the school feeding group and the non-feeding group .The difference within the group(in the school feeding group) in the feeding group before and after feeding is slightly significant (p=0.0434) this is may be due to the low nutrient composition of the food supplied and according to our result from dietary diversity data ,animal source food were very low in number or almost absent for majority of the students in in the school feeding group.

We can say that this small difference may be improved to significant difference if the composition of the food supplied and nutrient adequacy improved to slightly standard value like WHO,2007, daily dietary allowance for children and especially if their feeding pattern were improved to animal source food, fruits and vegetables rich in vitamins and other nutrient and these have bioavailable micronutrient especially iron, zinc, calcium, magnesium and vitamins which in turn makes significant difference on their hemoglobin level and academic performance because this result indicated that hemoglobin difference have association with academic performance but the difference may be improve if the above preconditions were monitored strictly. This shows that the difference mean and standard deviation before feeding and after feeding were 13.67±1.3 and 13.95±1.12 which shows

that there was significantly different at (p-value =0.010) of hemoglobin difference before feeding and after feeding for school fed group.

4.14. Hemoglobin level and academic performance

When we compare average students score for both group together as general female students (or girls) mean 66.57 ±11.87 score higher than male students (or boys) mean score 62.59 which was significantly different at p-value of 0.01 .The majority of the students involved in the feeding and non-feeding group having normal range of hemoglobin level had higher average score than those in below or above normal range of hemoglobin level at p-value of 0.012.There was high correlation of normal hemoglobin level and above average score. Students in the school feeding program had higher hemoglobin level mean and SD(13.98 ±1.05)and show higher academic performance (64.5±11.88) than those in the non-school feeding program mean and SD(13.5±1.45) 59.5±8.53 respectively(p-value=0.035) .

Strength and Limitation

Strength of the study: This study is the first study in that administrative area, which had assessed the effect of school feeding on academic performance. The method was relatively cheap and appropriate technology was easily accessible and easy to set up at the health center. The study did not need any special training, sophisticated material and technology. The study used multiple tools/techniques for data collection to get uniform or consistent results. Training and thorough supervision helped to COLLECT QUALITY DATA.

Limitation: The methods employed and comparison tools used are not well developed for 7-14years age category. No standard of academic performance evaluation tools were available. The standard used to compare nutritional status of adolescents was not suitable.

5. Conclusion and Recommendation

The prevalence of wasting in the area was high. It was affected school performance in Arada sub city school children. Most children in the school feeding program (80%) and non-feeding group (88%) were in the lowest dietary diversity group consuming 1-3 food groups. Absenteeism in the students involved in the feeding program less likely than non-feeding group. Underweight, overweight and obesity were less prevalent in the area. Students with normal nutritional status achieve good academic performance in the study. In this study there was an association of school feeding with performance significantly ($p=0.021$). Feeding group are achieves higher score than non-feeding .Girls in the feeding group score better result than those in the control group as well as boys within the same group. In this study nutritional status has significant effect on academic performance ($p=0.012$).

Living with in a large family size, inadequate amount of nutrient in food supplied, anemia and malnutrition were the cause of poor academic performance. Hunger and wasting were also still a public health problem and not yet resolved as planned even if school feeding help alleviate short term hunger, stay in the school and it makes them to focus only on the school activities than before .The overall study result is difficult to generalize to the city administration of Addis Ababa level, but it has its own indication to that administrative area and other similar sub city.

The amount of food supplied, energy value and its diversity is not adjusted according to the children age level. Majority of the schools meals contain inadequate level of calcium, zinc and magnesium but contains adequate level of iron but this iron is not from animal source food or vegetables. There was a significant difference in hemoglobin between the feeding and the non-feeding after the intervention ($p=0.007$). The prevalence of anemia in the study subject for the school feeding group before feeding program started was 35.5% while the prevalence significantly($p\text{-value}<0.001$) reduced into 18.9% for students but no significant($p=0.451$) change for non-school feeding student . The nutrient content and the energy supplied to the children through school feeding was below the recommended dietary allowance so further intervention should have to be implemented.

Recommendations:-

- Qualified food scientists, nutritionist, dietitians and caterers should be involved in running the program and made responsible for the purchase of the needed food items to be cooked in the school.
- Feeding should be well guided by a menu which reflects the nutritional need for energy and micronutrients body requirements of a particular age group.
- Dietary diversity education has to be delivered to school children and care givers.
- Nutrition and health education about anemia and problem of malnutrition on academic achievements must be exercised by all stakeholders.

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Annex

1. Anthro`pometry measurement

001	Age	Date of birth ……./……./…….	……...months	
002	Gender	F/M		
		Measure 1	Measure 2	*Circle*
003	Height/length	_ _ _ , _ cm	_ _ _ , _ cm	Standing/lying
004	Weight	_ _,_ _ KG	_ _,_ _ KG	

1. Hemoglobin measurement

005	Age	Date of birth ……./……../…….	…….. months
006	Gender	F/M	
007	Hg	…….. g/dl	
008	<11.5µg/dl	Yes/no	

COLLEGE OF NATURAL SCIENCES
Addis Ababa University

OFFICE OF THE DEAN
የዲን ጽ/ቤት

የተፈጥሮ ሣይንስ ኮሌጅ
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Ref.
ቁጥር CNSDO/208/16

Date.
ቀን February 1, 2016

To Whom It may Concern

College of Natural Science Institutional Review Board (CNS-IRB) in its meeting held on December 31, 2015 has reviewed an MSc thesis project proposal entitled **"Nutrient composition of the food supplied, nutritional status of the children, the impact..."** by Gutema Mekonne from Center for Food Soience and Nutrition.

The proposal was approved for implementation.

With regards,

Shibru Temesgen /Dr./
Dean, College of Natural Science

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Please quote our reference number in your correspondence.

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

"ሁሉን መርምሩ መልካሙን ያዙ"

በአዲስ አበባ ዩኒቨርስቲ
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ADDIS ABABA UNIVERSITY
College of Natural Science

የምግብ ሳይንስና ኒውትሪሽን ማዕከል

Center for Food Science and Nutrition

ቀን፡ ህዳር 06/2008 ዓ.ም
ቁጥር፡ ምሳኒማ/96 /08/15

ለ፡ ኢትዮጵያ ሕብረተሰብ ጤና ኢንስቲትዩት
አዲስ አበባ

ጉዳዩ፡- ትብብርን ይመለከታል

በአዲስ አበባ ዩኒቨርስቲ የምግብ ሳይንስና ኒውትሪሽን ማዕከል የሶስተኛ ዓመት MSc ተማሪ የሆኑት አቶ ጉተማ መኮንን የምርምር ስራቸውን በመስራት ላይ የሚገኙ ሲሆን በሕጻናት ላይ hemoglobin መጠን እና የ Anthrophometric measarement በአንደኛ ደረጃ ተማሪዎች ላይ ለሚደረገው ጥናት የላቦራቶሪ ክፍሉ ትብብር እንዲያደርግላቸው በትህትና እንጠይቃለን፡፡

ከሰላምታ ጋር

ቀላሁን በቀለ (ረዳት ፕሮፌሰር)
የምግብ ሳይንስና ኒውትሪሽን ማዕከል ዳይሬክተር

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የእናት ወግ በጎ አድራጎት ማህበር/YE ENAT WEG CHARITEBL ASSOCIATION/

የምግብ ዝርዝር ፕሮግራም /MENU/

- የቁርስ ዝርዝር

ተ.ቁ	ቀናት	የምግቡ ዓይነት	ምርመራ
1.	ሰኞ	እንጀራ ፍርፍር እና ሻይ	
2.	ማክሰኞ	ድፎ ዳቦ እና ሻይ	
3.	ረቡዕ	ዳቦ በማልማት እና ሻይ	
4.	ሐሙስ	እንጀራ ፍርፍር እና ሻይ	
5.	አርብ	ከላይ ከተዘረዘሩት ዉስጥ አንዱን መድገም ይቻላል::	

- የምሳ ዝርዝር

ተ.ቁ	ቀናት	የምግቡ ዓይነት	ምርመራ
1.	ሰኞ	እንጀራ በምስር ወጥ	
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3.	ረቡዕ	እንጀራ በሽሮ ወጥ	
4.	ሐሙስ	እንጀራ በድንች ቀይ ወጥ	
5.	አርብ	ከላይ ከተዘረዘሩት ዉስጥ አንዱን መድገም ይቻላል::	

Assent/Consent Form

ADDIS ABABAUNIVERSITYSCHOOLOFGRADUATESTUDIES

CENTER FOR FOOD SCIENCEAND NUTRITION

Title: Nutrient composition of the food supplied, nutritional status of the children, the impact of school feeding program on their school performance and academic achievements of registered school age children in Arada Sub city elementary school, Addis Ababa Ethiopia .

Principal investigator: GutamaMokonnen, working in Arada Education Office as Educational. Experts and school feeding program coordinator and 3rdyear of center for food science and nutrition student working the research telephone 0111580905. E-mail:gute932005@yahoo.com, cellphone: 0911339725.

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

Introduction: Malnutrition is a major public health concern affecting a significant number of school age children influencing their health, growth and development, and academic performance as well as academic achievement. The persistence of hunger, malnutrition, and micronutrient deficiencies can have long lasting effects on the health status and productivity of people and their nations. Early malnutrition can adversely affect physical, mental, and social aspects of child health, which in turn leads to underweight, stunted growth, lowered immunity, and mortality. Childhood under nutrition imposes significant economic costs on individuals and nations, and that improving children's diets and nutrition can have positive effects on their academic performance and behaviors at school as well as their long-term productivity as adults. School Feeding Program provides food to school children or their family in exchange for enrollment and attendance in school, and directly relates to the first three Millennium Development Goals: to eradicate extreme poverty and hunger, achieve universal primary education, and promote gender equality and empower women by 2015. School feeding programs help ensure healthy, productive future generations. School feeding should be viewed as a societal investment with a clear and significant societal return. In looking at why countries focused on school feeding, the main reasons were: 1) it provides a social safety net, particularly during a crisis;2) it supports education by increasing enrollment and decreasing absenteeism; and 3) it helps provide nutrition to children. Countries also see benefits in leveraging school nutrition programs to help get more girls into school and keep them enrolled. School feeding programs are likely to improve the nutrient intake of participating children. It is then likely that giving children a daily breakfast or a meal at school may improve their scholastic achievement through several mechanisms: increasing

the time spent in school, improving certain cognitive functions and attention to tasks and, perhaps indirectly, improving nutritional status.

Procedures

If you agree to participate, I will collect a finger-prick blood sample, height and weight of your child for analysis.

Risks

Nothing harmful will come from your child participation.

Benefits

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

Cost

There is no cost to you for participating

Compensation

There will be no compensation to you for participating

Participant's right

As I have said things that are not clear to you, you may ask me without any fear and I will give you answer and explanation .you may feel free and ask questions. Your child participation in the study is entirely volunteer and up to you to decide. There is no penalty if you don't agree to participate. You can say no without worry. The school and the feeding program providers as well as health care center will continue to give food and care for your child as usual.

Parent's right

You have the right to ask about anything that are not clear and I wish you could understand the whole process and you may ask me without any fear and I will give you answer and explanation to you and please feel free and ask questions as parent/guardian . Your child participation in the study is entirely volunteer and up to you to decide. There is no penalty if your child or you don't agree to participate. You can say no without worry. The school administration on or all stakeholders will assist for your child or for you as usual.

Confidentiality

By excluding names and other identifying numbers from the questionnaire confidentiality of information will be assure. Test results and any information about your child will be kept privet.

Persons to contact

If you have any question, you can ask at any time, if you have additional questions about the study you may contact: Gutama Mokonnen, working in Arada Education Office as Natural science Educational Experts and school feeding program coordinator. Office telephone 0111570908. E-mail:gute932005@yahoo.com, cellphone: 0911339725.Would you allow your child to participate in the study? Thank you

VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title Nutritional status and school performance of children benefited from school feeding program in selected elementary school, Arada Sub city, Addis Ababa, Ethiopia has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

_____ _____

Child's name Name of child's guardian/parent

_____ _____

Date Signature or mark of child's guardian/parent

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

_____ _____

Date Name and signature of witness

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual. _____

_____

Date Name Signature of Person Who Obtained Consent

Thank you for your cooperation

<u>ለአዲስ አበባ ዩኒቨርስቲ ስነየምግብ ሳይንስና ኒውትሬሽን ማዕከል</u>

<u>የሦስተኛ ዓመት የድህረ ምረቃ ተማሪ የሚያደርጉት ጥናት</u>

የጥናት ፈቃድ ፎርም

የተማሪዎች ምግባ ፕሮግራም ተማሪዎች የምመገቡት ምግብ ያለው ይዘት ፤ ለተማሪዎች የተመጣመነ ንጥረ ነገሮች በማስገኘት እና የተማሪዎች ውጤት ለማሻሻል ያለው ፋይዳ እዲሁም የተማሪዎች ንሁትራሽን ያለበት ደረጃ ለማወቅ በአራዳ ክፍለ ከተማ አንደኛ ደረጃ ት/ቤት ተማሪዎች ላይ የሚካሄድ ጥናት፡፡

<u>ዋናተመራማሪ</u>፡- ጉተማ መኮንን ከአዲስ አበባ ዩኒቨርስቲ ስነ-ምግብ ሳይንስና ኒውትሬሽን ማዕከል

ማብራሪያ፡-የምግብ እጥራት ትልቁ ህብራተሰባችን የጤና ችግሮች መሆኑን በተለይ በት/ቤት ተማሪዎች ላይ የነላ ችግር የሚያስከትል መሆኑን እዲሁም በውጤታቸው እና በአጠቃላይ የተማሪዎች የመማር ማስተማሪ ሂደት ላይ የነላ ሚና አለው፡፡ የተመጣጠነ ምግብ እጥርት በተማሪዎች ላይ የአጭር ጊዜና እና የረጀም ጊዜ ችግሮች ያስከትላል ፡፡የትምህርት ቤት ምግባ ማላት ለተማሪዎች የተመጣጠነ ምግብ ማቅርብ እና መመገብ ማለት ነው፡፡የትምህረት ቤቶች ምገባ ፕርግራም ዘርፍ ብዙ ጥቅሞች እስጣል በተለይ የተማሪዎችን ውጤት ለማሻሻል ያለው ፋይዳ እዲሁም አካላዊ እና አዕምሮአዊ እድገታቸው ላይ ያለው አስተዋጾ እጅግ የነላ ፋይዳ አለሁ ፡፡የተለያዩ ሀገሮች የተማሪዎች ምገባ ፕሮግራም እንድ አንድ የመህብርብ አቀፍ ጥቅም አድሪነ ዘርፈብዙ እንቅስቃስ እያደረጉ እገኛሉ ለምሳሌ በተፈጥሮ አደጋ ጊዜ፤የተማሪዎች ወደ ትምህርተ ገበታ ለማምጣት ፤የትምህርት ብክነት እዳይኖሪ ለማድርግ እዲሁም የተመጣጠኔ ምግብ እድያገኙ ብሎም የመቅርት ችግሮች ለመቀነስ በተለይ የሴት ተማሪዎች የትምህርት ተሳትፎ ለማሳደግ በአጠቃላይ አስፈላጊ ንጥረ ነገሮች ለሰውነታቸው ንጥር በጣም አስፈላጊ በመሆኑ በተለይም ደግሞ ለትምህርት ቤት ተማሪዎች የአዕምሮ እድገትና በመማር ማስተማሪ እና በተማሪዎች ውጤት ለማሻሻል ላይ የነላ ፋይዳ አለው፡፡በመሆኑም የተመጣጠነ ምግብ እጥርት በትምህርት ቤት ተማሪዎች ላይ በይበልጥ ለችግሩ ተጋላጭ በመሆናቸው ምክንያት ጥናቱ በእነሱ ላይ እንዲሆን አድርነታል፡፡ እንዲሁም በምግብ እጥረት የሚጠቁ የትምህርት ቤት ህጻናት ቁጥር በከፍተኛ ደረጃ ቁጥራቸው እየጨመረ በምጣቱ ችግሩን አውቆ መፍትሄ ለመስጠት ያስችል ዘንደ የሚደረግ ጥናት ነው፡፡

<u>መመሪያዎች፡-</u>ጥናቱ ላይ ለመሳተፍ ከተስማማሽ/ህ ከጣት ደም ከልጅሽ/ህ ላይ ለምርምር ይወሳዳል ፡፡

<u>ሲጋት፡</u>- ያንቺ /ተ መሳተፍ ምንም አይነት ጉዳት በልጅሽ /ህ ላይ አያደርስም

<u>ጥቅም፡</u>-ምንም አይነት ቀጥተኛ ጥቅም ላንቺም/ተም ለልጅህ/ሽ አይኖርም፡፡ ግን በተዘዋዋሪ በሌሎች ልጆች ምሆነ ላንቺ/ተ ልጅ የጥናቱ ውጤት ላይ ተመርኩዞ ለውጥ ሊያመጡ የሚችሉ ባለድርሻ አካላት በማሳወቅ እንዲሰሩበት ያስችላል፡፡

<u>ዋጋ፡</u>- በመሳተፍሽ/ህ ምንም አይነት ዋጋ አያስከፍልም

<u>ማካካሻ፡-</u>በመሳተፍሽ/ህ ምንም አይነት ማካካሻ አይኖረውም፡፡

የተሳታፊ መብቶች፡-ምንም አይነት ግልጽ ያልሆ ነነገር ካለ የፈለግሽውን/ከውን ጥያቄ ካለ ምንም ፍርሀትና ጭንቀት መጠየቅ ትችያለሽ/ላለህ፡፡ የልጅሽ /ህ ተሳታፊ በሙሉ ፍቃደኝነት ላይ የተመሰረተ ነው፡፡

ወላጅ/አሳዳጊ ልጅህ/ሽ ጥናቱ ላይ በመሳተፉ ፍቃደኛ በመሆንህ/በመሆንሽ በቅድሚያ ላቅ ያለ ምስጋና ማቅርብ እወዳለሁ በራሴ ሰም እና በሀኒቨርሲቲው ስም፡፡

ባለመሳተፍሽ የሚደርስብሽ/ህ ምንም አይነት ቅጣት አይኖረውም፡፡ ትምህርት ቤቱም ሆነ የምገባ አዘጋጆች ባለሞያዎቹ የሚያስፈልገውን አገልግሎት ልክ እንደ በፊቱ ይሰጣሉ፡፡

ሚስጥራዊነቱ ማንኛው ምላሻ የሆኑ ነገሮች ማለትም ስም ቁጥር የመሳሰሉትን በማስወገድ ማንኛውን መረጃበ ሚስጥር ይጠበቃል፡፡

ጉዳዩ፡- የሚመለከታቸው ሰዎች አድራሻ

ምንም አይነት ጥያቄ ወይም አስተያየት ቢኖራችሁ (gute932005@yahoo.com) ስልክቁጥር ፡0911339725 office :0111580905, ጉተማ መኮንን ብለው ይጻፉልን/ይደወሉልን፡፡

ልጅሽ/ህ ጥናቱ ላይ እድሳተፊ ትፍቅዳለህ/ሽ?

ጥናቱ ላይ ለመሳተፍ ፍቃደኛ ኖት?

ስም ---------- ፊርማ ---------- ቀን ----------

የጥናቱ አስተባባሪ ፊርማ ----------

ለትብብርዎት እናመሰግናለን፡፡

Appendix **A**: Questionnaires

Appendix Table 2: Key Informant Interview with student

1. City _____

2. Woreda /sub city _____

4. Name of the school_____

5. Name of the principal_____

6. Enumerator's name _____

7. Supervisor's name_____

8. Date of Interview _____

9. Signature _____

Consent Form

My name is Gutama mokonnen, a graduate student of Center for Food Science and Nutrition at Addis Ababa University. The purpose of this interview is to collect data for my master's thesis about the Nutrient composition of the food supplied, nutritional statutes of the children and Impacts of School Feeding Program on Students Academic performance/Achievement on selected schools in Arada sub city government Elementary school, Addis Ababa. The information gathered in this interview will be used only for academic purposes and are strictly confidential. Your full name will not be written down anywhere and there will be no way to identify you. Your participation is voluntary. You may refuse to answer any question and choose to stop the discussion at any time. You can also ask questions about this study at any time. There is no direct benefit or money to be given for you in participating to this study. However, I hope that the study will benefit your community by helping me understand the impacts of School Feeding Program and recommending what should be done to improve school performance.

Thank you in advance!

ለተማሪዎች ወላጅ/አሳዳጊ የቀረበ ቃለ መጠይቅ

ኮድ ----------

ቃለ መጠይቅ የተደረገበት ቀን ----------

የተጀመረበት ሰዓት ----------

ያለቀበት ሰዓት ----------

ሀ. የተማሪው /ዋ አጠቃላይ ሁኔታ

ዕድሜ ☐

ፆታ ወንድ ☐ ሴት ☐

የትምህርት ደረጃ ----------

እህቶች እና ወንድሞች አለህ /ሽ

አለኝ ☐ የለኝም ☐

ካለህ/ሽ ስንት ?

እህት ---------- ወንድም ----------

ስንተኛ ልጅ ነህ /ሽ ----------

ት/ቤት ለመሄድ/ለመሚጣት የሚፈጀው ሰዓት በከቤትህ/ሽ ☐ ከ15 ደቂቃ በላይ ☐ ከ15 ደቂቃ በታች

የሚትጠቀመው የተራንስፖርት ጫነት ባስ/ታከስ ☐ በእግር ☐

ለ. በአሁኑ ወቅት ከማን ጋር ነው የምትኖረው (የምትኖሪው)

እናት ☐ አባት ☐ እህት ☐ እናት አባት ☐

ወንድም ☐ ሴት አያት ☐ አጎት ☐ አክስት ☐

ሌላ ☐

ሐ. የወላጆችህ/ሽ የአሣዳጊዎችህ/ሽ የትምህርት ደረጃ

የወላጆችህ/ሽ የአሣዳጊዎችህ/ሽ ማንበብና መፃፍ ይችላሉ ?

ይችላሉ ☐ አይችሉም ☐

የወላጆችህ/ሽ የአሣዳጊዎችህ/ሽ የትምህርት ደረጃ

አንደኛ ደረጃ ☐ ሁለተኛ ደረጃ ☐ ከሁለተኛ ደረጃ በላይ ☐

መ. ሐይማኖት

አርቶዶክስ ☐ መስሊም ☐ ካቶሊክ ☐ ፕሮቴስታንት ☐

ሠ. የወላጆችህ/ሽ የአሣዳጊዎችህ/ሽ የስራ እና የኑሮ ሁኔታ

የወላጆችህ/ሽ የአሣዳጊዎችህ/ሽ ሥራ ምንድን ነው

የመንግስት ቅጥር ሠራተኛ ☐ የግል ሠራተኛ ☐ ሌላ ----------

የደመወዝ መጠን ከ300በታች ☐ ከ300-900 ☐ ከ900በላይ ☐

ሬዲዮ አላችሁ ? አለ ☐ የለም ☐

ቴሌቪዥን አላችሁ ? አለ ☐ የለም ☐

ፍሪጅ አላችሁ ? አለ ☐ የለም ☐

የመደበኛ ቤት ስልክ አላችሁ ? አለ ☐ የለም ☐

የተንቀሣቃሽ ስልክ አላችሁ ? አለ ☐ የለም ☐

ምግብ ለማብሰል የምትጠቀሙት በምንድን ነው ?

ኤሌትሪክ ☐ ነጭ ጋዝ ☐ እንጨት ☐

ምግብ የምታበስሉበት ማዕድ ቤት ነው ወይስ ቤት ውስጥ ፤

ማዕድ ቤት ☐ ቤት ውስጥ ☐

የሚቲኖረዉ የቤት ዓነት በከራይ ☐ በግልቤት ውስጥ ☐

ረ. የምገባ መርሐ ግብርን የተመለከተ መጠይቅ ፤

ት/ቤቱ ውስጥ ባለው ምገባ መርሐ ግብር ተጠቃሚ ነህ/ሽ ?

ነኝ ☐ አይደለሁም ☐

ከሆንክ /ሽ መመገብ የጀመርከው/ ሽው መቼ ነው ?

ከ2007 በፊት ☐ 2007 ☐ በ2008 ☐ 3ወር ወዲህ ☐ 1 ወር ወደህ

ከዚህ በፊት ሌላ የምገባ መርሐ ግብር ተጠቃሚ ነበርክ /ሽ ?

ነበርኩ ☐ አልነበርኩም ☐

ሰ. ባለፉት 24 ሰዓታት ውስጥ የተበሉ ምግቦች ወይም ትናትና ሙሉ ቀን የተበሉ ምግቦች ዝርዝር ?

የቀረበት ቀን ብዛት 5 ቀን እና በታች ☐ ከ6 ቀን በላይ ☐

ትምህርት አቋርጠህ/ሽ ደግመህ/ሽ ታውቃለህ/ሽ ?

አዎ ☐ አላውቅም ☐

አዎ ከሆነ ስንት ጊዜ

Interview for students parents/Guardians

ID ----------

Date of Interview ----------

Starting Time ----------

Ending Time ----------

A) Socio – Demographic Characteristics of the students:-

Age ----------

Sex Female ☐ Male ☐

Grade ----------

Do you Have Brother and /or Sisters?

Yes ☐ No ☐

If yes how many are they?

Brother ---------- Sister ---------- Your position ----------

Take Taxi/Bus ☐ on foot ☐

Time taken to reach school <=15 minutes ☐ >15 minutes ☐

B) Caregiver Type

Mother ☐ Father ☐ Mother and Father ☐

Brother ☐ Sister ☐ Grand Mother ☐

Grand Father ☐ Uncle ☐ Aunt ☐ Other ☐

C) Educational level of caregivers

Do your Caregivers Read and Write?

Yes ☐ No ☐

If yes which in their level

Primary ☐ Secondary ☐ Tertiary ☐

D) Religion

Orthodox ☐ **Muslim** ☐ **Catholic** ☐

Protestant ☐ **Other** ☐

E) Occupation of Caregivers

Private ☐ **Civil/Gov. Servant** ☐ **Other** ☐

Salary below 300birr ☐ **from 300 to 900 birr** ☐ **Above 900 birr** ☐

No Permanent income ☐

Living house

Rent ☐ **owned** ☐

F) Socioeconomic status, Do You Have?

Radio **Yes** ☐ **No** ☐

Television **Yes** ☐ **No** ☐

Refrigerator **Yes** ☐ **No** ☐

None Mobile Telephone **Yes** ☐ **No** ☐

Mobile Telephone **Yes** ☐ **No** ☐

What type of fuel does your house hold 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 the school feeding program

Yes ☐ **No** ☐

If yes. When did you start using the program ----------

Before 2007 ☐ **In 2007** ☐ **in 20008** ☐ **last moths** ☐

Have you ever been in other feeding program before?

Yes ☐ **No** ☐

H) 24 hours dietary recall?

Foods eaten preceding 24 hours ?

Absent number of days <=5 **>6** ☐

Have you ever drop out or repeat Class

Yes ☐ **No** ☐

If yes how many times ? ----------

IDDS (Children) Food Groups (Score -8) (FANTH, 2006)

Grains , Roots Or tubers	
Vitamin A-rich or plant foods	
Other fruits or vegetables	
Meat, Poultry, Fish Seafood	

Eggs	
Pulses / legumes /nuts	
Milk and Milk products	
Foods Cooked in Oil /Fat	

For each food item, indicate with a check mark the category that best describes the frequency with which you usually eat that particular food item in 24h preceding the survey **.**			
Food item	once per day	more than once per day	Not at all
	☐	☐	☐
Cereals			
Teff	☐	☐	☐
Maize	☐	☐	☐
Sorghum	☐	☐	☐
Millet	☐	☐	☐
Wheat	☐	☐	☐
Barely	☐	☐	☐
Rice	☐	☐	☐

Pulses, Legumes and nuts

Beans ☐ ☐ ☐

Lentils ☐ ☐ ☐

Roots and tubers

Sweet potato ☐ ☐ ☐

Potato ☐ ☐ ☐

Vegetables ☐ ☐ ☐

Carrot ☐ ☐ ☐

Tomato ☐ ☐ ☐

Mango ☐ ☐ ☐

Papaya ☐ ☐ ☐

Green leafy vegetables ☐ ☐ ☐

Animals –source foods

Eggs ☐ ☐ ☐

Chickens	☐	☐	☐
Beef	☐	☐	☐
Lamb	☐	☐	☐
Fish	☐	☐	☐
Milk	☐	☐	☐

Fruits

Lemon	☐	☐	☐
Orange	☐	☐	☐
Banana	☐	☐	☐
Guava	☐	☐	☐
Mango	☐	☐	☐
Papaya	☐	☐	☐
Avocado	☐	☐	☐