



**SCHOOL OF GRADUATE STUDIES
COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES
CENTER FOR FOOD SCIENCE AND NUTRITION**

**Association of Hemoglobin Concentration and BMI with Academic
Performance among Adolescent Girls in Addis Ababa, Ethiopia**

By

Tibebu Belayneh

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

December, 2017
Addis Ababa, Ethiopia

Addis Ababa University
College of Natural Science and computational sciences
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By: Tibebe Belayneh

Advisors: 1. Dr Dawd Gashu

2. Prof.Birhanu Erko

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| Approved by Examining Board: | Signature | Date |
|-------------------------------------|-----------|------|
| (External Examiner) | | |
| (Internal Examiner) | | |
| 1. Dr. Dawd Gashu (advisor) | | |
| 2. Prof.Berhanu Erko(advisor) | | |
| (Chairman) | | |

Declaration

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

Signature.....

Date.....

The Thesis has been approved for submission by:

Name of Supervisor

Signature

Date

Dr. Dawd Gashu (Advisor)

Prof.Berhanu Erko(Advisor)

Acknowledgements

First and for most, I would like to thank the Almighty God for his endless help throughout my life. Next, my special thanks go to my advisors, Dr. Dawd Gashu and Prof. Berhanu Erko for devoting their precious time in providing constructive comments from the beginning to the final compilation of this thesis.

I would also like to extend my thanks to the study participants, school directors, teachers, Sub-cities education officers, Addis Ababa City Government Education Bureau subject expertise in curriculum department and staff , technical staff of Medical Parasitology Research Unit of the Akilu Lemma Pathobiology, Mr.Sintayehu Mulugeta(Laboratory technician), Addis Ababa University Food Science and Nutrition Center laboratory technicians and staff for their unreserved help and contributions to my thesis work.

I am grateful to my instructors, my friends and my family for their invaluable input to this thesis work.

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List of abbreviations and acronyms

| | |
|--------------|--|
| AOR | Adjusted Odds Ratio |
| ANOVA | Analysis Of Variance |
| BMI | Body Mass Index |
| CDC | Centers for Disease Control and Prevention |
| COR | Crudes Odds Ratio |
| EDHS | Ethiopian Demographic and Health Survey |
| FDRE | Federal Democratic Republic of Ethiopia |
| FMoE | Federal Ministry of Education |
| FMoH | Federal Ministry of Health |
| GABA | Gamma-Amino Butyric Acid (GABA) |
| GTP | Growth and Transformation Plan I |
| NO | Nitric Oxide |
| SPSS | Statistical Package for Social Sciences |
| STHs | Soil-Transmitted Helminths |
| WDD | Women Dietary Diversity |
| WHO | World Health Organization |

Abstract

Adolescent girls are among the vulnerable groups affected by anemia. Anemia is associated to reduce physical growth, high frequency of morbidity, and low cognitive functions that in turn affects school performance.

This study assessed the association between blood hemoglobin concentration and anthropometric characteristic with academic performance of adolescent girls in selected junior high schools in Addis Ababa. A total of 292 adolescent girls age 14 were involved in the study. Socio-demographic and psychosocial characteristics, dietary intake, BMI, school performance, hemoglobin concentration of study participants were determined. Out of the total participants, 45.5% were in a family size of five or more, 208(71.2%) had a workload and 61(20.9%) had one parasite. The prevalence of low BMI (<18.5) was 56.5% and low hemoglobin concentration 57.5%. Dietary Diversity Score (DDS) showed that 15.4% low (\leq 3 food groups), 45.2% medium (4-5 food groups) and the rest 39.4% had high ($>$ 5 food groups) out of the total participants. Bivariate correlation analysis was used to find any statistically significant association between dietary diversity, BMI and hemoglobin level. Among several variables studied, hemoglobin level [COR: 0.16, 95%CI (0.07, 0.22)], DDS [COR: 3.76, 95%CI (1.56, 9.04)], and BMI [COR: 0.04, 95%CI (0.01, 0.14)] were significantly associated with academic performance. When these variables were entered into the regression model to obtain the Adjusted Odds Ratio (AOR), hemoglobin concentration was found to be significantly associated with academic performance [AOR: 0.22, 95%(0.09,0.44)] with $p < 0.01$.

Hemoglobin concentration is a factor that has significant association with the academic status of the study participants. Low hemoglobin concentration is highly prevalent in the country and may contribute to the anemia incidence in the present study adolescents. Therefore, nutritional interventions should be considered in the study area may contribute to reduction of anemia, and hence academic performance in adolescent girls.

Key words: *hemoglobin, anthropometry, adolescent girls, academic performance, Addis Ababa*

1. Introduction

1.1 Background

Health and nutritional status influence adolescent's learning and academic achievements (UNICEF, 2012; Weichselbaum and Buttriss, 2011; Acham *et al.*, 2012). They highly determine how well students perform; adolescents who lack certain nutrients in their diet (particularly iron and iodine), or who suffer from protein-energy malnutrition (PEM), parasitic infections or other diseases do not have the same potential for learning as adolescents who are healthy and well-nourished. Poor health and nutrition also reduce cognitive development either through physiological changes (such as: menstruation that can lead to a peak for iron need, brain, bones, organs and body system or by reducing their ability to participate in learning experiences or both (Manger *et al.*, 2008; DeMaeyer *et al.*, 1989; Eskinder,2011; Kordas *et al.*, 2004; Musaiger, 2002; Soemantri *et al.*, 1985; Hlatshwayo,B., 2011).

Anemia is a condition that is marked by low levels of hemoglobin in the blood. Iron is a key component of hemoglobin, and iron deficiency is estimated to be responsible for half of all anemia prevalence globally. Other causes of anemia include helminths, nutritional deficiencies, chronic infections, and genetic conditions. Anemia is a serious concern for children because it can impair cognitive development, growth, and increase morbidity from infectious diseases(Ethiopian Central Statistical Agency , 2016).

Adolescence (between ages 10 and 19.) is a period of transition accomplished by marked changes in growth rates, body compositions, menstrual cycle blood flow and physiological and endocrinal changes. Moreover, twenty percent of the final adult height and 50% of adult weight occurs during this period: bone mass increase by 45%, dramatic bone remodeling and soft tissues, organs, red blood mass increase in size (Teji *et al.*, 2016; UNICEF., 2011). The dramatic physical changes of body include increase in height, weight, deposition and redistribution of fat, increased lean body mass and enlargement of many organs including the sexual components. Adolescence growth and development is closely linked to the diet they receive during childhood and adolescence (Sajjan *et al.*, 2012). In general, anemia disproportionately affects children and adolescents during their productive years by hindering both the development of individual

human potential and the national social and economic development (Hlatshwayo, B., 2011; Ruel *et al.*, 2000).

Women and young children are most vulnerable to anemia due to insufficient iron in their diets, ongoing blood loss and periods of rapid growth (UNICEF, 2012). Regarding health and nutritional status, balanced diets are not accessible for a large proportion of the world's population, particularly those who live in developing countries (Ruel *et al.*, 2000). Many populations live on staple plant-based diets that often lack diversity (and also inadequate quantity sometimes), which may result in micronutrient deficiencies. Vitamin A and iron deficiency are among the nutritional deficiencies of greatest public health significance in the world today contributing to anemia. Helminths are also known to be significant contributors to the overall anemia burden in the developing world (Sungthong *et al.*, 2002).

School underachievement of adolescent girls has been a persistent area of concern for educators, parents, and students for at least in the past 35 years (Emerick, 2004). There are many reasons for adolescent to underperform at school, including nutrition, iron deficiency, medical problems, specific learning disability, attention deficit hyperactivity disorder, emotional problems, a poor socio-cultural home environment, psychiatric disorders, or even environmental causes (Manger *et al.*, 2008; Acham *et al.*, 2012).

In general, adolescent age is a period where both physical as well as psychological changes occur. Iron requirements reach peak during puberty due to rapid growth and increase in blood volume. Though this vulnerable period has been the focus of existing programs it has to be constantly enhanced to offset the added burden like menstrual blood loss which precipitates in the crisis often (WHO, 2009).

1.2 Statement of the Problem

Academic achievement can be affected by anemia and nutrition. The 2013 Global Burden of Disease study assessed the leading causes of global years lived with disability (YLDs) from 1990 to 2013 and estimated that iron deficiency anemia (IDA) was the leading cause of YLDs among children and adolescents, affecting 619 (95% uncertainty interval, 618–621) million in 2013. The 50 countries with the largest child and adolescent population contributed to 86% of global iron deficiency anemia cases in this population (Syed *et al.*, 2016). Anemia is one of the

most widespread public health problems, especially in developing countries with greater risk in adolescent girls. Anemia in adolescent girls result in lowered resistance to disease, increased susceptibility to infection, poor cognitive development, impaired physical development, poor school performance and reduced work capacity with impaired social and economic development of the country(Gashu *et al.*, 2016). In Ethiopia, studies on anemia often focus on pregnant women and children under five years of age. There are limited data on anemia in adolescent girls and predisposing factors in Ethiopia (Gutema et al., 2014). The relationship between anemia and cognitive performance is attracting interest (Unicef, 2011, Central Statistical Agency (CSA) [Ethiopia] 2016). Education planners have paid relatively little attention to adolescent's health and nutritional status despite the everyday observations of many teachers and parents about the importance of ill health(such as anemia) and malnutrition adversely affecting educational achievement (Leslie and Jamison, 1990, Choi *et al.*, 2011). Poor achievement levels among junior high school adolescents are a major problem in many developing countries (Hutchinson *et al.*, 1997).

As access to junior high schooling expands, increasingly marginal populations are being included; these populations typically manifest more severe problems of malnutrition and illness. These facts, combined with the growth of research literature quantifying some of the adverse educational consequences of ill health and malnutrition, have prompted increased international attention to the linkages among health, nutrition, and education (Leslie and Jamison, 1990; Sajjan *et al.*, 2012).

Due to the success of child survival programs coupled with increased access to junior high schooling through universal primary education, education systems are now faced with challenging health and nutrition related problems. This, combined with the recent growth of research quantifying some of the adverse consequences of ill health and malnutrition, call for prompt attention to the linkages among health, nutrition and education (Gashu *et al.*, 2016; Acham *et al.*, 2012).Anemia caused from Iron deficiency is one of most wide-spread health problem in the world. Children in school age and specially, in the age of puberty will come to experience the danger of anemia based on iron deficiency this is because of the fast growth, that occur during this period. In this age anemia will have a fast growth. Adolescents' need to have different foods, particularly iron, will increase but the need is much higher among females

(Soleimani, 2011). In Ethiopia, adolescents undernutrition and anemia continues to be a major public health problem (Amare *et al.*, 2012). Even though different studies were conducted on the association of nutrition and health with academic achievement of students in some part of the country; there are no previous studies conducted on such associations on adolescents particularly in Addis Ababa. Besides, enough emphasis was not given at national level to address the problem, especially using evidence based information driven from scientific researches. Therefore, this study was conducted to assess the association between anemia and nutritional status with academic achievements of adolescent girls enrolled in the selected governmental schools in Addis Ababa.

1.3 Objective of the Study

1.3.1 General Objective

To assess the association between hemoglobin level and BMI with academic performance of adolescent girls

1.3.2 Specific Objectives

- To determine hemoglobin level of adolescent girls in Addis Ababa.
- To determine BMI of adolescent girls in Addis Ababa.
- To find out the association between socio-economic characteristics, hemoglobin level and BMI with academic performance of adolescent girls in Addis Ababa.

1.4 Significance of the Study

Findings of the present study could serve as an input for policy makers and other relevant authorities to play their own role concerning adolescent girls' education, improving their health and nutritional status. Moreover, the findings could also be used for the scientific community working further in the areas. Because of the impact of anemia and undernutrition on cognitive development and physical growth, a study on the association of anemia and nutrition with school performance can contribute to efforts that aid to improve the quality of education by addressing such problems.

2 Literature review

2.1 Nutrition and Cognitive Development

Poor nutrition in school children seriously compromises their health and learning capacity and there is disturbing evidence that the nutritional status among school children is deteriorating. In previous generations, anemia, rickets and poor growth were associated with low socio-economic status. However, current radical changes in lifestyle among both poorer and better-off strata in industrialized countries mean that personal preference about foods, fashion, physical activity levels and the media are now driving the nutritional patterns of school children more than the availability of food itself(Amenu, 2013).

Balanced diets are not accessible for a large proportion of the world's population, particularly those who live in developing countries. Many populations or subgroups of populations subsist on staple plant-based diets that often lack diversity (and also quantity sometimes), which may result in micronutrient deficiencies. Vitamin A and iron deficiencies are among the nutritional deficiencies of greatest public health significance in the world today. Almost one third of children in developing countries are affected to some degree by vitamin A deficiency, which impairs their growth, development, vision and immune function, and in extreme cases leads to blindness and death(Ruel and Levin, 2000).

Food provides the raw materials needed not only for energy requirements, but also for growth and development. It is not surprising that good nutrition would be associated with a positive effect on cognitive development and function (Taljaard, 2011). Good health and nutrition have been positively associated with less school grade repetition, less absenteeism, more grades completed and better performances on test scores (Behrman, 1996). Each of the factors mentioned can have an influence on cognitive performance, and research has probed questions regarding the relationship between food, health and education (Taras, 2005).

Protein-energy malnutrition has been reported as having significant negative effects on tests of cognitive function in preschool and school-aged children (Leslie and Jamison, 1990). When nutritional deprivation reaches a degree that is severe enough to cause stunting, cognitive development may also be retarded (Taljaard, 2011; Black, 2003; Jennings and Hirbaye, 2008).

The relationship between dietary behavior and academic performance of students has not been widely investigated. There is some evidence that food insufficiency and dietary behaviors are associated with school performance beyond socio-economic status. Children from families that report experiences of food insufficiency and hunger are more likely to show academic problems. It has also been suggested that participation in the school breakfast program significantly improves school performance and reduces absenteeism and tardiness. Whether or not a child eats breakfast may have an effect on nutrient intake and nutritional status, which in turn could affect cognition(Kim et al., 2003).

In other studies, the relationship between diet and academic performance is often stated; however, few studies have examined the effects of diet quality on academic performance. Studies of nutrition and academic performance have typically focused on hunger, malnutrition, and micronutrient deficiency. Undernourished children have been shown to have decreased attendance, attention, and academic performance as well as experience more health problems compared to well-nourished children. More recently, studies have examined the impact of breakfast on cognition, behavior, and academic performance of school-age children(Florence et al., 2008).

2.2 The Role of Iron in Cognitive Development

Iron deficiency is known to affect the lives of more than 1.2 billion people worldwide; many of these individuals are women, children, and infants. Efforts have been made for nearly 30 years to document the effects of iron-deficiency anemia on developmental delays in young children and infants(Beard and Connor, 2003).

Iron deficiency is the most common single-nutrient deficiency disease in the world: An estimated 50% of women of reproductive age and a similar percentage of adolescents are iron deficient. In Latin America, approximately 10–30% of reproductive-age females and 40–70% of pregnant women may be iron deficient. The true prevalence in young children and infants is often hard to determine because of problems in survey design, data collection, or sampling. Numerous intervention studies—performed across the world with varying success—clearly show that in

nearly all situations iron deficiency is a preventable disease with preventable consequences. One such consequence is the alteration in cognition that occurs in iron-deficient individuals at the early parts of their life cycle and perhaps at later times as well (Beard and Connor, 2003).

The exact mechanism by which a shortage of iron impairs cognitive function is not yet fully understood (Eden, 2005). It is, however, important to note that the number of studies on how iron affects brain function is limited, and that these have been conducted on animals. The areas that have been studied can be divided into the following three functional groups: firstly, oligodendrocyte metabolism and myelination; secondly, monoamine metabolism; and thirdly, gamma-aminobutyric acid (GABA) metabolism (Taljaard, 2011). Oligodendrocytes are neuroglia cells with dendritic projections that coil around axons of neurons and are responsible for the production of myelin sheaths of the neurons of the central nervous system (Mosby, 2012). Decreased availability of iron to oligodendrocytes could lead to decreased amounts of iron in the composition of myelin sheaths (Stevens, 2000). With iron deficiency severe enough to be classified as IDA, the neuron myelination and neurotransmitter synthesis may be influenced. Iron also acts as a cofactor for enzymes involved in neurotransmitter synthesis and the catabolism of neurotransmitters (Petranovic *et al.*, 2008). Through the influence on nerve myelination and neurotransmitter synthesis, nerve impulse conduction may also be influenced. This may in turn influence the processing of information, affecting cognitive function.

It has also been suggested that the role of iron on the neurotransmitter systems could affect behavior through the effect on the metabolism of the monoamine transmitter dopamine (Black, 2003). The rate of dopamine clearance from the interstitial space highly influences processing of environmental information. Therefore, alterations in dopamine metabolism could influence attention, perception, memory, motivation and motor control (Beard and Connor, 2003). Each of these factors can affect cognitive function in some way. In general, deficiency of iron has been associated with poorer cognitive performance in children and was implicated in long lasting effects even after treatment for iron deficiency (Gashu *et al.*, 2016).

Several mechanisms linking anemia to altered cognition are possible. The most direct one is that changes that affect development occur to the structure and function of the central nervous system (CNS). One study linked children's behavior during assessment on the Bayley Scales to their test scores. The children with abnormal ratings were more likely to have lower Bayley

scores. The investigators hypothesized that the anemic children's lower scores were mediated through behavior disturbances. There are therefore several biologically plausible ways, demonstrated in both animal and human research, in which iron deficiency could affect child development(Grantham-McGregor and Ani, 2001).

More recently, different studies established that cognitive impairment may be closely associated with neuroanatomical damage and zinc metabolism in the hippocampus due to iron deficiency, and which may result from abnormal cholinergic function. The hippocampus is the focus of many studies today, since this brain structure has high zinc concentration and is highly involved in many forms of cognitive deficits as a consequence of cholinergic deficiency and has achieved prominence because of dementia in ageing and Alzheimer's disease. Thus, it is now apparent that cognitive impairment may not be attributed to a single neurotransmitter, but rather, alterations and interactions of several systems in different brain regions. In animal models of iron deficiency it is apparent that dopaminergic interaction with the opiate system and cholinergic neurotransmission may be defective(Agaoglu *et al.*, 2007).

2.3 Etiology of Anemia

Anemia is one of the most widespread public health problems, especially in developing countries with greater risk on adolescent girls(Gutema *et al.*, 2014). The highest prevalence of anemia exists in the developing world where its causes are multi-factorial. In the developing world, 42% of children less than five years of age and 53% of children 5–14 years of age are anemic. Anemia has been related to reduce work capacity, reduced ability to execute activities of daily living, poor pregnancy outcomes, and reduced cognitive function. With limited resources and the complex, often multi-factorial nature of anemia in the developing world, combating this problem is a global public health challenge (Tolentino and Friedman, 2007).

Anemia in adolescent girls result in lowered resistance to disease, increased susceptibility to infection, poor cognitive development, impaired physical development, poor school performance and reduced work capacity with impaired social and economic development of the country(Gutema *et al.*, 2014). Anemia is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs, which varies by age, sex, altitude, smoking, and pregnancy status. Parasitic diseases, including helminthes infections

and *P. falciparum*, have long been recognized as important contributors to anemia in endemic countries. The effects of infection with a single helminthes species on the risk of anemia are also well documented, with risk correlated to infection intensity. Hookworm causes iron deficiency anemia through the process of intestinal blood loss and through nitric oxide (NO) release. Its infection is considered a major health threat to school-age girls and women of reproductive age, with adverse effects on the outcome of pregnancy (Getachew *et al.*, 2012). The contributors are poor nutritional status, micronutrient deficiencies, intestinal helminthes, HIV infection, and malaria (Crawley, 2004). Helminths are known to be significant contributors to the overall anemia burden in the developing world (Ezeamama *et al.*, 2005; Taylor-Robinson *et al.*, 2012).

Nutritional anemia occurs due to insufficient intake of nutrients by cells. Among the most important nutrients whose deficiency can lead to nutritional anemia are iron, folic acid, vitamin B12, vitamin B6, vitamin C and protein. Iron deficiency anemia is one of the most frequent health problems in the world The World Health Organization recently reported that 1.62 billion of the world population is anemic. The rate among students is 25.4% and in preschool age children anemia reaches its highest percent-age of 47.4. Iron deficiency anemia accounts for 75% of all types of anemia in the third world, affecting 30% of population. In females of child-bearing age, the most frequent cause of iron-deficiency anemia is loss of iron in blood due to significant menstruation or pregnancy. Iron-deficiency anemia can also be caused by a poor diet or by certain intestinal diseases that affect how the body absorbs iron. Literature about anemia in adolescents and youth is scarce, as compared to that focusing on women and children(Al Hassan, 2015).

Hookworm. On the basis of disability-adjusted life years (DALYs), hookworm infection is one of the most important parasitic diseases in humans, outranking schistosomiasis, African trypanosomiasis, Chagas disease, and leprosy. This is due to the fact that infection produces a high degree of long-term morbidity by causing iron deficiency anemia. The primary morbidity caused by human hookworm infection results from adult parasites causing chronic intestinal blood loss. Thus, in addition to dietary iron deficiency in the developing world, many experience ongoing iron loss in the stool caused by this parasitic infection. Blood loss is caused primarily by parasite release of anticlotting agents (i.e., coagulase, a blood thinner), which cause ongoing blood loss in the stool, rather than actual blood consumption by the parasite. For example,

Ancylostoma duodenale can cause in excess of 0.25 mL of blood loss per worm per day. Because of already low iron stores among women and young children caused by diets insufficient to meet demands, these populations are most at risk for hookworm-associated iron deficiency anemia (Tolentino and Friedman, 2007).

Anemia caused by hookworm infection has important sequelae. Among adults, chronic hookworm infection causes physical impairment resulting in reduced work capacity or even inability to work. Because iron deficiency is associated with adverse birth outcomes, most notably low birth weight, hookworm infection is likely a major contributor to this outcome. Among children, developmental and behavior impairment have been identified, resulting in recent initiatives to treat school children with antihelmintic drugs. It should be noted, however, that a recent meta-analysis addressing the topic of treatment of soil-transmitted helminths (hookworm, *Ascaris*, and *Trichuris*) and cognitive outcomes concluded that a relationship between antihelmintic treatment and improved cognitive performance could not be determined. This meta-analysis was highly controversial, with many published and unpublished differences of opinion. Recent publications have highlighted the fact that the age intensity of hookworm infection does not follow the same pattern as most helminthic infections, such as schistosomiasis, in which intensity of infection peaks during childhood and adolescence, and then decreases. The intensity of hookworm infection follows a steady increase during childhood and does not reach a peak or plateau until adulthood. The variation in hookworm intensity by age has led to the conclusion that hookworm infection suppresses the immune system. Recent studies have examined human cellular immune responses to hookworm, as well as mechanisms that hookworms use to suppress the immune system of the host (Tolentino and Friedman, 2007).

There are many negative effects of intestinal parasites on school children: Health problems such as malnutrition/anemia, growth retardation, diarrhea and vomiting/nausea, intestinal obstruction and poor concentration at class, high absenteeism/lower attendance, high repetition and dropout rates, and poor academic performance. Helminth infections are important causes of morbidity and mortality in many developing countries. An estimated 1,471 million cases of infection with *Ascaris lumbricoides*, 1,200 million cases of infection with hookworm, 1,049 million cases of infection with *Trichuris trichiura*, and 200–300 million cases of schistosomiasis occurred worldwide (Amenu, 2013).

2.4 Factors associated with Educational Status of Students

Educational researchers and scholars have identified a number of factors affecting academic status of students(Soleimani, 2011) and these can be summarized as follows:

| <u>Family, Society and school</u> | <u>Student</u> | <u>Academic Status</u> |
|---|---|--|
| <ul style="list-style-type: none">• School variables | <ul style="list-style-type: none">• Physical health | <ul style="list-style-type: none">• Academic dropout |
| <ul style="list-style-type: none">• Family variables | <ul style="list-style-type: none">• Flair and motivation to study | <ul style="list-style-type: none">• Academic achievement |
| <ul style="list-style-type: none">• Environmental variables | <ul style="list-style-type: none">• Mental health | |

As shown above, it is found that physical health and nutritional status of students along with the other variables affect students' academic status. There are several indicators of physical health. Students who are not healthy may experience different symptoms. Anemia, and especially iron deficiency anemia is one of the common problems among students which can have a negative impact on their academic performance and productivity (Soleimani, 2011). The practice of nutrition researchers in controlling for cognitively stimulating materials and experiences when studying the impact of inadequate nutrition on cognitive development is a step in the right direction (Bradley and Corwyn, 2002).

The quality of students' performance remains at top priority for educators. It is meant for making a difference locally, regionally, nationally and globally. Educators, trainers, and researchers have long been interested in exploring variables contributing effectively for quality of performance of learners. These variables are inside and outside school that affect students' quality of academic achievement. These factors may be termed as *student factors*, *nutrition factors*, *family factors*, *school factors* and *peer factors* (Crosnoe, Johnson & Elder, 2004).

Generally these factors include age, gender, geographical belongingness, ethnicity, marital status, socioeconomic status (SES), parents' education level, parental profession, language, income and religious affiliations(Farooq et al., 2011).

In a broader context demography is referred to as a way to explore the nature and effects of demographic variables in the biological and social context. Unfortunately, defining and measuring the quality of education is not a simple issue and the complexity of this process

increases due to the changing values of quality attributes associated with the different stakeholders' view point (Blevins, 2009; Parri, 2006).

There is a range of factors that effect on the quality of performance of students. A series of variables are to be considered when to identify the affecting factors towards quality of academic success. Identifying the most contributing variables in quality of academic performance is a very complex and challenging job. The students in public schools belong to a variety of backgrounds depending upon their demography(Farooq et al., 2011).

The academic performance of children impacts their future educational attainment and health and has therefore emerged as a public health concern. Generally, as levels of education increase, there is an associated increase in income and social status. This associated increase in socioeconomic status affects health by influencing access to health care, quality of housing, work environment, lifestyle factors, such as nutrition and recreation, and social psychological factors, such as self-esteem and health awareness. Given the demonstrated importance of academic performance and resulting educational attainment to future health, it is imperative to understand the determinants of school performance. A number of factors are recognized as affecting school performance including gender, ethnicity, and quality of school and school experience, nutrition, child health, and socioeconomic factors(Florence et al., 2008).

The relationship between diet and academic performance is often stated; however, few studies have examined the effects of diet quality on academic performance. Studies of nutrition and academic performance have typically focused on hunger, malnutrition, and micronutrient deficiency. Undernourished children have been shown to have decreased attendance, attention, and academic performance as well as experience more health problems compared to well-nourished children. More recently, studies have examined the impact of breakfast on cognition, behavior, and academic performance of school-age children(Florence et al., 2008).

Nationally, only 3 per cent of Ethiopia's schools have clinics serving students. About 75 per cent of the population suffers from some form of communicable disease. Primary school children have to walk long distances and through difficult terrain to attend school often in crowded classroom, inadequate trained teachers, school materials. Four out of ten children will not reach their full educational potential. Playgrounds are basically nonexistent in Ethiopia; though plays have a significant role in the primary years of life and help children develop socially,

emotionally and intellectually. Educational factors are too much to list that could affect student's school academic performance, but few were listed in the above introduction(Amenu, 2013).

2.5 Adolescent girls and their nutritional problem

Adolescents, comprised of 10–19 year olds, form the largest generation of young people in our history. There are an estimated 1.8 billion adolescents in the world, with 90% residing in low- and middle-income countries(Abalkhail and Shawky, 2002).

World interest in adolescent health issues has grown dramatically in the past decade. Among adolescents, girls constitute a vulnerable group, particularly in developing countries where they are traditionally married at an early age and exposed to a greater risk of reproductive morbidity and mortality. Adolescence represents a real opportunity to make a difference in lifelong patterns(Kaur et al., 2006).

The prevalence of anemia is disproportionately high in developing countries, due to poverty, inadequate diet, certain diseases, pregnancy/lactation and poor access to health services. The nutritional anemia in this group attributes to high maternal nutrition restriction (MMR), high incidence of low-birth weight babies, high perinatal mortality and fetal wastage and consequent high fertility rates. This phase of life is also important due to the ever-increasing evidence that control of anemia in pregnant women may be more easily achieved if satisfactory iron status can be ensured during adolescence. To plan effective interventions, it is important to understand the epidemiology(Kaur et al., 2006).

The burden of disease among adolescents has its origins in infectious and injury-related causes, but nutritional deficiencies, suboptimal linear growth, and undernutrition are major public health problems, even as overweight may be on the rise in many contexts. Adolescence is an important period in the individual's life. They represent around 20% of the global world's population and around 84% of them are found in developing countries. Little attention has been given to the nutrition of adolescence and there is not much published information on the subject(Abalkhail and Shawky, 2002).

Adolescence is an intense anabolic period when requirements for all nutrients increase. During adolescence, 20% of final adult height and 50% of adult weight are attained, bone mass increases of 45% and dramatic bone remodeling occur and soft tissues, organs, and even red blood cell mass increase in size. This situation is further complicated when adolescents are often exposed to infections and parasites that can compromise nutritional status(Mulugeta et al., 2009). According to world health organization declaration, adolescent are remain largely neglected, difficult to measure, hard to reach population in which the need of adolescent girls in particular often ignored. Nutritional status during adolescence plays an important role in the human life cycle(Teji et al., 2016).

Nutritional deficiencies have far reaching consequences, especially in adolescent girls. If their nutritional needs are not met, they are likely to give birth to undernourished children, thus transmitting undernutrition to future generations. One way to break the intergenerational cycle of malnutrition is to improve the nutrition of adolescent girls prior to conception. The vicious cycle of malnutrition, if not broken, will goes on resulting in more and more severe consequences(Mulugeta et al., 2009).

Surprisingly, information regarding the nutritional status of adolescents from the developing world is lacking. Part of the reason for the lack of information has been the difficulty of interpreting anthropometric data in these age groups (de Onis M and Habicht JP., 1996).

2.6 Measurement of academic achievements

The overall subjects the students were given in the academic year 2015/16 were considered to determine the academic achievements of the students. Annual average score was calculated by taking the result of two consecutive semesters of the year. To examine the effect of nutritional status on educational performance, average marks of the overall subjects the students received were divided into two categories, poor score and good score, based on a cut-off mark of 50%. This cut off point was determined by considering the pass mark set by federal ministry of education, Ethiopian.

Rotberg (2006) mentioned that few countries in the world hold educators accountable for how their students perform on standardized tests. Countries admired for their educational success, such as Canada, Finland, France, Japan, and Sweden, do not use standardized testing to hold educators accountable for student success. They feel that using standardized testing limits the curriculum which teachers use in their classroom lessons. The 2001 legislation of No Child Left Behind (NCLB) in the United States has mandated all schools to participate in state standardized testing. Rotberg concluded this might cause schools to focus on those students close to reaching proficient test scores and lose interest in those low and high achieving students. Teachers feel obligated to focus on areas which will be tested and not use their imaginations in their curriculum and classroom lesson development. The educational gap between low and high income students is evident, but mandated state standardized testing, holding teachers accountable, and centralization is not the cure for those students in poverty. Schools solve the problem of poverty, but NCLB legislation assumes standardized testing solves the problem of poverty (Rotberg, 2006).

Sutton and Soderstrom (1999) reviewed the Illinois School Report Card (IGAP) to measure student achievement. The authors determined that a school's IGAP achievement score is determined more by the demographics of the school than its socioeconomic status. With emphasis on achievement for all students, focus was placed on the learning of basic skills. The authors stated that educators must be held accountable for student success, and the best way to determine this success is to use standardized testing with all students. There must be accountability and accurate assessment in order to evaluate and compare results. Students' achievement must be monitored in order to place proper accountability on school districts. The most efficient results for accountability are standardized test scores (Sutton and Soderstrom, 1999).

Jennings (2006) stated an important factor in the development of state evaluation systems is the effects of the home background of the students and other influences that are out of the control of the schools that affect academic performance, including test scores. Research has shown that socioeconomic status plays a large role in the performance of standardized test scores. Accountability systems that do not take into consideration the home background and socioeconomic status of students are considered to be deferring a bigger challenge than other

districts face in educating their students. Systems that do take socioeconomic status into consideration are accused of setting different standards for students based on their economic background(Jennings, 2006).

3 Materials and methods

3.1 Study Period and Area

The study was conducted in Addis Ababa city between November and December, 2016.

The city is divided into ten administrative sub-cities namely: Arada, Yeka Gulele, Addis Ketema, Akaki-kality, Nefassilk-Lafto, Lideta, Bole, Kolfekeranio, and Kirkos.

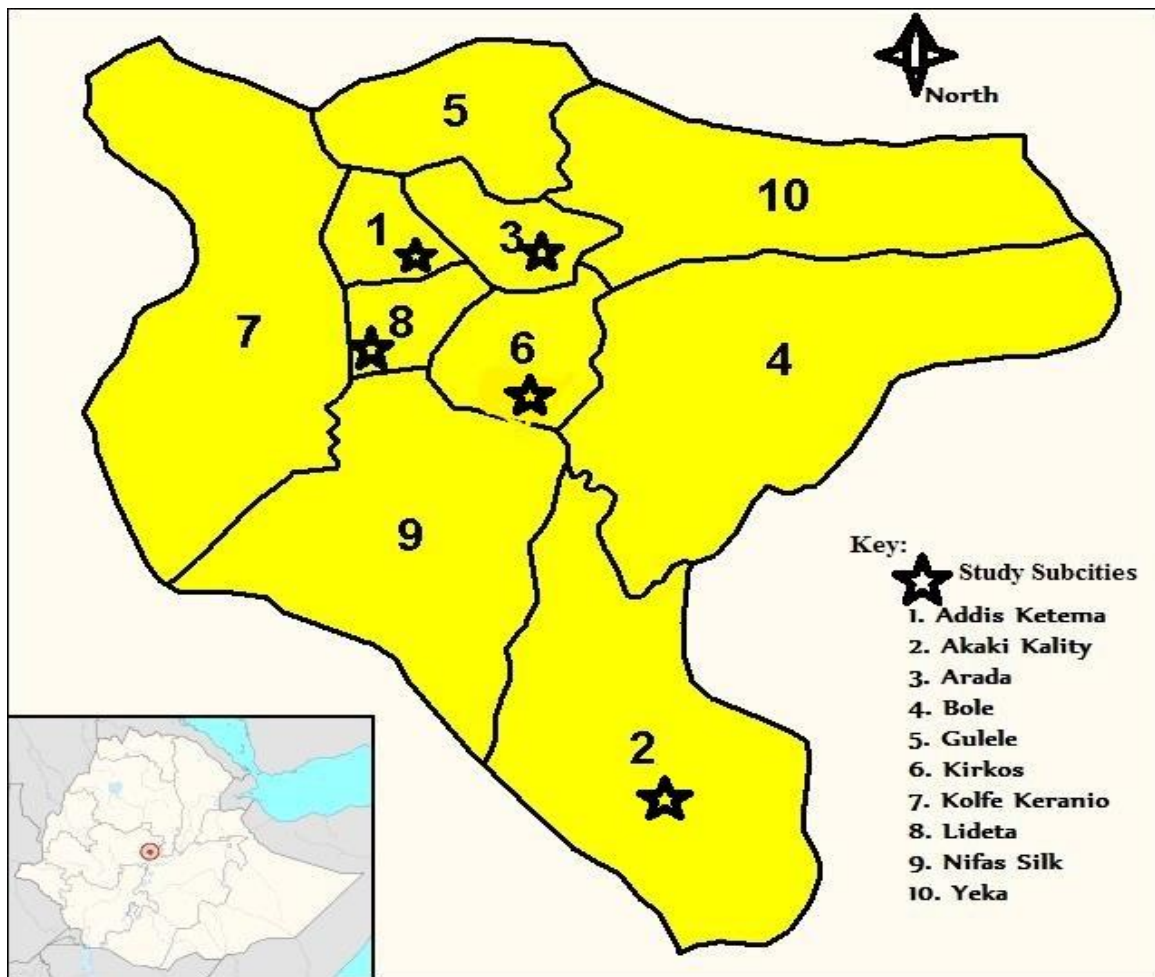


Figure 1 . Map of Addis Ababa showing the study sites.

3.2 Source population

All adolescent girls attending government schools in Addis Ababa.

3.3 Study Population/participants

The study participants were grade 8 adolescent girls who were 14 years old and enrolled in selected government junior high schools found in Addis Ababa in 2016 academic year. The

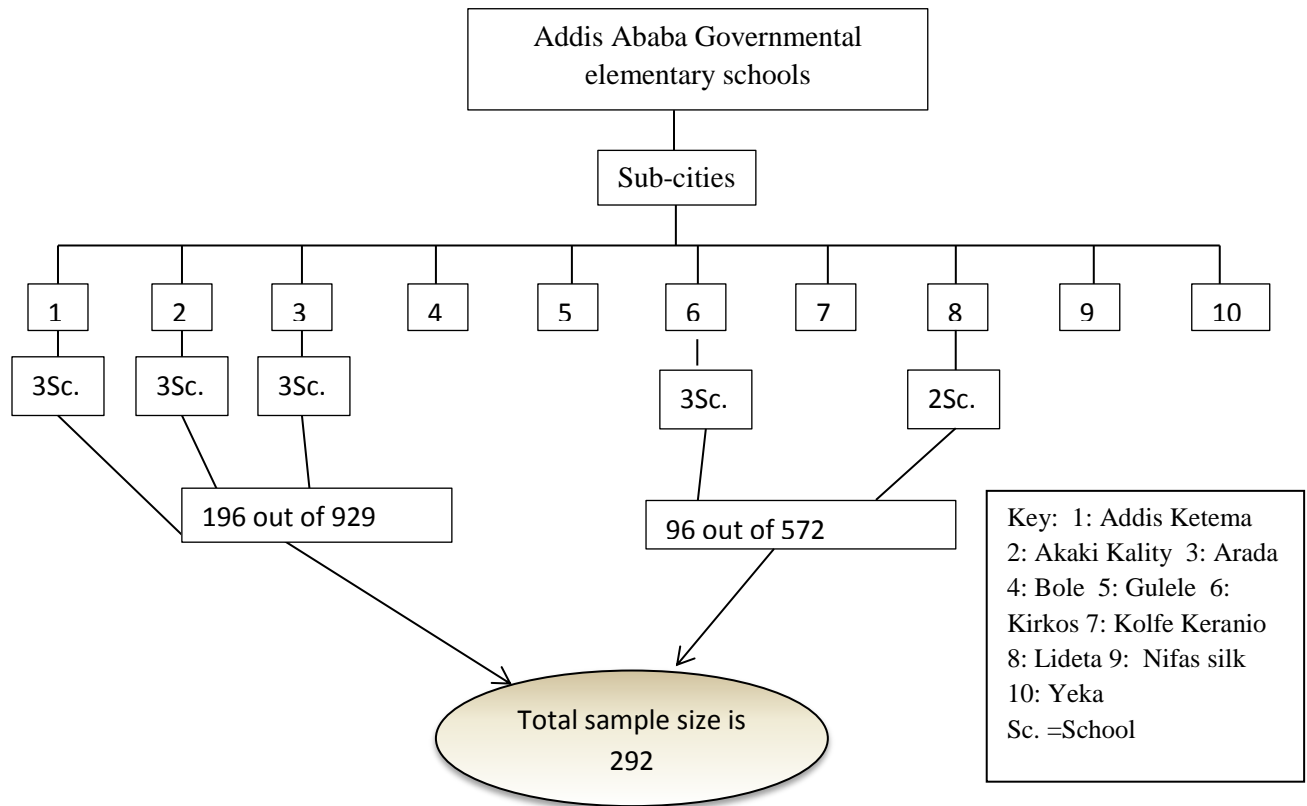
sample population was taken from randomly selected government junior high schools found in the selected sub cities – Addis Ketema, Arada, kirkos, Lidata and Akaki Kality sub cities.

3.4 Study Design and sampling

A school based cross sectional study was conducted among adolescent girls aged 14 year prior to the data collection in Addis Ababa. The sample size was calculated using a single population proportion formula as follows.

$$n = \frac{Z_{\frac{\alpha}{2}}^2 \times P(1-P)}{d^2}$$
, where p = prevalence of anemia = 0.234 (EDHS, 2016), at 95% confidence level (Z-value = 1.96) and margin of error (d) = 0.05. The sample size calculated using this formula became 272. Then 7.5% of contingency for non-response rate was added and the total sample size becomes 292. This sample size was distributed proportionally to randomly selected schools found in the five sub cities (Adis Ketema, Arada, kirkos ,Lideta and Akaki Kality). The study subjects were selected using random sampling methods from the students' roster.

Figure 2. Sampling Framework



3.5 Study Variables

3.5.1 Dependent Variable

- Academic achievement of the study subject

3.5.2 Independent Variables

- Socio-demographic status
- Psychosocial variables
- Hemoglobin level
- Nutritional status
- Height
- Weight
- Intestinal parasitic infection

3.6 Operational definition

Adolescence – is the period of 10-19yrs according to WHO.

Academic performance – is a school level summary measure based on the percentile ranking of student scores on the standard of school achievement test.

High score – a score above mean of the students' grade.

Low score – a score below mean of the students' grade.

Absenteeism – Students' non-attendance during school hour from school.

Repeating – students' failed to pass the last academic year achievement test (failed to pass the last calendar year examination)

Standardized Tests– are tests that are uniformly developed, administered and scored. They are given to a group in a similar setting under similar conditions in order to determine and evaluate against a norm.

3.7 Data Collection Tools

Multiple data collection techniques were implemented to collect all the necessary data regarding socioeconomic status, hemoglobin level, nutritional status and academic performance of the study subjects.

3.7.1 Hemoglobin Level Measurement

Hemoglobin determination was done by taking a finger-prick blood sample using a HemoCue 301((Hemo Cue, Angelholm, Sweden). After wearing gloves for protection, the students' middle or ring finger was cleansed with disinfectant wipe and the side of it was pricked by using a pre-prepared lancet. Hemoglobin determination was done by laboratory technicians for the selected students in

the school compound. The haemoglobin concentration 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 microcuvette 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 for use in field surveys [18, 19]. Data collection was supervised daily by trained field supervisors and the principal researcher. Hemoglobin concentrations were corrected for altitude as proposed by the WHO [21]. Blood hemoglobin level for each of the participants were measured and categorized as anemic if the hemoglobin level was below 12 mg/l.

3.7.2 Anthropometric Measurements

Weight- Body weight of the study subject was measured using a beam balance with non-detachable weighing scale with light clothing.

Height - Height of the study subject was measured using a calibrated wooden height measuring board on a leveled surface without shoes in standing position.

BMI < 18.5 (under nourished) and BMI between 18.5 and 25.5 were categorized as nourished.

3.7.3 Parasitological examination

The study participants were asked to bring about two grams of fresh stool sample in a plastic stool container. Students were asked to bring about two grams of stool sample with a plastic stool

container. Diagnosis of parasites' ova or egg in the stool was done by two laboratory

technicians of the health center. A direct saline suspension (wet mount) technique was

used for the stool examination. The specimens were examined for eggs of soil-transmitted helminths (STHs) using Kato-Katz method and all parasites using formol-ether concentration (WHO., 1991). Two Kato slides were prepared for each stool specimen using a template delivering 41.7 mg of stool. Students who are infected by parasite were referred to the Woreda Health Centers.

3.7.4 Socio-demographic status

Socio-demographic information was collected using semi-structured questionnaire. The questionnaire was prepared in English and to the local language (Amharic) of the study population then translated back into English to check for consistencies or distortions of words or concepts.

3.7.5 Dietary diversity data

Structured questioner was administered to determine dietary intake pattern by the study subjects. The part of the questionnaire used to assess the Dietary Diversity (DD) was adopted from Food and Agriculture organization (FAO) guide line for Women Dietary Diversity Score (WDDS) (FAO, 2010). Number of food-groups consumed during preceding 24 hours to the survey was assessed. The foods consumed in the preceding 24-hours recall was listed in detail as it can be used as a potential proxy indicator of adequacy of nutrients (Annex 8).

3.7.6 Document Review and School Standard Achievement Examination

This was used to gather information from the schools about the student's grade report; grade averages, days of absenteeism, and results for school standard achievement examination.

School Standard Achievement Examination was administered by the selected school teachers at the same time or 4:00pm o'clock in the afternoon. It is prepared by professionals and edited and checked by Addis Ababa education Bureau subject expertise.

3.7.7 Bivariate correlation and binary logistic regression

The bivariate correlation among dietary diversity from the 24 hour dietary recall, nutritional status determined from anthropometric measurement and hemoglobin status from the measured blood hemoglobin level were analyzed using Pearson correlation coefficient and a statistically significant correlation between the variables ($\alpha = 0.01$, CI = 99%) were found (**Table 9**). A linear correlation was found between being anemic, malnourished and low dietary diversity.

3.8 Inclusion and Exclusion Criteria

3.8.1 Inclusion criteria

- Grade 8 adolescent girls at the age of 14 years who were learning in government junior high schools of the selected sub cities.

3.8.2 Exclusion criteria

- Grade 8 adolescent girls who were seriously ill and not able to respond the question.
- Grade 8 adolescent girls who were not willing to participate in the study.
- Grade 8 adolescent girls who were difficult to measure their height (disabled).

3.9 Data Quality Assurance

Hemoglobin determination was done using internationally accepted method and measuring device. The measurement was conducted by two senior medical laboratory technologists and one nurse from hospital having all the necessary experience. The calibration of the HemoCue was checked daily using control micro cuvettes provided by the manufacturer. Anthropometric measurements were also done by two nurses from the health center trained for this purpose. The measurements were done using standard and calibrated measuring devices. Parasitological examination was done using laboratory grade reagents and two senior medical laboratory technologists and one nurse from hospital were involved.

Standard questionnaire were used to collect socio-demographic information and dietary intake by 24 hours dietary recall. Four data collectors who completed grade twelve and trained for this purpose were engaged in the data collection process. The principal investigator coordinates the overall activities during data collection and check for the consistency and quality of all the data collected. The principal investigator was also made the document review.

3.10 Ethical Consideration

This research was approved ethically by the institutional review of College of Natural Science, Addis Ababa University. Supportive letters to conduct the study was obtained from local authorities and concerned government bodies. Written consent (Annex I) was sought from

parents/guardians of the study children. The children also gave their assent and took part in the study.

3.11 Data Analysis

Coding, data entry and cleaning was carried out using Epi-Info version 3.5.3 and data analysis was done using SPSS version 23. Ten percent (10%) of the questionnaire was double entered for data cleaning. The evaluation of students' academic performance assessed using semester average scores for subjects and by giving school standard examination achievement. Descriptive statistics were used to analyze socio-demographic, psychosocial, nutritional status and other variables. Associations between the dependent variable and independent variables were analyzed by using binary logistic regression (95% confidence intervals). Those independent variables that showed significant associations were taken to multivariate analysis. Logistic regression was used to identify independent predictors by controlling confounding variables. $P < 0.05$ was considered to determine statistical significance.

4 Results

This study investigates the association between hemoglobin level, anthropometry, and academic achievement of students attending government schools in Addis Ababa. A total of 292 female adolescents enrolled in grade 8 were included in the study with a 100% response rate.

4.1 Socio-demographic status of participants family

Socio-demographic characteristics of participants are presented in Table 1. About 45.5% participants had a family size of five or more and 2.4% had a family size with 2 family members. Two hundred eight (71.2%) of the family were living in rent house while 72 (24.7%) were living in privately owned house. Regarding number of rooms in the house, 29 (9.9%) respondents reported that their house have only one room and 47 (16.1%) have two rooms and the majority 157 (53.8%) reported their house have three rooms. Out of the total participants, 103 (35.2%) responded that their houses are not comfortable to study. Crowdedness was the major reason mentioned by 70 (67.9%) of these respondents followed by lack of separate room 29.2%.

Table 1 Socio-demographic family profile of school adolescent girls (n=292) in Addis Ababa, December, 2016

| Variables | Frequency | Percent |
|--|-----------|---------|
| Family size (Number of family members) | | |
| 2 | 7 | 2.4 |
| 3 | 33 | 11.3 |
| 4 | 119 | 40.8 |
| ≥5 | 133 | 45.5 |
| House ownership | | |
| Family owned | 72 | 24.7 |
| Rent | 208 | 71.2 |
| I don't know | 12 | 4.1 |
| Number of partition rooms in the house | | |
| 1 | 29 | 9.9 |
| 2 | 47 | 16.1 |
| 3 | 157 | 53.8 |
| 4 | 47 | 16.1 |
| Other | 12 | 4.1 |
| Do you have a Television? | | |
| Yes | 268 | 91.8 |
| Where do you prefer to study? | | |
| Home | 140 | 47.9 |
| School | 141 | 48.3 |
| Open field | 11 | 3.8 |
| Is your home comfortable to study? | | |
| Yes | 189 | 64.7 |
| If uncomfortable to study, why? | | |
| Crowdedness | 70 | 67.9 |
| No separate room | 30 | 29.2 |
| Insects | 1 | 0.97 |
| Other | 2 | 1.9 |
| Educational level of fathers | | |
| No formal education | 14 | 4.8 |
| Read and Write | 59 | 20.2 |
| Junior high School | 209 | 71.6 |

| | | | |
|------------------------------|------------------------|-----|------|
| | Secondary School | 2 | 0.7 |
| | Above secondary School | 8 | 2.7 |
| Educational level of mothers | | | |
| | No formal education | 25 | 8.6 |
| | Write and Read | 26 | 8.9 |
| | Junior high School | 17 | 5.8 |
| | Secondary School | 85 | 29.1 |
| | Above secondary School | 139 | 47.7 |
| Fathers' occupation | | | |
| | Teacher | 11 | 3.8 |
| | Farmer | 20 | 6.8 |
| | Merchant | 50 | 17.1 |
| | Government employee | 165 | 56.5 |
| | Private employee | 30 | 10.3 |
| | Daily laborer | 10 | 3.4 |
| | Unemployed | 2 | 0.7 |
| | others | 4 | 1.4 |
| Mothers' occupation | | | |
| | House wife | 30 | 10.3 |
| | Teacher | 19 | 6.5 |
| | Farmer | 7 | 2.4 |
| | Merchant | 49 | 16.8 |
| | Government employee | 154 | 52.7 |
| | Private employee | 27 | 9.2 |
| | Daily laborer | 2 | 0.7 |
| | Unemployed | 2 | 0.7 |
| | others | 2 | 0.7 |

4.2 Psychosocial and Behavioral Characteristics

Participants' relationships with their families, teachers and peers were assessed. Respondents were also assessed regarding support they got from their families to their educational achievement. Relationship among family members and the effect of their living environment on their school performance was analyzed.

Most of the participants, 277 (94.9%) and 287 (98.3%), had good relationship with their families and peers, respectively. About 127 (43.5%) of the respondents said they had offended by one of their family members and 129 (44.2%) punished at school (**Table 2**).

Majority of the participants, 208 (71.2%) reported they had a work load in their house and mentioned as the main factor to spend shorter time studying. However, 260 (89%) of them practice studying at night and from 32 (11%) who did not study at night, 10 of them mentioned house work load as a reason. Most of the respondents, 263 (90.1%), said they had family support in their education. On the other hand; 189 (64.7%) of them answered they had a shortage of educational materials

For the question “Do your families often quarrel each other?” 62 (21.2%) of them said “Yes” and 157 (53.8%) said family quarrel disturb them. Besides; 28 (9.6%) of the respondents said they did not have breakfast when they came to school, and 47 (16.1%) said they travel on foot more than one hour to reach their school (Table 2).

Table 2 Psychosocial and behavioral characteristics of school adolescent girls (n=292) in Addis Ababa, December, 2016

| Variables | | Frequency | Percent |
|--|-----------------------------------|-----------|---------|
| Have you ever bullied by one of your families? | Yes | 127 | 43.5 |
| Have you ever punished at school? | Yes | 129 | 44.2 |
| If you have punished at school. What was the reason? | Disagreement with teachers | 65 | 50.4 |
| | Disagreement with students | 50 | 38.8 |
| | Violating the rules of the school | 8 | 6.2 |
| | Others | 5 | 3.9 |
| Do you study during night? | Yes | 260 | 89.0 |
| If you don't study at night. What was the reason? | Lack of light sources | 5 | 15.6 |
| | Uncomfortable environment | 8 | 25.0 |
| | Family discouragements | 9 | 28.1 |
| | Work load from family | 10 | 31.3 |
| Do you have a work load in the home? | Yes | 208 | 71.2 |
| Do your families support your education? | Yes | 263 | 90.1 |
| Do you have a shortage of educational materials? | Yes | 189 | 64.7 |
| Do your families often quarrel each other? | Yes | 62 | 21.2 |
| Is their quarrel disturbing you? | Yes | 157 | 53.8 |
| Do you eat breakfast? | Yes | 264 | 90.4 |
| Do you have a brother or sister in this school? | Yes | 231 | 79.1 |
| Do you have a brother or sister in the University? | Yes | 151 | 51.7 |
| How long does it take you to reach school? | < 1 Hour | 245 | 83.9 |
| | ≥ 1 Hour | 47 | 16.1 |

4.3 Academic performance

Participants' subject score from the last academic year and absenteeism in the current academic year were assessed. Regarding participants' subject score, in the previous academic year, 90 (30.8%) had a score below the mean and, 60 (20.6%) of the 30.8% them repeated grade 8 last year – 21 (35%) due to academic failure, 17 (28.3%) because of family problem, 15 (25%) due to health related problems and 7 (11.7%) for other unmentioned reasons. About 41 (14%)

respondents were absent for more than five days, and 237 (81.2%) respondents were absent for one to five days (**Table 3**).

Table 3 . Grade score, grade repetition and absenteeism score of school adolescent girls (n=292) in Addis Ababa, December, 2016

| Variables | Frequency | Percent |
|---|-----------|---------|
| Semester average in the last academic year? | | |
| < Mean | 90 | 30.8 |
| ≥ Mean | 202 | 69.2 |
| Did you repeat the same grade last year? | | |
| Yes | 60 | 20.6 |
| Reason to repeat | | |
| Academic | 21 | 35 |
| Family | 17 | 28.3 |
| Disease | 15 | 25 |
| Other | 7 | 11.7 |
| Absenteeism from school | | |
| > 5 days | 41 | 14.0 |
| 5 days | 34 | 11.6 |
| 4 days | 27 | 9.3 |
| 3 days | 69 | 23.6 |
| 2 days | 79 | 27.1 |
| 1 day | 28 | 9.6 |
| No absenteeism | 14 | 4.8 |

Based on the average result calculated for the total subjects the respondents were taken, they are categorized as below average or above average. One hundred fifty seven (53.8%) of the study participants were below average and 135 (46.2%) were above average.

4.4 Medical History and Parasitological Examination

Medical history of the study participants was assessed. As shown in **Table 4** , 118 (40.4) of the respondents were found ill and the reported diseases were both communicable and non-

communicable. Since most of the study participants were dewormed there was very low result for the parasitological examination.

Table 4 Medical history of school adolescent girls (n=292) in Addis Ababa, December, 2016, n=292

| Variables | | Frequency | Percent |
|--|----------------------|-----------|---------|
| Have you been sick since last September? | Yes | 118 | 40.4 |
| | No | 174 | 59.6 |
| Parasites | Ascariasis | 9 | 7.6 |
| | Hookworm | 8 | 6.8 |
| | Amebiasis | 25 | 21.2 |
| | Others | 76 | 64.4 |
| Symptoms | Fatigue | 28 | 36.8 |
| | Irregular heart beat | 17 | 46.1 |
| | Shortness of breath | 7 | 9.2 |
| | Dizziness | 35 | 46.1 |
| | Headache | 40 | 52.6 |

Based on a laboratory result for parasitic infection, Out of 292 students who had stool examination, 61(20.9%) had one parasite. This infection prevalence is 61(20.9%). Of those, the dominant parasite was ascaris 21 (7.2%), followed by amoeba 20(6.8%) and the remaining are Giardia

4.5 Dietary diversity

The dietary diversity (DD) level was assessed using 24 hr. recall method. The mean dietary diversity (DD) of the study participants was 5.53(±1.28), ranging between 2 to 8. The Dietary Diversity score result (figure 3) revealed that 15.4% of the study participants took low (below 3 food groups), 45.2% medium (4 to 6 food groups) and the rest 39.4% had high (above 6 food groups). According to this study more than half,

263(90.1%) of the study participants were drinking tea with and after a meal. Less than half, 134(45.9%) organ meat and 74(25.3%) of participants took flesh meat and fish which are iron rich foods. Dietary diversity of study subjects are shown in table 5 below and Dietary Diversity Score are shown in **Figure 3** below.

Table 5. Food groups consumed by school adolescent girls (n=292) in Addis Ababa, December, 2016, n=292

| Food Groups | Frequency, n (%) |
|--------------------------------------|------------------|
| Starchy Staples | 250(85.6) |
| Dark green leafy vegetables | 190(65.1) |
| vitamin A rich fruits and vegetables | 245(83.9) |
| Other fruits and vegetables | 287(98.3) |
| Legumes nuts and seeds | 252(86.3) |
| Milk and milk products | 77(26.4) |
| Flesh meat and fish | 74(25.3) |
| Organ meat | 134(45.9) |
| Eggs | 161(55.1) |

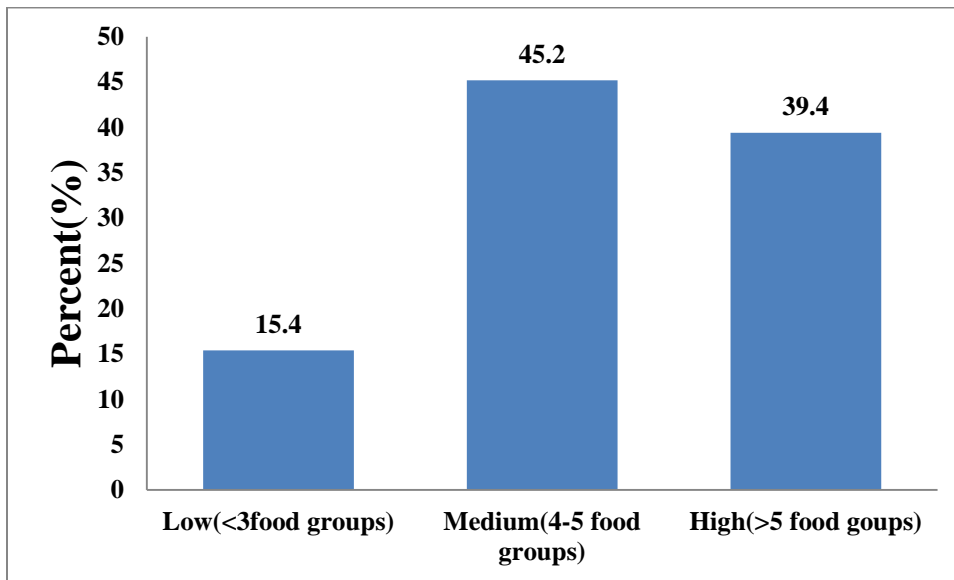


Figure 3 . Dietary diversity score of school adolescent girls (n=292) in Addis Ababa, December, 2016, n=292

4.6 Nutritional status of the participants

The Body Mass Index (BMI)-for-age of the students was calculated according to the Quetelet's Index nutritional evaluation tools used for adults that were adopted to adolescents by CDC, (Rosalind S.G., 2003) According to the Quetelet's index, the mean, the range and standard deviation of the BMI-for-age were calculated as 18.94, 17.00 and 3.64, respectively.

Out of the total study participants; 165 (56.5%) had BMI < 18.5, 127 (43.5%) had BMI > 18.5. One hundred sixty five (56.5%) of the study participants were categorized as malnourished while 127 (43.5%) of them were categorized as nourished.

4.7 Hemoglobin Level

Around 168 (57.5%) of the study participants were anemic. The mean, range and standard deviation of the hemoglobin level of the participants are 12, 11 and 1.8 respectively.

4.8 Comparison of hemoglobin level, BMI, school exam result with dietary diversity.

There were a significant difference among hemoglobin level, BMI and school exam along with DDSs. As DDS increases the hemoglobin level was showed a strong significant improvement (p-value < 0.001).

Table 6 Comparison of school performance by homoglobin level, BMI with dietary diversity of school adolescent girls (n=292) in Addis Ababa, December, 2016

| variables | Dietary diversity score(DDS) | | | p-value |
|------------------|------------------------------|-------------------------|--------------------------|---------|
| | low(<3) | Medium(4-6) | High(>6) | |
| Hemoglobin level | 11.03±1.22 ^a | 11.86±1.59 ^b | 12.73±1.33 ^c | 0.001 |
| BMI | 17.03±1.93 ^a | 18.39±3.33 ^b | 20.29±4.00 ^c | 0.001 |
| School exam | 39.16±4.88 ^a | 44.33±9.56 ^b | 45.85±10.74 ^b | 0.001 |

Values are presented as mean±SD, and p-value < 0.05 indicator of a significant difference between groups. Different letters were given along each variable with respect to low, medium and high categories of dietary diversities to show a significance difference.

4.9 Exam result and hemoglobin level

Result from independent t-test implied that non-anemic adolescent girls highly significantly perform their exam than anemic (p < 0.001). Compared to non-anemic children, anemic children had significantly lower scores in exam result (47.31 ± 10.09 vs 42.32 ± 9.09; p < 0.001).

4.10 Exam result and nutritional status

The independent t-test showed that undernourished adolescent girls highly significantly perform less exam result (40.33± 7.7) than nourished (49.07±9.97).

4.11 Association of hemoglobin level, anthropometric characteristics, and other variables with school performance

There exist a statistically significant relationship among hemoglobin level($r=0.132$, $p<0.01$), BMI($r=0.444$; $p<0.01$), and DDS($r=0.215$; $p<0.01$) with school exam average.

Table 7. Correlation(Pearson,2-tailed) among homoglobin level, BMI, school exam average result with dietary diversity of school adolescent girls (n=292) in Addis Ababa,December,2016

| variables | | BMI | average score | DDS |
|------------------|---|---------|---------------|---------|
| hemoglobin level | | 0.444** | 0.132** | 0.340** |
| | p | .000 | 0.025 | 0.000 |
| BMI | | | 0.444** | 0.345** |
| | p | | .000 | 0.000 |
| average score | | | | 0.215** |
| | p | | | 0.000 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

4.12 Association of hemoglobin level, BMI, and DDS

In the preliminary logistic regression analysis, hemoglobin level, BMI and dietary diversity have a potential correlation on academic performance or dependent variable. In addition to that Omnibus test ($p=0.001$) and Hosmer and Lemeshow goodness of fit test ($p=0.197$) show how well the model fit to the data.

Results from the binary logistic regression implied that among several variables studied, DDS, BMI and hemoglobin level have significant association with academic performance of the study participants ($P\text{-value} < 0.05$) with their respective Crude Odds Ratio (COR). For instance, the COR result implied that those students who were non-anemic 0.16 times more likely to have a better academic performance than those with anemic [COR: 0.16, 95%CI (0.07, 0.22)] **The regression** analysis indicated as follows:

Table 8).

When these variables were entered into the model to obtain the Adjusted Odds Ratio (AOR) and a P-value of < 0.05 as a level of significance, hemoglobin level remain statistically highly significant after adjusting all others variables [AOR: 0.22 ,95%CI (0.09,0.44)] with academic performance of the study participants. In this particular study, hemoglobin level has a significant association (95% CI, p < 0.05) with academic performance. The regression analysis indicated as follows:

Table 8. Binary logistic regression analysis for factors associated with academic performance of school adolescent girls (n=292) in Addis Ababa,December,2016

| Variables | Category | School performance(average grade score) | | Crude OR (95%CI) | Adjusted OR (95%CI) |
|------------------|-------------|---|-----------|---------------------|------------------------|
| | | Below | Above | | |
| | | Average (%) | n, | Average (%) | n, |
| Hemoglobin level | anemic | 131(71.2) | 53(28.8) | 1 | 1 |
| | non-anemic | 26(24.1) | 82(75.9) | 0.16(0.07,0.22)** | 0.22(0.09,0.44)** |
| DDS | low | 38(84.4%) | 7(15.6%) | 1 | 1 |
| | medium | 78(59.1%) | 54(40.9%) | 3.76(1.56,9.04)** | 0.46(0.16,1.33) |
| | high | 47(40.9%) | 68(59.1%) | 7.85(3.23,19.08)** | 0.91(0.47,1.76) |
| BMI | underweight | 139(81.8%) | 31(18.2%) | 1 | 1 |
| | normal | 21(20.6%) | 81(79.4%) | 0.04(0.01,0.14) | 0.06(0.01,0.24) |
| | overweight | 3(15.0%) | 17(85.0%) | 0.68(0.18,2.54) | 0.62(0.16,2.46) |

*statistical significance at p<0.05

** significance at p<0.01

5 Discussion

Adolescent girls are among the vulnerable groups of anemia due to difference in the nutritional needs widens after the onset of puberty. Iron requirements peak during adolescence due to rapid growth and increase in blood volume and burden like menstrual blood loss which precipitates the crisis often (Premalatha *et al.*, 2012) which intern negatively affect performance in curricular and extra-curricular activities. The current study presents findings from school based cross sectional study that aimed to determining the association of hemoglobin level, anthropometric characteristics, dietary intake, and socioeconomic status with academic performance of adolescent girls in school. In this study, anemic students had significantly lower exam scores than their non-anemic counter parts.

This is in accordance to the study done in India, anemic school going adolescents had low scholastic performance in the form of low mathematics score and low scores in verbal learning, attention, mental balance, and recognition component of multicomponent test along with low IQ scores than their non-anemic comparers (More *et al.*,2013)..In other studies findings showed that in both pre-school and school-age children a consistent, strong relationship has been found between anemia and impaired cognitive function and poorer school performance (Leslie and Jamison, 1990). Other related studies implied that hemoglobin concentrations of 6 and 5 g/dl, human cognitive function is impaired subtly(Weiskopf *et al.*, 2000).

Some studies have shown that children with anemia, score significantly lower in intelligence tests (Pollit, 1993). Even though, it is commonly considered that iron deficiency is responsible for half of anemia incidence, the deficiency is not regarded as a public health concern in Ethiopia. On the other hand, deficiency of otherwise micronutrients such as zinc, B vitamins, which are important for hemoglobin are highly prevent in the country and may contribute to the anemia incidence in the present study children, In addition, sanitation, health and socio-economic status also determine hemoglobin level. Therefore, addressing such issues may contribute to reduction of anemia, hence school achievement in adolescent girls.

In addition, other researchers showed that low serum iron, decreased IQ, precision, concentration and learning in school-age children, and iron supplementation in children, can increase their scores of intelligence and academic tests (Nachvak and Rezaei, 2006; Berton and Roberts, 2007).

Moreover, differences were observed in students with anemia compared with healthy students in terms of homework completion, sensory and physical abilities, attention and concentration, learning ability and memory capacity (Nachvak and Rezaei, 2006).

The study of Hall et al,(2008) regarding the academic success of students with anemia in 8 Asian and African countries showed the anemia prevalence is more than 40% in adolescents in the countries such as Ghana, Indonesia, Malawi, Mozambique, Tanzania, Vietnam. The survey results show that this students' Academic failure, decrease of mental concentration and also reduce of learning power of the anemic students were more than the rest of their peers.

In the current study underweight adolescent girls perform less academic result when compared to normal weight. Other similar studies found in Nigerian primary school, in which underweight was 47%, severe underweight was 4% and the overall nutritional status significantly affects school performance (Goon *et al.*, 2011).

Regarding association between the dietary diversity from the 24 hour dietary recall, the nutritional status, and anemia status; there were a significant linear correlation among the variables. This finding implies that estimated dietary diversity and nutritional status have a direct effect on the hemoglobin level and occurrence of anemia. Similar studies also reported the direct association between nutrition and anemia (Hutchinson *et al.*, 1997;Leslie and Jamison, 1990, Barragán-Ibañez *et al.*, 2016). However, in this study dietary diversity from the 24 hour dietary recall was significantly associated with school performance of the adolescents in bivariate analysis but the association disappeared when the effect of other variables was controlled in multivariate analysis ($P>0.05$). P-value as a level of significance implied that the study participants who were categorized as malnourished found to have 0.62 times likely to have good academic status than those who categorized as nourished. Several studies conducted to assess the effect on nutrition on academic achievement were also reported similar findings (Gashu *et al.*, 2016; Leslie and Jamison, 1990 Teji *et al.*, 2016).

The relationship between diet and academic performance is often stated; however, few studies have examined the effects of diet quality on academic performance. Studies of nutrition and academic performance have typically focused on hunger, malnutrition, and micronutrient

deficiency. Undernourished children have been shown to have decreased attendance, attention, and academic performance as well as experience more health problems compared to well-nourished children. More recently, studies have examined the impact of breakfast on cognition, behavior, and academic performance of school-age children(Florence et al., 2008).

In general, anemia has an impact on cognitive development and academic performance of children (Beard and Connor, 2003;Eden , 2005; Cook *et al.*, 2017). In this study, the Adjusted Odds Ratio (AOR) and a P-value as a level of significance implied that the study participants who were anemic found to have lower academic status than those who were non-anemic. . Similarly, A study conducted in some part of rural Ethiopia on selected school children showed that a Comparison to non-anemic children, anemic children had significantly lower scores for the similarity test (9.5 ± 1.7 vs 8.9 ± 2.2 ; $p = 0.02$)(Gashu et al., 2016)

In the present study, intestinal helminth infection was detected very low among the study participants. This could be due to the national de-worming program by the FMOH as part of elimination of soil-transmitted helminthiasis in Ethiopia (Negussu *et al.*, 2017).

6 Limitation of the study

- Since the study was facility based and the participants may not represent the general population
- Assessment of dietary diversity depends on the 24hour recall method, which may not accurately reflect their past feeding experience

7 Conclusions and recommendations

7.1 Conclusions

From this study it is concluded that exclusion of overall nutritional, and health intervention to increase their hemoglobin is necessary to reduce occurrence of anemia and there by an impact on academic performance positively.

- The likely hood of having lower academic performance was significantly predicted by lower hemoglobin level.
- Anemia status was found to have a statistically significant association with academic performance of the study participants.
- The academic performance status of the study participants was affected by their nutritional status.

7.2 Recommendations

Based on the findings the following recommendations are forwarded.

Government / community

Basic education programs for adults who cannot attend formal education is recommended that the government and other relevant stakeholders who work on educational quality, specifically on females' education should consider

- improving nutritional status in order to improve academic performance
- Information on causes and management of anemia is important for adolescent girl and can be included in school curricula.

- Health education and awareness creation of community on eating affordable & iron rich food like kidney

School officials

- Awareness should be created on the negative impacts of nutritional anemia on academic performance
- School officials should work with health sector and families in order to improve educational status of adolescent girls.

Further research

- Further school based studies are needed to find out the association of hemoglobin level and nutritional status on academic performance by longitudinal design.

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Annexes

Annex 1. Consent Form & Information sheet

This sheet is to be read for the participants & participant's parents of the study.

Good morning/afternoon, my name is ----- and I am one of the data collectors for the study being conducted by Addis Ababa University, Natural science faculty, Center of food science and Nutrition. You are selected scientifically to be participant of this study if you give me consent after you have understood the following information:

Title of the study: Association of Hemoglobin Level and Anthropometric Characteristics with Academic Performance of Adolescent girls in Governmental Elementary School in Addis Ababa.

Introduction: Nutrition and health status are powerful influences on a child's learning and on how well a child performs in a school. Children who lack certain nutrients in their diet (particularly iron and iodine), or who suffer from protein-energy malnutrition, hunger, parasitic infections or other diseases, do not have the same potential for learning as healthy and well-nourished children. Weak health and poor nutrition among adolescents diminish their cognitive development either through physiological changes or by reducing their ability to participate in learning experiences—or both.

Procedures: the study involves 14 age adolescent girls in grade 8 governmental elementary schools in Addis Ababa. Your daughter selected to be one of the study participants if you are willing to participate. We are so happy finally your daughter will be kindly requested to give her genuine response in the questionnaires. We would like to ask your permission to measure your daughter's weight, height, mid upper arm circumference, hemoglobin test & stool test.

Benefit of the study: -the participant will not get any direct benefit for being participant

-The result can be used as a baseline for further studies that can be done in this city.

- The result will be used to design prevention and control measures of the problem.

-The result will be disseminated to the Addis Ababa Education Office and Health Office.

Harm of the study: the study has no any harm except that participant will spend up to 30minutes in the interview and giving one drop of blood from finger prick.

Rights of the participant: -participation has full right

-Not participate

- The participant can stop participating in the study at any time

-The participant can skip question which she does not want to respond

-During the interview, the participant can ask questions which are not clear

Confidentiality: - the secrecy of any information forwarded will be maintained.

We assure you that whatever answers you give us will be kept strictly secret. We do not need yours and your daughter's name and address. We also inform you that you have the full right to withdraw from the study or stop the interview at any time and /or skip any questions that you don't want to answer. You may find some of the questions too personal and difficult to talk about, but your experience will be very helpful for other people. Also you will not get/receive direct benefit for participating in the study.

Person to contact: If you have any question, don't hesitate to ask me at any time. For additional questions or any other concern about the study, you may contact:

➤ **Principal Investigator :**

Tibebu Belayneh: phone number 0911642803

Email: tibebubelayneh79@gmail.com

Working Place: Kotebe University College Chemistry department

➤ **Advisors :**

1. Dr. Dawd Gashu Mobil 0911-745153

dawd.gashu@aau.edu.et

2. Berhanue Erko (Prof.) Mobil 0911-371173

berhanue@yahoo.com

If you agree your students to participate in the study, please sign at the space provided below:

And I would like to thank you for your cooperation!!

Participant's Name _____

Signature _____

Date _____

Person Obtaining Consent

Name _____

Signature _____

Date _____

Annex 2. Questionnaire

Identification number _____

Pupil's name _____

I. Dietary diversity questionnaire using 24-hour recall period.

| Question number | Examples | Yes=1 No=0 |
|------------------------|---|-----------------------|
| 101 | <ul style="list-style-type: none">• Corn/maize• Rice• Wheat• Sorghum• Millet• Barley• Oats• Teff | |
| 102 | <ul style="list-style-type: none">• White potato• Sweet potato• White cassava• ginger | |
| 103 | <ul style="list-style-type: none">• Carrot• Pumpkin• Sweet potato• Red sweet pepper | |

| | | |
|-----|--|--|
| 104 | <ul style="list-style-type: none"> • Cassava leafs • Spinach • Broccoli • Cucumber • Cabbage • Salad | |
| 105 | <ul style="list-style-type: none"> • Tomato • Onion • Garlic • Others | |
| 106 | <ul style="list-style-type: none"> • Banana • Orange • Lemon • Grapes • Mango • Papaya • Watermelon • Strawberry • Others | |
| 107 | <ul style="list-style-type: none"> • Liver meat • Kidney • Heart • Other organ meat or blood based meat | |
| 108 | <ul style="list-style-type: none"> • Beef • Pork • Lamb • Goat | |

| | | |
|-----|---|--|
| | <ul style="list-style-type: none"> • Chicken • Others | |
| 109 | <ul style="list-style-type: none"> • Eggs | |
| 110 | <ul style="list-style-type: none"> • Fish | |
| 111 | <ul style="list-style-type: none"> • Dried beans • Dried peas • Nuts • Lentil • Chick-pea | |
| 112 | <ul style="list-style-type: none"> • Milk • Cheese • Yoghurt • Others | |
| 113 | <ul style="list-style-type: none"> • Oil • Fats or butter added to food or used for cooking | |
| 114 | <ul style="list-style-type: none"> • Sugar • Honey • Sweetened soda or sweetened juice drinks • Sugary foods such as chocolates, • candies • cookies and • cakes | |
| 115 | <ul style="list-style-type: none"> • Red pepper • Salt • Cloves | |

| | | |
|-----|---|--|
| | <ul style="list-style-type: none">• Mustard• Chilies• Cinnamon• Mayonnaise• Ketchup• Salsa (sauce) | |
| 116 | <ul style="list-style-type: none">• Tea• Coffee• Homemade nonalcoholic beverages | |

II. Socioeconomic and educational status of the student

| Sr No. | Question | Response | Skip to |
|--------|--|---|---------|
| 201 | Do you have radio? | 1. Yes 2. No | |
| 202 | Do you have TV set? | 1. Yes 2. No | |
| 203 | Whose property is the house in which you live? | 1. Our own 2. Rent 3. I do not know | |

| | | | |
|-----|--|---|---------|
| 204 | How many rooms does your house have? | _____ | |
| 205 | How many persons live in your house? | _____ | |
| 206 | Is your home comfortable for studying? | 1. Yes 2. No | Skip to |
| 207 | If no, for the above question, what is the reason? | 1. Crowded ness of room 2. Have no separate room 3. Problem of insect infestation 4. Others (specify)_____ | |
| 208 | Where do you prefer to study? | 1. At home 2. At school 3. At open field | |
| 209 | What is your father's educational level? | 1. Unable to write & read 2. Able to write & read | |

| | | | |
|-----|--|---|--|
| | | <ul style="list-style-type: none"> 3. Grade 1-6 4. Grade 7-12 5. Grade 12+1 6. Grade 12+2 7. Degree and above | |
| 210 | What is your mother's educational level? | <ul style="list-style-type: none"> 1. Unable to write & read 2. Able to write & read 3. Grade 1-6 4. Grade 7-12 5. Grade 12+1 6. Grade 12+2 7. Degree and above | |
| 211 | What is your father's occupation? | <ul style="list-style-type: none"> 1. Teacher 2. Farmer 3. Merchant 4. Other gov't employee 5. Private employee/NGO 6. Daily laborer 7. Unemployed 8. Other (specify)_____ | |
| 212 | What is your mother's occupation? | <ul style="list-style-type: none"> 1. House wife's 2. Teacher 3. Farmer 4. Merchant 5. Other gov't employee 6. Private employee/NGO 7. Daily laborer 8. Unemployed 9. Other (specify)_____ | |

III. Psychosocial and behavioral characteristics of the student

| S.No | Question | Response | Skip to |
|------|---|--|---------|
| 301 | Do you think you have good relationship with your peers? | 1. Yes 2. No | |
| 302 | Do you think you have good relationship with your families? | 1. Yes 2. No | |
| 303 | Have you ever been bullied by One of your families? | 1. Yes 2. No | |
| 304 | Have you ever been punished at school? | 1. Yes 2. No | Skip to |
| 305 | If yes, to for above question what was the reason? | 1. Disagreement with teachers 2. Disagreement with students 3. Violating the rules of the school 4. Others (specify)_____ | |
| 306 | Do you study at night? | 1. Yes 2. No | Skip to |
| 307 | If no, for above question what | 1. Lack of light sources | |

| | | | |
|-----|---|--|---------|
| | might be the reason behind? | 2. Uncomfortable environment 3. Family discouragements 4. Work load from family | |
| 308 | Have you had much workload at home/out of home? | 1. Yes 2. No | |
| 309 | Do your families' support/encourage your education? | 1. Yes 2. No | |
| 310 | Do you have a shortage of educational materials? | 1. Yes 2. No | |
| 311 | Do your family quarrel each other, while you are at home? | 1. Yes 2. No | Skip to |
| 312 | If yes, how frequent they did? | 1. More than once a week 2. Once a week 3. More than once a week 4. Once a month 5. Others(specify)_____ | |
| 313 | Could their quarrel have disturbed You? | 1. Yes 2. No | Skip to |
| 314 | If yes, how much severely being Disturbed? | 1. Less 2. Moderate 3. Severely 4. Very severely | |
| 315 | Do you have a breakfast? | 1. Yes | Skip to |

| | | | |
|-----|---|----------------------------|--|
| | | 2. No | |
| 316 | If yes, for above question how frequent you ate? | 1. Always 2. Some times | |
| 317 | Do you have brothers/sisters who are student with your school or another? | 1. Yes 2. No | |
| 318 | Do you have brothers/sisters who have joined college/university? | 1. Yes 2. No | |
| 319 | How long you walk to your home? | _____ Minutes | |

IV. Medical history

| Sr.No | Question | Response | Skip to |
|-------|---|--|---------|
| 401 | Have you been sick since last September? | 1. Yes 2. No | Skip to |
| 402 | If yes, for above question, what type of disease? | 1. Schistosomiasis (Bilharzia) 2. Ascariasis 3. Hookworm 4. Amebiasis | |
| 403 | | 1. Fatigue 2. A fast or irregular Heart beat 3. Shortness of breath 4. Dizziness 5. Cold hands and feet 6. Headache | |

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

V. School score of students, repeating and absenteeism

| Ser.No | School status | Response | Skip to |
|--------|--|--|---------|
| 501 | Grade score of last academic year | 1. Below mean 2. Above mean | |
| 502 | Class repeated last year | 1. Yes 2. No ----- | |
| 503 | If yes, what was the reason? | 1. Academic 2. Family 3. Disease 4. Other (specify)- _____ | |
| 504 | Absenteeism from the school in last Academic year | 1. ≥ 5 days 2. 5 days 3. 4 days 4. 3 days 5. 2 days | |

| | | |
|--|-------------------|--|
| | 6. 1 day | |
| | 7. No absenteeism | |

VI. Anthropometric measurements of the student

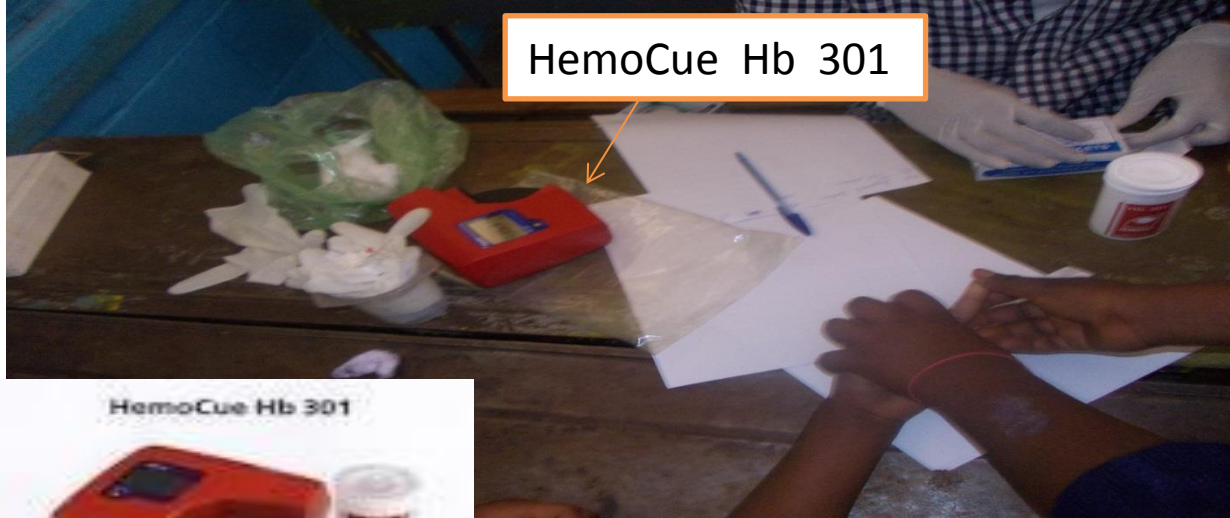
601. Weight __ __. __ in Kg,

602. Height __ __ __ in Cm

VII. Direct stool examination

| Parasites | Parasites seen | No of eggs/larvae per slide |
|-------------------------------|----------------|-----------------------------|
| <i>Ascaris lambricoides</i> | | |
| <i>Entameba histolitica</i> | | |
| <i>Giardia lamblia</i> | | |
| <i>Hookworm</i> | | |
| <i>Strongyloides</i> | | |
| <i>Taenia saginata</i> | | |
| <i>Trichuris trichiura</i> | | |
| <i>Others (specify) _____</i> | | |

Annex 3. Hemoglobin test using a HemoCue haemoglobinometer 301 from a drop of blood taken from the students' finger.



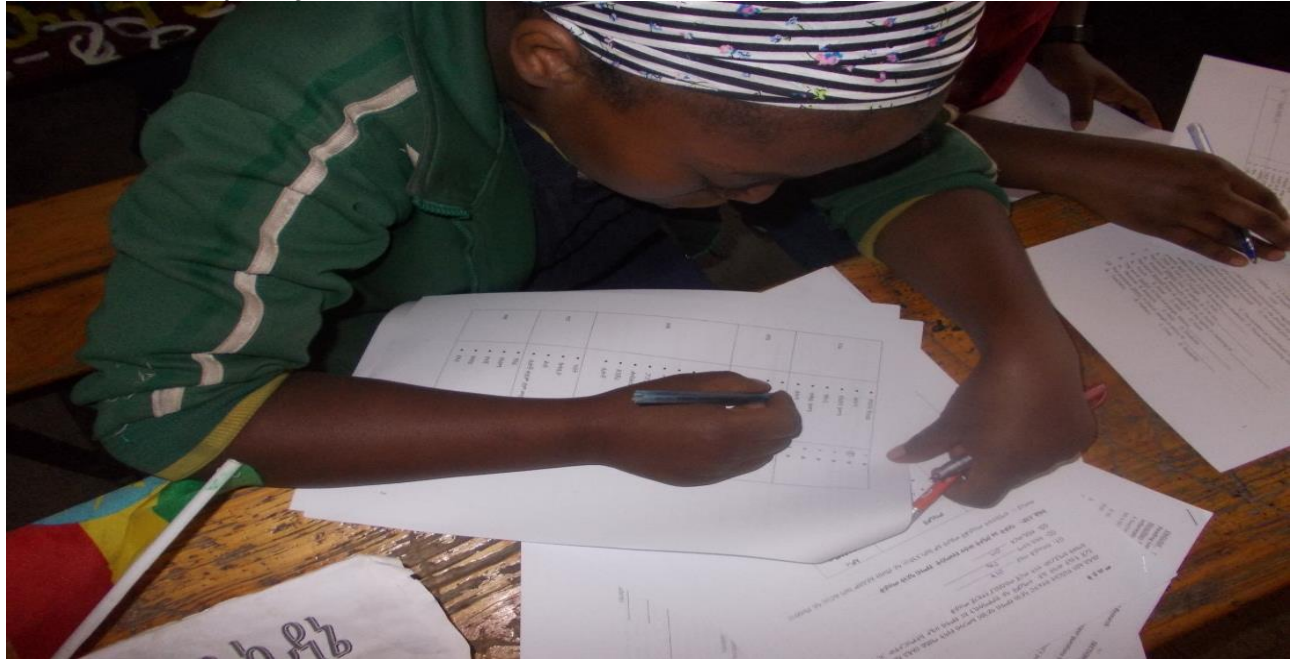
Annex 4. Anthropometric measurements by measuring the body weight and height of the study subjects.



Annex 5. Parasite examined for eggs of soil-transmitted helminths (STHs) using Kato-Katz method and all parasites using formol-ether concentration



Annex 6. Administering structured questioner to determine dietary diversity status and Standardized, close ended and coded questionnaire with a few open ended questions was used to collect the socio-demographic and psychosocial variables of the study subjects.



Annex 7. Amharic version

1. የስምምነት ሰነድ እና የጥናቱ መግለጫ

(መረጃ በመስጠት ለሚሳተፉ ልጆች እና ወላጆች የሚነበብ)

ጤና ይስጥልኝ እንደምን አደርክ/ዋልክ/ሽ? ስሜ ----- ይባላል የመጣሁት ከዚህ ከአዲስ አበባ ከተማ ስሆን በወጣትነት ዕድሜ ክልል ባሉት የመንግስት የመጀመሪያ ደረጃ ሴት ተማሪዎች ላይ በአዲስ አበባ ዩኒቨርሲቲ በምግብ ሳይንስና አመጋገብ ጥናት ማዕከል ለሚካሄደው ጥናት መረጃ በመስጠት ላይ ከሚገኙት መረጃ ሰብሳቢዎች መካከል አንዱ ነኝ አንተ/አንቺ ከዚህ የሚነበበው የጥናቱን መግለጫ ተገንዝበው ፍቃደኛ ከሆኑ መረጃ ለመስጠት የዚህ ጥናት ተሳታፊ እንዲሆኑ ሳይንሳዊ በሆነ መንገድ ልጅዎ ተመርጧለች።

የጥናቱ ርዕስ:- የሆሞግሎቢል መጠንና የምግብ ሁኔታ ከተማሪዎች አጠቃላይ የትምህርት ውጤታቸው ጋር ያለውን ተዛምዶ በአዲስ አበባ የሚገኙ የመንግስት የመጀመሪያ ደረጃ ወጣት ሴት ተማሪዎች ላይ ያጠናል።

መግቢያ:- የአመጋገብና የጤና ሁኔታ ከልጆች የትምህርት አቀባበልና ውጤት ጋር ከፍተኛ ግንኙነት ከመኖሩ በተጨማሪ በተለይ በምግባቸው ውስጥ የብረት እና የአዮዲን ንጥረ ነገሮች መኖር የአህምሮአቸውን ጤንነትና የመቀበል አቅም ይወስናሉ። የጥገኛ ትሎችም ተፅእኖ የብረት እጥረትን ያስከትላል። በተለይ በዚህ እድሜ ክልል የሚገኙ ሴት ተማሪዎች የወር አበባ የሚያዩበትና እድገታቸው ፈጣን ስለሆነ ለብረት ንጥረ ነገር እጥረት ይጋለጣሉ።

ቅደም ተከተል:- በጥናቱ የሚሳተፉት እድሜያቸው 14 የሆኑ በአዲስ አበባ የሚገኙ የ8ኛ ክፍል የመንግስት ት/ቤት ተማሪዎችን ነው። ስለዚህም የርስዎ ልጅ የዚህ ጥናት ተሳታፊ እድትሆን በሳይንሳዊ መንገድ ተመርጧለች። በደስታና በነፃነት ያዘጋጀውን መጠይቅ ስለምትመልስልን በቅድሚያ እናመሰግናለን። በመሆኑም የልጅን ክብደት ፣ ርዝመት፣ የላይኛው ክንድ ዙሪያ፣ የጣት የደም ናሙና እና የሰገራ ምርመራ እንድናደርግላት እንዲተባበሩን በትህትና እንጠይቃለን።

የጥናቱ ጥቅም:- ተሳተፊው ተሳተፊ በመሆኑ የሚያገኘው የገንዘብ ጥቅም የለም

- ከዚህ ጥናት የሚገኘው ውጤት በከተማው ለወደፊት ለሚጠኑ ተመሳሳይ ጥናቶች ፅንሰ ሀሳብ መነሻ ግብአት ያገለግላል።
- የጥናቱ ውጤት በሽታውን ለመከላከልና ለመቆጣጠር ትኩረት አቅጣጫ መሆኑን ይጠቅማሉ።
- የጥናቱ ውጤት ለአዲስ አበባ ከተማ ጤና ጽ/ቤትና ትምህርት ጽ/ቤት ይገለጻል።

የጥናቱ ጉዳት:- የጥናቱ ተሳታፊ እስከ 30 ደቂቃ የሚደርስ ጊዜ ከማባከን እና ከጣታቸው የደም ጠብታ እና የሰገራ ናሙና ከመውሰድ ውጪ በጥናቱ ተሳታፊ በመሆናቸው የሚደርስባቸው ጉዳት ምንም የለም።

የጥናቱ ተሳታፊ መብቶች:- በዚህ ጥናት መሳተፍም ሆነ አለመሳተፍ ሙሉ መብት ነው። በመሳተፍ ላይ ያሉ በማንኛውም ሰዓት ማቋረጥ ይቻላል። ከጥያቄዎች ውስጥ ለመመለስ የማይፈልጉትን ጥያቄ አለመመለስ ይቻላል።

የጥናቱ ሚስጥራዊነት:- የተሳተፈው ማንነት በሚስጥር ይያዛል።

ማንኛውም ጥያቄ ካለዎት?

የተመራማሪው አድራሻ : ጥበቡ በላይነህ

ሞባይል:- 0911642803

ኢሜል:- tibebubelelayneh79@gmail.com

የአማካሪዎች አድራሻ:-1. ዶ/ር ዳውድ ጋሹ

ሞባይል:- 0911-745153

ኢሜል: dawd.gashu@aau.edu.et

2. ፕሮፌሰር ብርሃኑ ኢርኮ

ሞባይል:- 0911-371173

ኢሜል: berhanue@yahoo.com

በጥናቱ ለመሳተፍ ፈቃደኝነቴን በፊርማዬ አረጋግጣለሁ፡፡

የወላጅ ስም _____ ፊርማ _____

የመጠይቁን መለያ ቁጥር _____

የመረጃ ሰብሳቢ ስም _____ ፊርማ _____ ቀን _____

የተቆጣጣሪው ስም _____ ፊርማ _____ ቀን _____

መ ጠ ይ ቅ

በአዲስ አበባ ዩኒቨርሲቲ በተፈጥሮ ሳይንስ የምግብ ሳይንስና አመጋገብ የጥናት ማዕከል በአዲስ አበባ የመንግስት የመጀመሪያ ደረጃ ት/ቤት ወጣት ሴት ተማሪዎች ላይ የሆሞጎሎቢን እና የምግብ ሁኔታ ከትምህርታቸው ጋር ያለውን ተዛማጅነት ለማወቅ ለሚደረገው ጥናት መረጃ መሰብሰቢያ የተዘጋጀ መጠይቅ

01- የመጠይቅ መለያ -----

02- ክፍለ ከተማ -----

03- ቀበሌ/ወረዳ -----

ክፍል አንድ:- ባለፉት 24 ሰዓታት ውስጥ የተመገቡት የምግብ ዓይነት መጠይቅ

| የጥያቄ ቁጥር | ምሳሌዎች | አዎ=1 አይደለም=0 |
|----------|---|-----------------|
| 101 | <ul style="list-style-type: none"> • በቆሎ • ሩዝ • ስንዴ • ማሸላ • ዳጉሳ • ገብስ • አጃ • ጤፍ | |
| 102 | <ul style="list-style-type: none"> • ነጭ ድንች • ስኳር ድንች • ነጭ ካሳቫ • ዝንጅብል | |
| 103 | <ul style="list-style-type: none"> • ካሮት • ዱባ • ስኳር ድንች • ቀይ ስር | |
| 104 | <ul style="list-style-type: none"> • የካሳቫ ቅጠል • ቆሰጣ • የአበባ ጎመን • ዝኩኒ • ጥቅል ጎመን • ሰላጣ | |
| 105 | <ul style="list-style-type: none"> • ቲማቲም • ቀይ ሸንኩርት • ቀይ ሸንኩርት • ሌሎች | |

| | | |
|-----|---|--|
| 106 | <ul style="list-style-type: none"> • ሙዝ • ብርቱካን • ሎሚ • ወይን • ማንጎ • ፓፓያ • ሐብሐብ • እንጆሪ • ሌሎች | |
| 107 | <ul style="list-style-type: none"> • ጉብት • ኩላሊት • ልብ • ሌሎች ወይም ደም መሰል | |
| 108 | <ul style="list-style-type: none"> • የበሬ • የአሳማ • የጥጃ • የፍየል • የዶሮ • የሌሎች | |
| 109 | <ul style="list-style-type: none"> • እንቁላል | |
| 110 | <ul style="list-style-type: none"> • አሳ | |
| 111 | <ul style="list-style-type: none"> • የደረቅ ባቄላ • የደረቅ አተር • ለውዝ • ምስር • ሽንብራ | |
| 112 | <ul style="list-style-type: none"> • ወተት • አይብ • እርጎ | |

| | | |
|-----|---|--|
| | <ul style="list-style-type: none"> • ሌሎችም | |
| 113 | <ul style="list-style-type: none"> • ዘይት • ለማጣፈጫነት ምግብ ላይ የተጨመረ ቅባት ወይም ቅቤ | |
| 114 | <ul style="list-style-type: none"> • ስኳር • ማር • ጣፋጭ ለስላሳ መጠጦች • ጣፋጭ ምግቦች ለምሳሌ ቸኮሌት • ከረሜላዎች • ኩኪስ እና • ኬኮች | |
| 115 | <ul style="list-style-type: none"> • የበርበሬ ድቁስ • ጨው • ቅርንፉድ • ሰናፍጭ • በርበሬ • ቀረፋ • ማዮኔዝ • ከች-አፕ • ድልህ | |
| 116 | <ul style="list-style-type: none"> • ሻይ • ቡና • በቤት ውስጥ የተሰሩ ከአልኮል ነፃ የሆኑ መጠጦች | |

ክፍል ሁለት፡- የልጅ ወላጅ/አሳዳጊ ማህበራዊ ስነ ህዝባዊና

| ተ. ቁ | ጥያቄ | ምላሽ | ይለፉ |
|------|-----------------------------|---|-----|
| 201 | ቤተሰብ ሬድዮ አለው? | 1. አዎ 2. የለውም | |
| 202 | ቤተሰብ ቴሌቪዥን አለው? | 1. አዎ 3. የለውም | |
| 203 | የመኖሪያ ቤት የባለቤትነት ሁኔታ | 1. የግል 2. የኪራይ 2. አላውቅም | |
| 204 | ቤቱ ስንት ክፍሎች አሉት ? | 3. ----- | |
| 205 | ቤቱ ውስጥ ስንት ሰዎች አሉት ? | ----- | |
| 206 | ቤታችሁ ውስጥ ለማንበብ/ለማጥናት ይመቻል ? | 1. አዎ ----- 2. አይመችም | |
| 207 | ለማንበብ የማይመች ምክንያቱ ምንድን ነው | 1. ቤቱ ይበልጣል 2. የጥናት ክፍል የለም 3. ጥቃቅን ነፍሳት ያስቸግራሉ ? 4. ሌላ (ይግለጽ)----- | |
| 208 | የት ለማጥናት ትመርጣለህ ? | 1. ቤት 2. ት/ቤት 3. ሜዳ 4. ሌላ (ይግለጽ)----- | |
| 209 | የአባት /ያሳዳጊ የትምህርት ሁኔታ | 1. ያልተማረ 2. ማንበብና መፃፍ የሚችል 3. አንደኛ ደረጃ ያጠናቀቀ 4. ሁለተኛ ደረጃ ያጠናቀቀ 5. ኮሌጅ ያጠናቀቀ | |
| 210 | የእናት/ያሳዳጊ የትምህርት ሁኔታ | 1. ያልተማረች 2. ማንበብና መፃፍ የሚችል 3. አንደኛ ደረጃ ያጠናቀቀች 4. ሁለተኛ ደረጃ ያጠናቀቀች | |

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| | | 5. ኮሌጅ ያጠናቀቀች | |
| 211 | የአባት /ያሳዳጊ ሥራ | 1. መምህር 2. ገበሬ 3. ነጋዴ 4. ሌላ የመንግስት ሠራተኛ 5. የግል ተቀጣሪ 6. ያልተቀጠረ 7. ሌላ (ይገለጽ) ----- | |
| 212 | የእናት /ያሳዳጊ ሥራ | 1. የቤት እመቤት 2. መምህር 3. ገበሬ 4. ነጋዴ 5. ሌላ የመንግስት ሰራተኛ 6. የግል ተቀጣሪ 7. የቀን ሰራተኛ 8. ያልተቀጠረች 9. ሌላ (ይገለጽ) | |

ክፍል ሦስት:- የህፃኑ ሥነ - ልቦናዊ ሁኔታ

| ተ.ቁ | ጥያቄ | ምላሽ | |
|-----|---|--------------------------|-----|
| 301 | ከጓደኞችህ/ሽ ጋር ጥሩ ግንኙነት አለኝ ብለህ/ሽ ታስባለህ/ሽ? | 1. አዎ 2. የለኝም | |
| 302 | ከቤተሰብህ/ሽ ጋር ጥሩ ግንኙነት አለኝ ብለህ/ሽ ታስባለህ/ሽ? | 1. አዎ 2. የለኝም | |
| 303 | ቤት ውስጥ ተገርፈህ ታውቃለህ /ሽ? | 1. አዎ 2. አልተገረፍኩም | |
| 304 | ትምህርት ቤት ተገርፈህ /ሽ ታውቃለህ /ሽ ተቀጥተህ /ሽ | 1. አዎ 2. አልተገረፍኩም --- | 306 |
| 305 | የተቀጣህ /ሽ ከሆነ ምክንያቱ ምንድን ነበር? | 1. ከመምህሩ ጋር አለመስማማት | |

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|-----|--|---|-----|
| | | 2. ከተማሪ ጋር አለመስማማት 3. የተ/ቤቱን ሥርአት ባለማክበር 4. ሌላ /ይግለጽ ----- | |
| 306 | ማታ ታነባለህ /ሽ ወይም ታጠናለህ /ሽ? | 1. አዎ ----- 2. አላነብም | 308 |
| 307 | የማታነብ ከሆነ ምክንያቱ ምንድን ነው? | 1. ሙብራት ስለሌለ 2. ቤት ውስጥ ስለማይመች 3. ቤተሰቦቼ ለማንበብ አያበረታቱኝም 4. ሥራ ይበዛብኛል 5. ሌላ /ይግለጽ----- | |
| 308 | ቤት ውስጥ ሥራ ይበዛብህል ? | 1. አዎ 2. አያበረታቱም | |
| 309 | ቤተሰቦችህ እንድትማር ያበረታታሉ ? | 1. አዎ 2. እጥረት የለም | |
| 310 | የትምህርት መሣሪያዎች (መጽሐፍ፣ እስክራብቶ የመሳሰሉ) እጥረት አለ ? | 1. አዎ 2. ተጣልተው አያውቁም ----- --- | |
| 311 | አባትህና እናትህ ተጣልተው ያውቃሉ ? | 1. በሳምንት አንድ ጊዜ 2. በሳምንት ከአንድ ጊዜ በላይ 3. በወር አንዴ 4. ሌላ (ይግለጽ)----- --- | 401 |
| 312 | ከተጣሉ ምን ያህል ጊዜ ? | | |
| 313 | በነሱ ጥል ምክንያት ተረብሽሻል ? | 1. አዎ 2. አልረብሽም | |
| 314 | በምን ያህል ይረብሹሻል? | 1. በትንሹ 2. በመካከለኛ 3. በከፍተኛ 4. በጣም ከፍተኛ | |
| 315 | ቁርስ ትበያለሽ? | 1. አዎ | |

| | | | |
|-----|---|-------------------|--|
| | | 2. አልበላም | |
| 316 | በዚህ ት/ቤት የሚገኙ /በሌላ ህህዳች /ወንድሞች አሉሽ? | 1. አሉኝ 2. የሉኝም | |
| 317 | ዩኒቨርሲቲ የገቡሰ ? | 1.አሉኝ 2.የሉኝም | |
| 318 | 1. የትምህርት ቤትሽ ርቀት ከቤትሽ ምን ያህል ደቂቃ ይፈጅብኛል? | _____ደቂቃ | |

ክፍል አራት:- የህመም ሁኔታ

| ተ.ቁ | ጥያቄ | ምላሽ | |
|-----|-------------------------|---|--|
| 401 | ከመስከረም ጀምሮ ታመሽ ታውቂያለሽ? | 1. አዎ 2. አልታመምኩም | |
| 402 | መልስሽ አዎ ከሆነ ምንአይነት በሽታ? | 1.1. ብልሃርዚያ 2. የወስፋት ህመም 3. የመንጠቆ ትል 4. ጃርዲያ | |

ክፍል አምስት፡- የተማሪዎች የት/ቤት ውጤት እና ሁኔታ

| ተ.ቁ | የትምህርት ሁኔታ | ምላሽ | ይለፉ |
|-----|------------------------------|--|-----|
| 501 | በዚህ ሴሚስተር የክፍል ውጤት | <ol style="list-style-type: none"> 1. ከአማካይ በታች 2. ከአማካይ በላይ | |
| 502 | ባለፈው ዓመት በክፍል ደገም/ች? | <ol style="list-style-type: none"> 1. አዎ 2. አልደገመም | |
| 503 | የደገመ /ች ከሆነ ምክንያቱ ምንድን ነው ? | <ol style="list-style-type: none"> 1. አነስተኛ ውጤት 2. በቤተሰብ ውጤት 3. በበሽታ 4. ሌላ (ይግለጽ) | |
| 504 | በዚህ ሴሚስተር ከትምህርት ቤት የቀረበት ቀን | <ol style="list-style-type: none"> 1. ከአምስት ቀን በላይ 2. አምስት ቀን 3. አራት ቀን 4. ሦስት ቀን 5. ሁለት ቀን 6. አንድ ቀን 7. ቀርቶም አያውቅም | |

**Annex 8. A detail list of dietary diversity using the 24 hour dietary recall survey
Response of the Study Participants for the Dietary Diversity from the 24
Hour Dietary Recall Survey**

| Characteristics (292) | Number | Percent |
|----------------------------------|---------------|----------------|
| Did you eat maize | | |
| yes | 242 | 82.9 |
| No | 50 | 17.1 |
| Did you eat rice | | |
| yes | 245 | 83.9 |
| no | 47 | 16.1 |
| Did you eat wheat | | |
| yes | 227 | 77.7 |
| no | 65 | 22.3 |
| Did you eat millet | | |
| yes | 59 | 20.2 |
| no | 233 | 79.8 |
| Did you eat sorghum | | |
| yes | 31 | 10.6 |
| no | 261 | 89.4 |
| Did you eat oats | | |
| yes | 204 | 69.9 |
| no | 88 | 30.1 |
| Did you eat teff | | |
| yes | 194 | 66.4 |
| no | 98 | 33.6 |
| Did you eat white potato | | |
| yes | 169 | 57.9 |
| no | 123 | 42.1 |
| Did you eat sweet potato | | |
| yes | 141 | 48.3 |
| no | 151 | 51.7 |
| Did you eat white cassava | | |
| yes | 7 | 2.4 |
| no | 285 | 97.6 |

| | | |
|-----------------------------------|-----|------|
| Did you eat ginger | | |
| yes | 171 | 58.6 |
| no | 121 | 41.4 |
| Did you eat carrot | | |
| yes | 251 | 86 |
| no | 41 | 14 |
| Did you eat pumpkin | | |
| yes | 213 | 72.9 |
| no | 79 | 27.1 |
| Did you eat redroot | | |
| yes | 234 | 80.1 |
| no | 58 | 19.9 |
| Did you eat cassava leaves | | |
| yes | 17 | 5.8 |
| no | 275 | 94.2 |
| Did you eat spinach | | |
| yes | 207 | 70.9 |
| no | 85 | 29.1 |
| Did you eat broccoli | | |
| yes | 23 | 7.9 |
| no | 269 | 92.1 |
| Did you eat cucumber | | |
| yes | 54 | 18.5 |
| no | 238 | 81.5 |
| Did you eat cabbage | | |
| yes | 259 | 88.7 |
| no | 33 | 11.3 |
| Did you eat salad | | |
| yes | 246 | 84.2 |
| no | 46 | 15.8 |
| Did you eat tomato | | |
| yes | 276 | 94.5 |
| no | 16 | 5.5 |
| Did you eat onion | | |

| | | |
|-------------------------------|-----|------|
| yes | 282 | 96.6 |
| no | 10 | 3.4 |
| Did you eat garlic | | |
| yes | 219 | 75 |
| no | 73 | 25 |
| Did you eat banana | | |
| yes | 224 | 76.7 |
| no | 68 | 23.3 |
| Did you eat orange | | |
| yes | 142 | 48.6 |
| no | 150 | 51.4 |
| Did you eat lemon | | |
| yes | 76 | 26 |
| no | 216 | 74 |
| Did you eat grapes | | |
| yes | 40 | 13.7 |
| no | 252 | 86.3 |
| Did you eat mango | | |
| yes | 40 | 13.7 |
| no | 252 | 86.3 |
| Did you eat papaya | | |
| yes | 32 | 10.9 |
| no | 260 | 89 |
| Did you eat watermelon | | |
| yes | 14 | 4.8 |
| no | 278 | 95.2 |
| Did you eat strawberry | | |
| yes | 23 | 7.9 |
| no | 269 | 92.1 |
| Did you eat liver meat | | |
| yes | 127 | 43.5 |
| no | 165 | 56.5 |
| Did you eat kidney | | |

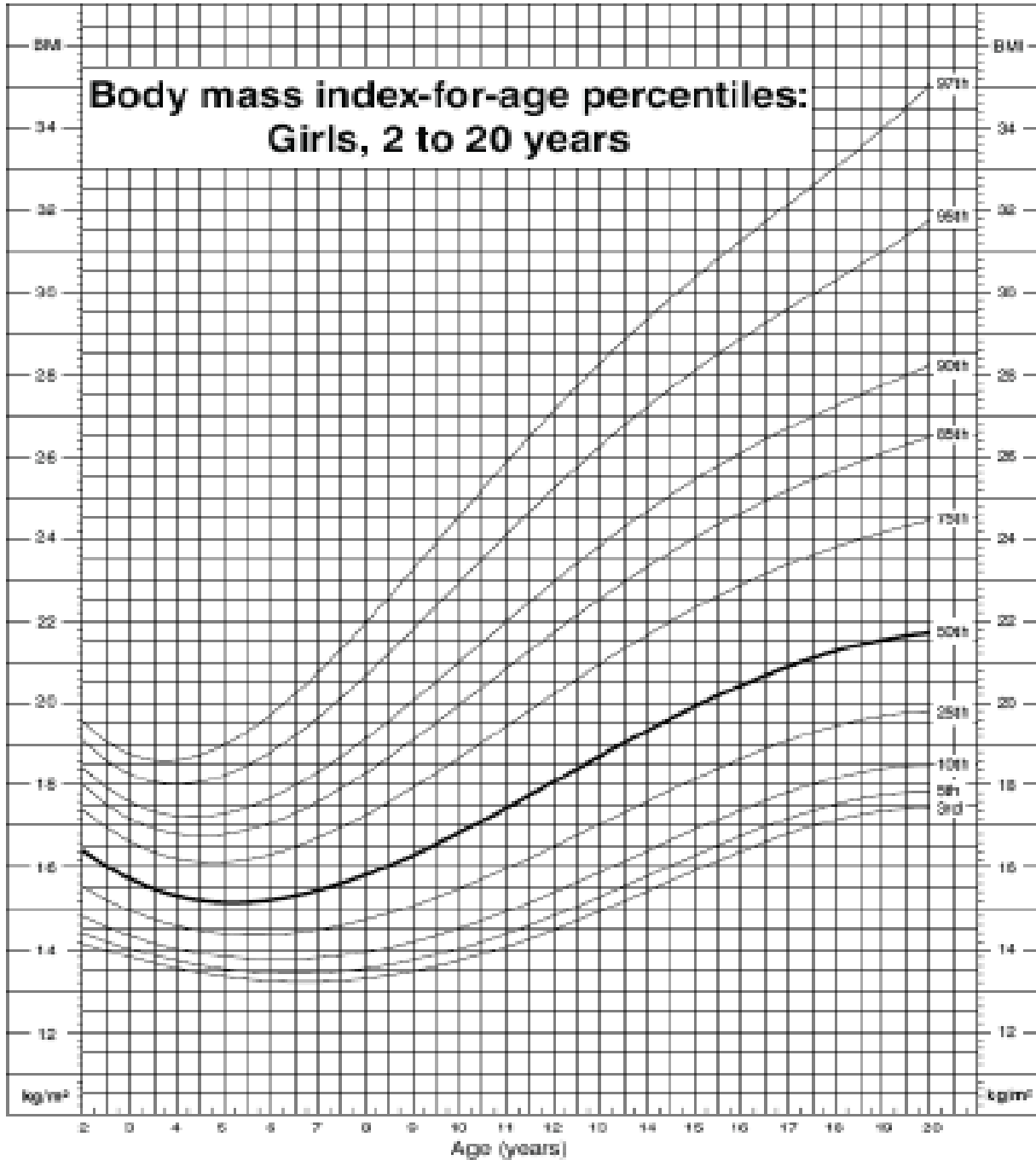
| | | |
|--------------------------------|-----|------|
| yes | 80 | 27.4 |
| no | 212 | 72.6 |
| Did you eat heart | | |
| yes | 15 | 5.1 |
| no | 277 | 94.9 |
| Did you eat beef | | |
| yes | 51 | 17.5 |
| no | 241 | 82.5 |
| Did you eat pork | | |
| yes | 12 | 4.1 |
| no | 280 | 95.9 |
| Did you eat lamb | | |
| yes | 3 | 1 |
| no | 289 | 99 |
| Did you eat goat | | |
| yes | 11 | 3.8 |
| no | 281 | 96.2 |
| Did you eat chicken | | |
| yes | 52 | 17.8 |
| no | 240 | 82.1 |
| Did you eat egg | | |
| yes | 178 | 61 |
| no | 114 | 39 |
| Did you eat fish | | |
| yes | 174 | 59.6 |
| no | 118 | 40.4 |
| Did you eat dried beans | | |
| yes | 243 | 83.2 |
| no | 49 | 16.8 |
| Did you eat dried peas | | |
| yes | 125 | 42.8 |
| no | 167 | 57.2 |
| Did you eat nuts | | |
| yes | 145 | 49.7 |

| | | |
|---|-----|------|
| no | 147 | 50.3 |
| Did you eat lentil | | |
| yes | 237 | 81.2 |
| no | 55 | 18.8 |
| Did you eat chickpea | | |
| yes | 155 | 53.1 |
| no | 137 | 46.9 |
| Did you eat milk | | |
| yes | 78 | 26.7 |
| no | 214 | 73.3 |
| Did you eat cheese | | |
| yes | 47 | 16.1 |
| no | 245 | 83.9 |
| Did you eat yoghurt | | |
| yes | 47 | 16.1 |
| no | 245 | 83.9 |
| Did you eat oil | | |
| yes | 219 | 75 |
| no | 73 | 25 |
| Did you eat fats or butter added in food | | |
| yes | 56 | 19.2 |
| no | 236 | 80.8 |
| Did you eat sugar | | |
| yes | 286 | 97.9 |
| no | 6 | 2.1 |
| Did you eat honey | | |
| yes | 197 | 67.5 |
| no | 95 | 32.5 |
| Did you eat sweetened soda | | |
| yes | 48 | 16.4 |
| no | 244 | 83.6 |
| Did you eat sugary foods like chocolate | | |
| yes | 38 | 13 |
| no | 254 | 87 |

| | | |
|--------------------------------|-----|------|
| Did you eat candies | | |
| yes | 51 | 17.5 |
| no | 241 | 82.5 |
| Did you eat cookies | | |
| yes | 37 | 12.7 |
| no | 255 | 87.3 |
| Did you eat cakes | | |
| yes | 53 | 18.2 |
| no | 239 | 81.8 |
| Did you eat red pepper | | |
| yes | 174 | 59.6 |
| no | 118 | 40.4 |
| Did you eat salt | | |
| yes | 241 | 82.5 |
| no | 51 | 17.5 |
| Did you eat cloves | | |
| yes | 29 | 9.9 |
| no | 263 | 90.1 |
| Did you eat mustard | | |
| yes | 22 | 7.5 |
| no | 270 | 92.5 |
| Did you eat chilies | | |
| yes | 228 | 78.1 |
| no | 64 | 21.9 |
| Did you eat cinnamon | | |
| yes | 40 | 13.7 |
| no | 252 | 86.3 |
| Did you eat mayonnaise | | |
| yes | 15 | 5.1 |
| no | 277 | 94.9 |
| Did you eat ketchup | | |
| yes | 52 | 17.8 |
| no | 240 | 82.2 |
| Did you eat salsa sauce | | |

| | | |
|--------------------------------------|-----|------|
| yes | 134 | 45.9 |
| no | 158 | 54.1 |
| Did you drink tea | | |
| yes | 263 | 90.1 |
| no | 29 | 9.9 |
| Did you drink coffee | | |
| yes | 29 | 9.9 |
| no | 263 | 90.1 |
| Did you drink homemade drinks | | |
| yes | 35 | 12 |
| no | 257 | 88 |

Annex 9. CDC BMI CHART



SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

