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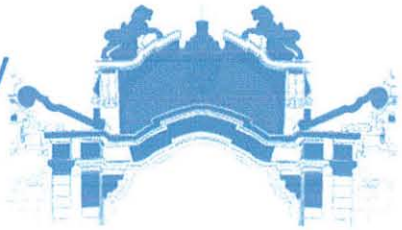

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCE

CENTER FOR FOOD SCIENCE AND NUTRITION

PROGRAM; MSc IN COMMUNITY NUTRITION

Hemoglobin concentration and nutritional status of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia.

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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 Community Nutrition.

Addis Ababa, Ethiopia

July, 2019

APPROVED BY THE BOARD OF EXAMINER

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Declaration

I the undersigned declare that this thesis is my original work and that it has not been submitted or presented for a degree in any other institution and that all source of material used for the thesis have been duly acknowledge.

Abdirahman Ahmed Hassan

July, 2019

This thesis work has been submitted for examination with my approval as an advisor of the candidate.

Dawd Gashu (PhD)

July, 2019

Contents

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Abbreviations

AOR	Adjusted Odd Ratio
BMI –	Body Mass Index
CDC-	Centers for Disease Control and Prevention
CI	Confidence Interval
COR	Crude Odd Ratio
DDS	Dietary Diversity Score
ECSA	Ethiopia Central Static Agency
EDHS	Ethiopian Health Demographic Survey
FAO	Food Agricultural Origination
Hb	Hemoglobin
HIV	Human Immune deficiency Virus
ICRW	International Center for Research on Women
Kg	Kilo gram
MDDS	Minimum Dietary diversity Score
NIN-	National institute of Nutrition
NNP	Notational Nutrition program
RDA	Recommended Daily Allowance
SRS-	Somali Regional State
SSP-	Senior secondary and preparatory school
UN	United Nation
WDDS	Women dietary diversity score
WHO-	World Health Organization

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Abstract

Background: *Anemia is a global public health problem affecting 24.8% of the world population. Approximately 50% of cases of anemia are considered to be due to iron deficiency. In Ethiopia, the prevalence of anemia among the age group 15-19-year-old males and females range from 2.8% to 15% and 9.3 to 34.8, respectively indicating it is mild to moderate public health problem. Studies and initiatives, unfortunately, focuses on, prevention of anemia targeting infants, young children, and pregnant and lactating women. However, adolescent girls are neglected groups despite vulnerable to anemia. The problem is severe in populations from disadvantage and pastoralist communities.*

Objective: *To determine hemoglobin concentration and assess nutritional status of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia*

Methods and Materials: *A school-based cross-sectional study was employed among adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia. Multi-stage sampling was selected, study participants. Multivariable logistic regression was used to measure the association between anemia and independent variables with a 95% confidence interval. Statistical significance was declared at p-value < 0.05.WHO Anthro Plus software was used to calculate body mass index for age z-score and height for age z-score and BMI.*

Result: *The result of the study show that 31.5% were anemic, 43% were underweight. 16.1% were wasting, and 2.2% of adolescent girls were stunted/ short stature than normal. Family size ≥5 people [(AOR= 1.80), CI :(1.14, 2.85)] and lack of anemia knowledge [(AOR=1.62) CI: (1.01, 2.59)] were independent predictors of anemia.*

Conclusion: *prevalence of anemia among adolescent school girls in Godey and Degahbor council Somali region is a moderate public health problem. Family size ≥5 people and lack of anemia knowledge were independent predictors of anemia. Therefore, iron-rich and diversified food consumption, intermittent iron-folic acid supplementation and family planning and nutrition education awareness at school level should be given attention with particular focus on female adolescents for improving nutritional status and health of adolescent girls.*

Keywords: *Anemia, Stunting, wasting, underweight school adolescent girls.*

CHAPTER ONE

1. Introduction

Adolescence is a particularly unique period in life because it is a time of intense physical, psychosocial, and cognitive development and it is the age at which growth is faster than at any other time in the individual's life next to infancy (WHO, 2002).

The main nutritional problems which affect adolescence, particularly girls, are under-nutrition in terms of stunting, thinness; iron deficiency anemia; iodine, vitamin A; and calcium deficiencies; and other specific nutrient deficiencies (WHO, 2002). Globally, under-nutrition among adolescent girls is highly prevalent in different parts of the world. For example, according to the study which was done by World Health Organization (WHO) on South East Asia region (both sex) in India, Bangladesh, Nepal and Myanmar showed around 32%, 48%, 47% and 39% of adolescents were suffered from stunting respectively, and 53%, 67%, 36%, and 32% adolescents were affected by thinness respectively (WHO, 2006).

Under-nutrition among adolescent girl in Ethiopia is also a public health problem as some studies done in different parts of the country indicated. The Ethiopia nutrition baseline report reported in 2010 that, 23 % of adolescent girls were stunted (EHNRI, 2009/10). In addition, community based studies which were conducted in Tigray and Amhara region reported that both thinness and stunting were highly prevalent among adolescent girls of rural Ethiopia which were 26.5% stunted and while 58.3% thin; and 13.6 % thin and while 31.5 % stunted respectively (Mulugeta *et al.*, 2009; Wassie *et al.*, 2015).

On the other hand, anemia which is a global public health problem affecting 24.8% of the world population and it is estimated that 1620 million people are affected by anemia, while it is a severe public health problem for Africa (45% for adolescent girls) the least affected being Latin America and the Caribbean WHO Regions (12% for adolescent girls). An estimated 27 % of the adolescent girls in developing countries are anemic as compared to 6% for developed countries with high rates in India (55%), Nepal (44%), Cameroon (32 %) and Guatemala (48%) (WHO. 2008).

Anemia prevalence is disproportionally high in developing countries due to poverty, inadequate diet, worm infection, pregnancy/lactation and poor access to health service (Premalatha *et al.*, 2012).

In Ethiopia, about one- fourth of women age 15 to 49 (23 %) are anemic. The majorities are mildly anemic (17%), (5%) are moderately anemic and less than (1%) are severely anemic (CSA 2012). Intestinal parasitic infection, poor hygiene and low body mass index have been reported as the main predictor of anemia (Alelig *et al.*, (2015), in addition, child bearing (12%) in Ethiopia particularly at an early stage which is also one of the risk factor of anemia (EDHS, (2011).

Generally, in Ethiopia studies conducted so far are very limited and localized, making it difficult to estimate the exact anemia prevalence in adolescent girls. According to the 2016 Ethiopian national micronutrient survey report, 18% of Ethiopian women age 15-49 are anemic and is considered a mild public health problem. However, women in the Somali, Gambella, and Afar regions have a relatively high prevalence of anemia (34.8, 26.7, and 26.2 percent respectively) compared to the national average.

Adolescents are the future generation of any country and their nutritional needs are critical for the well-being of society; however in most developing countries, nutrition initiatives have been focusing on children and women, thus neglecting adolescence particularly girls (WHO, 2006). Up to recently, little was known about the nutritional status of adolescent girls, particularly in low- and middle-income countries (WHO, 2005). This is also true for Ethiopia; Even though some studies which were conducted in different parts of Ethiopia indicates the existence of high prevalence of under-nutrition and anemia among adolescent girl, it doesn't get strong attention same as under-five children and maternal nutrition. There is also limited information in Ethiopia at the national level and no documented study is found in the study area in particular concerning under-nutrition and anemia among adolescent girls. Therefore, this study was aimed to fill this information gap by assessing the magnitude of under-nutrition and anemia among adolescent school girls in Godey and Degahbor council Somali region (a region known for food insecurity thus high rate of anemia). Also, the study attempted to identify factors associated with low hemoglobin concentration (anemia).

1.1. Statement of the problem

Under-nutrition is a major public health concern for adolescent girls in developing countries, with negative implications for growth, brain development, birth outcomes, and long-term health (WHO 2005). Also, anemia which commonly results from Iron deficiency adversely affects cognitive & motor development, causes fatigue & low productivity and, when it occurs in pregnancy, may be associated with low birth weight and increased risk of maternal and prenatal mortality (Cordeiro et al., (2012).

Adolescent girls are vulnerable to anemia due to low intake and absorption of iron, and increased iron requirements for growth and replacement of menstrual blood losses (Brabin and Brabin, (1992), malaria and worm infection (Leenstra. (2003), place of residence,(Goyal et al.,(2015), late adolescence (Nelima, (2015) and family size ≥5 (Tasfaye et al., (2015), traditional practice of early marriage and social pressure that often result not delaying first pregnancy are predisposing factors of anemia in adolescent girls many countries of the world (Kotadawala, (2000) and main contributor to adolescent girls' anemia in sub-Saharan Africa (WHO, (2001). In Ethiopia, particularly Somali region adolescent girls are vulnerable to anemia and under-nutrition due to parasite infection, restriction of food due to cultural beliefs, intra-household food distribution, poor knowledge regarding balanced diet and poor health service supply (FMoH and UNICEF, (2016).

Despite many preventive strategies such as school feeding program, de-worming and Iron/Folic acid supplementation are being implemented at the national level there should be a clear and evidence-based magnitude of anemia and under-nutrition among school adolescent girls in different parts of the country. Furthermore, there are few studies documented on anemia and under-nutrition among school adolescent girls in Ethiopia and no documented study is found in the study area. Therefore, this study was aimed to fill this information gap by assessing the magnitude of under-nutrition and anemia among adolescent school girls in Godey and Degahbor council Somali region (a region known for food insecurity thus high rate of anemia). Also, the study attempted to identify factors associated with low hemoglobin concentration (anemia).

1.2. Objectives

1.2.1. General objective

To determine hemoglobin concentration and assess nutritional status of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

1.2.2. Specific objective

- ✓ To determine hemoglobin concentration of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia
- ✓ To assess nutritional status of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia
- ✓ To identify factor associated to lower hemoglobin among adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

1.3. Research question

This study will attempt to address the following questions

What is the prevalence of anemia and under-nutrition among adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia?

What are the basic determinants associated with low hemoglobin concentration among adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia?

CHAPTER TWO

2. Literature review

2.1. Epidemiology anemia and under nutrition in adolescent girls

Adolescents make up roughly 20% of the total world population with 84% of the world adolescents being in developing countries. However, the proportion of the world's adolescent and youth living in Africa is expected to rise from 18 % in 2014 to 30 % in 2050 (WHO 2005: UN 2014). Adolescent girls constitute about 25 % of Ethiopian population (CSA, (2007).

The main nutritional problems which affect adolescent girls are under-nutrition in terms of stunting thinness, and underweight, anemia, iodine, vitamin A, and calcium deficiencies and other specific nutrient deficiencies (WHO, (2005).

Adolescent girls are vulnerable group under-nutrition because of dynamic period of physical growth and mental development. Globally, under-nutrition among school adolescent girls is a major public health concern. Nutritional status has powerful influence on an adolescent girls learning and how well the adolescent girls perform in school. Literatures show that there is strong link between nutrition and academic performance of adolescent girls (The Partnership for Child Development, 1997).

According to many researchers, poor nutritional status in primary school-age adolescent girls is among the most common causes of low school enrollment, high absenteeism, early dropout and unsatisfactory classroom performance (Andrews, 2013; The Partnership for Child Development, 1999; Walker *et al.*, 2007).

Anemia is defined as a condition where there is less than the normal hemoglobin (Hb) level in the body, which decreases oxygen-carrying capacity. World Health Organization (WHO) definitions for anemia differ by age, sex, and pregnancy status as follows: for children 6 months to 5 years of age anemia is defined as a Hb level < 11g/dl, children 5–11 years of age Hb < 11.5 g/dl, adults males Hb < 13 g/dl; non-pregnant females Hb < 12g/dl, and pregnant females Hb < 11g/dl (WHO, (2001). Severe anemia is defined as Hb < 7.0 g/dl (WHO, (1999).

Adolescence girls is an ideal time to study pre-pregnancy iron status because many girls around the world (at least 25%) will have had their first child by age 19 years, and a great many more shortly thereafter (Senderowitz, (1995). Furthermore, adolescent girls develop iron deficiency anemia due to rapid growth and the start of menstruation (Brabin & Brabin, (1992). Despite strong reasons for focusing on anemia during adolescence, little research has been done on it. The estimated prevalence of anemia in adolescent girls among the thirty-two studies from developing countries was 27%, compared with 6% in developed countries (DeMaeyer & Adiels-Tegman. (1985). In addition, prevalence iron deficiency anemia among adolescent girls in 16 districts of India in 2006 showed that 90.1% adolescent girls were exposed to moderate anemia and 71% of girls were exposed to severe anemia (Hurlock, (2006).

2.2. Etiology of anemia

Anemia is the result of a wide variety of factors that can occur alone, but more often co-occur. Generally iron deficiency is the most common cause of anemia, so that iron deficiency anemia and anemia are always used simultaneously and the prevalence of anemia has often used as a proxy for iron deficiency anemia (WHO, 2001).Generally it's assumed that 50% of anemia is cause by iron deficiency (WHO, (2001).

Other important causes of anemia are inadequacy of hemo-poietic nutrients mainly folic acid, vitamin C, and vitamin B12, parasitic infections, especially hook worm and schistosomiasis, malaria, chronic infections (including HIV/AIDS) and genetic factors (thalasemias and haemoglobinopathies) may also cause anemia. However, iron deficiency is the main cause of anemia everywhere and it is also frequently associated with other factors (WHO, (2001).

2.3. Risk factor of anemia in adolescent girls

2.3.1. Micro-nutrient deficiencies

2.3.1.1. Iron deficiency

Iron deficiency is common and as the single greatest cause of anemia, is responsible for more than half the global cases of anemia (WHO, (2001). Lack of adequate dietary iron intake is central to the development of iron deficiency and is a main nutritional issue in developing countries (Trowbridge and Martorell (2002).In addition, adolescent girls iron deficiency occur at higher prevalence due to menstrual iron losses and the extreme iron demands of a growing fetus during pregnancies, which are approximately two times the demands in the non pregnant state (Levy *et al.,* (1999).

2.3.1.2. Folic acid Deficiency

The Prevalence of folic acid deficiency in Ethiopia among adolescent girls is 31.3% (Haidar, (2010). Folic acid is necessary for cell growth and repair and essential for the formation and maturation of red blood cells. Deficiency of folate leads to slowing of DNA synthesis and impaired cell proliferation. This, in turn, leads to intramedullary death of many of these abnormal cells and shortened lifespan of circulating red blood cells. In addition, Interactions between malaria and folate metabolism present further challenges. Recurrent malaria hemolysis stimulates production of red blood cell precursors, increasing the demand for folate (Menendez, (2000). this can lead to folate depletion and megaloblastic anemia, which can be profound, particularly during adolescent pregnancy (Fleming, (1989). Despite public health interventions globally to provide peri-conceptual folate to reduce the risk of neural tube defects (Tamura, (2006).

2.3.2. Low socio-economic status

Family income is the most important factor in the determination of the quality of these environments as well as the health and nutritional status of adolescent girls (Nilsen *et al.,* (2009). Low income families have tendency either purchase less nutritious cheap food items as a means to cope with the situation or reduce food intake. This practice however affects the nutritional

needs of the vulnerable such as adolescent girls where nutrient requirement are high to support their physiological growth and development (Nilsen *et al.*, (2009).

2.3.3 Level of knowledge about anemia

One of the most important reasons for the nutritional problem is a lack of nutritional knowledge and consequently improper practice in this issue which can cause complications such as malnutrition. Also, the theory of Suhardjo suggests that an important cause of nutritional disorders including anemia is a lack of knowledge about nutrition and applying it to everyday life (Suharjo, (2007).

2.3.4. Early marriage

Traditional practice of early marriage and social pressure that often result not delaying first pregnancy are also predisposing factor anemia in adolescent girls many countries of the world (Kotadawala, (2000). Onset of pregnancy during adolescence further increases demands for iron and contributes to aggravating anemia. In India 47% of girls and in Bangladesh and Nepal over 50% girls are married by the time they are 18 years of age. In Indonesia, Thailand and Sri Lanka, 22%, 9.7% and 10% girls respectively are married by 18years (UNCEF, (2005). In Ethiopia, particularly Somali region child bearing begins at an early stage (Bernal *et al.* 2014; UNICEF, (2013).

2.3.5. Menstrual pattern of adolescent girls

Menstruation is an issue in adolescent girl's life with medical, social and psychological dimensions. It is a milestone event in female puberty and an important indicator of reproductive health (Premalatha *et al.*, (2012). According to the theorist states that young women who have experienced menstruation are more susceptible to iron anemia because the amount of blood lost during a menstrual period could be in 12.5 to 15 mg/month(Arisman, (2009).The anemia caused by menstruation is strongly influenced by the duration of menstruation, menstrual cycle and menstrual frequency (Affandi, (2004).

2.3.6. Infection

2.3.6.1. HIV Infection

Anemia is significantly more prevalent among individuals infected with HIV than in their uninfected age-, sex-, and pregnancy-status– matched counterparts. Among individuals with HIV, anemia has been identified as a marker for disease progression and has been associated with decreased survival (Sullivan,*et al.*,(1998).One recent study found that even after controlling for important potential confounders such as CD4 cell count, clinical stage, and body mass index, moderate and severe anemia were associated with an increased relative hazard of all-cause mortality of 2.06 and 3.19, respectively, among Tanzanian women with HIV(O'Brien *et al.*,(2005). The predominant cause of anemia in the context of HIV is anemia of inflammation (AI), also known as anemia of chronic disease (Means, (2000). AI is characterized by decreased red blood cell production through a series of mechanisms such as suppression of the normal response of bone marrow to erythropoietin, decreased synthesis of erythropoietin, dyserythropoiesis (disturbances of bone marrow cellular division), and alterations in iron metabolism such that iron is sequestered into storage forms, such as ferritin, which make it less bio-available(Means, (2000).

2.3.6.2. Malaria infection

Malaria has a range of manifestations but malaria-related anemia is one of the leading causes of death, with reproductive women and children being the most affected (Nussenblatt and Semba (2002). In the past decade, our understanding of the mechanisms of plasmodium falciparum malaria related anemia has expanded greatly. Although hemolysis is still thought to be the primary mechanism, many other mechanisms are now recognized as contributors. In the early stage of infection, rupture of parasitized red blood cells is the primary cause of the acute decrease in hematocrit (Phillips, (1992). The severity of anemia with acute P. falciparum malaria correlates with density of parasitemia. In addition, hypersplenism is thought to contribute to the early anemia of acute malaria, sequestering red blood cells (Fleming, 1996). The persistent, often worsening anemia that is seen in the weeks after clearance of parasitemia is thought to be caused by a second mechanism, phagocytosis of both parasitized and not parasitized red blood cells by a hyperactive reticulo-endothelial system (Menendez *et al.*, (2000).

2.3.6.3. Worm infection

Hookworm infection is one of the most important parasitic diseases in humans. The primary morbidity caused by human hookworm infection results from adult parasites causing chronic intestinal blood loss (Crompton, (2000). 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 anti-clotting agents (i.e., coagulase, a blood thinner), which cause ongoing blood loss in the stool, rather than actual blood consumption by the parasite. Because of already low iron stores among adolescent girls, women and young children caused by diets insufficient and abnormal menstruation to meet demands, these populations are most at risk for hookworm-associated iron deficiency anemia(Crompton, (2000).

2.3.7. Family History

2.3.7.1. Thalassemia

Thalassemia: is the most common single gene disorder worldwide, resulting from defects in genes producing Hb (Olivieri, (1999). It is highly prevalent in many Asian, Mediterranean, and Middle Eastern countries (Greenber *et al.*, (2001). Heterozygous carriers are clinically normal. Individuals who inherit thalassemia from two carrier parents generally die in utero (α-thalassemia) or in early childhood (β-thalassemia) (Mentzer and Kan, (2001).

2.3.7.2: Sickle cell disease

Sickle cell disease is an inherited disorder of Hb that is among the most common genetic diseases in the world. It is characterized by lifelong hemolytic anemia and many other significant morbidities largely related to painful and debilitating vaso-occlusive phenomenon (Mentzer and Kan, (2001).

2.4. Prevalence of anemia and under-nutrition among adolescent girls

One year cross sectional study carried out in Belgaum/Belagavi, India shows that among 840 adolescents girls involved in the study was 41.1% (with that of severe anemia being 0.6%, that of moderate anemia being 6.3% and that of mild anemia being 34.6%).It was observed that the prevalence of anemia was high in late adolescence (15-19yrs) as compared to that in the early adolescent (10-14yrs). A majority of the girls had mild anemia (Shilpa *et al.*, (2012).

A research conducted on prevalence of anemia among school adolescent girls in 2014 among urban and rural schools in Haldwani, India reported the overall 48.18% of adolescent girls were anemic. Among those anemic 34.53%, had mild anemic, 10.13% and 3.52% were found with moderate and severe anemia, respectively (Goyal *et al.*, (2015) .

Nelima's (2015), descriptive cross sectional study among adolescent girls (14-18 years) of secondary schools in Siaya District, Kenya revealed that overall 26.5% girls were anemic with 17.4% mild, 7.4% moderate and 1.7% severe anemia.

School based cross sectional study conducted in 2014 among adolescent girls (14- 19 years) from government schools in Barahle district of Afar region revealed that the overall prevalence of anemia was found to be 22.8% (Adem *et al.*, (2015).

A community based cross sectional study conducted among adolescent girls in Babile district, Eastern Ethiopia in 2013 reported that among 547 adolescents involved in the study 32%, 21.6%, and 15% was anemic, thin and stunted respectively. Among those anemic 1.8% had severe anemia (Kedir *et al.*, (2016).

A school based cross sectional study conducted among adolescent girls in Dembia District, Northwest Ethiopia in 2017 reported that among 462 adolescent involved in the study 25.5% was anemic. Among those anemic 109(92.4%) had mild anemic, 7(5.9%) and 2(1.7%) were found with moderate and severe anemia, respectively (Gonete *et al.*, (2018).

Tegegne, *et al.*,(2016), report on nutritional status and associated factors of adolescent school girls, in Goba town, Southeast Ethiopia; shows that overall prevalence of thinness and stunting among school adolescent girls was 11.9% and 20.9 % respectively.

2.5. Dietary diversity and hemoglobin

Monotonous diets based on starchy staples lack essential micronutrients and contribute to the high burden of malnutrition and micronutrient deficiencies (Shashikanthan *et al.,* 2016). Iron is the key component of hemoglobin, and iron deficiency is estimated to be responsible for half of all anemia globally (GSS, GHS & ICF International, 2015).

2.6. Consequence of anemia in adolescent girls

2.6.1. Reduced work productivity

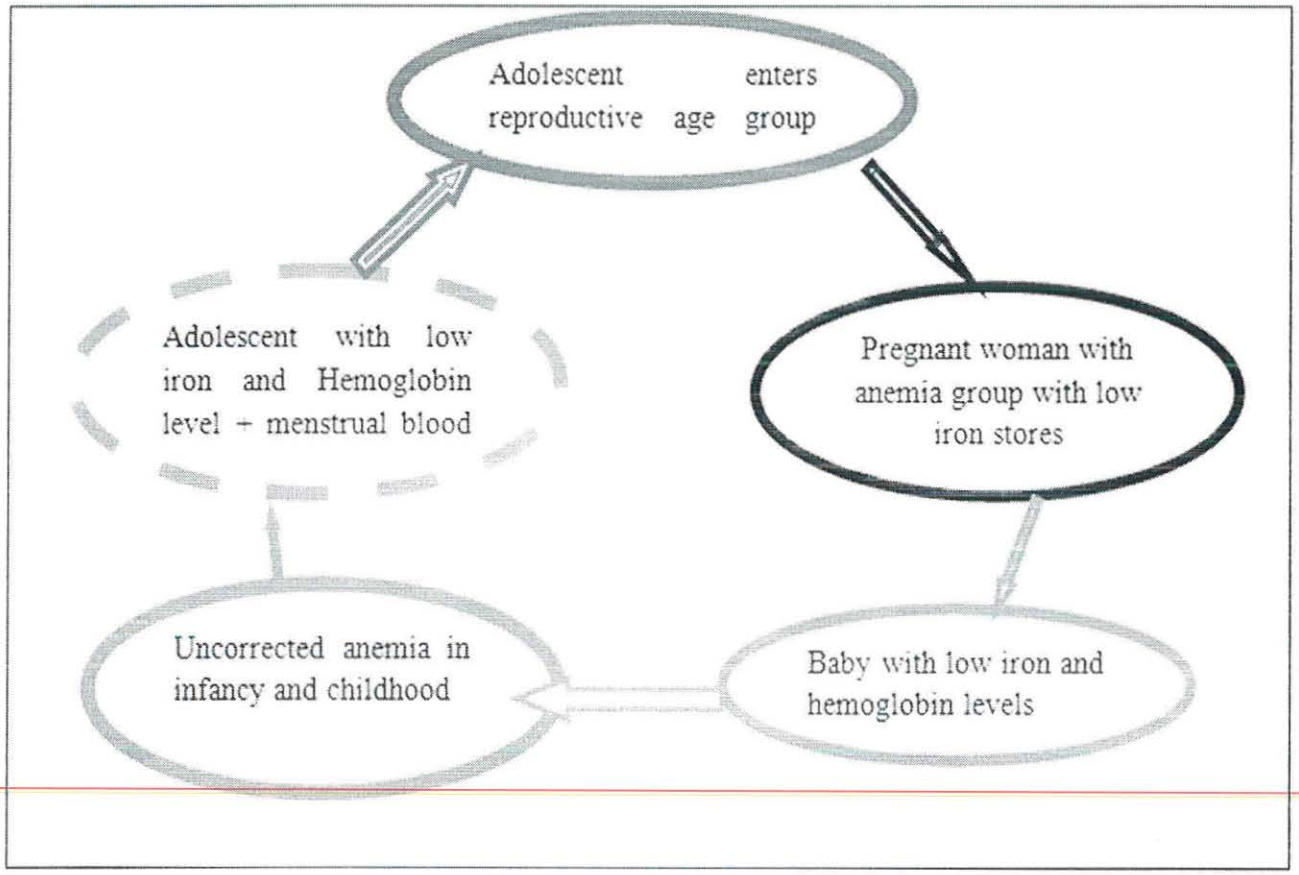
Hemoglobin transports oxygen in the blood for delivery to the body's tissues. Therefore one of the first signs of low hemoglobin, or anemia, is fatigue, due to lack of oxygen for physical activity. For the world's many anaemia causes impaired productivity and incomes to suffer, as well as compromised ability to carry out daily task. The relationship between anemia and reduced productivity has been well documented. A literature review examined the association between iron deficiency and work capacity identified a strong causal effect of severe and moderate anaemia on aerobic capacity, which translates into reduced physical activity and productivity (Haas and Brownlie. 2001).

On the other hand, studies have shown improvement in work capacity in response to provision of iron supplementation (WHO: UNICEF/UNU. 2001).

2.6.2. Adverse birth outcomes

Reduced levels of hemoglobin favor changes in placental angiogenesis, limiting the availability of oxygen to the fetus and, consequently causing potential restriction of intrauterine growth and low birth weight (Sari *et al.,* 2002).Pregnant women with hemoglobin levels below 11 g/dL are at higher risk of having low birth weight children compared with women who do not have anemia during pregnancy (Sari *et al.,* (2002).

2.6.3. Intergenerational cycle of anemia in adolescent girls



Source: (WHO, (2011).

2.7. Prevention and control of anemia

Correcting anemia often needs an integrated approach. To effectively combat it, the causative features must be recognized and addressed. In setting where iron deficiency is the most common cause, supplementation of the iron tablet is an appropriate way to prevent and control in vulnerable groups such as pregnant women, young children and adolescent girls (WHO, 2006). Food-based techniques to increase iron intake through food fortification and dietary diversification are important in a sustainable strategy for preventing anemia in the general population (WHO, 2006).

In a situation where iron deficiency is not the only cause of anemia combined intervention like iron tablet supplementation, de-worming for hookworms, used of the insecticide-treated net, anti-malaria prophylaxis is an appropriate way to prevent and control anemia (WHO, 2006).

2.8. Conceptual frame work

The study was used modified conceptual framework shown in Figure 2 illustrates the major nutritional issues in adolescence, whether nutritional problems as such or threats, along with underlying factors which is loosely adapted from UNICEF (1990),

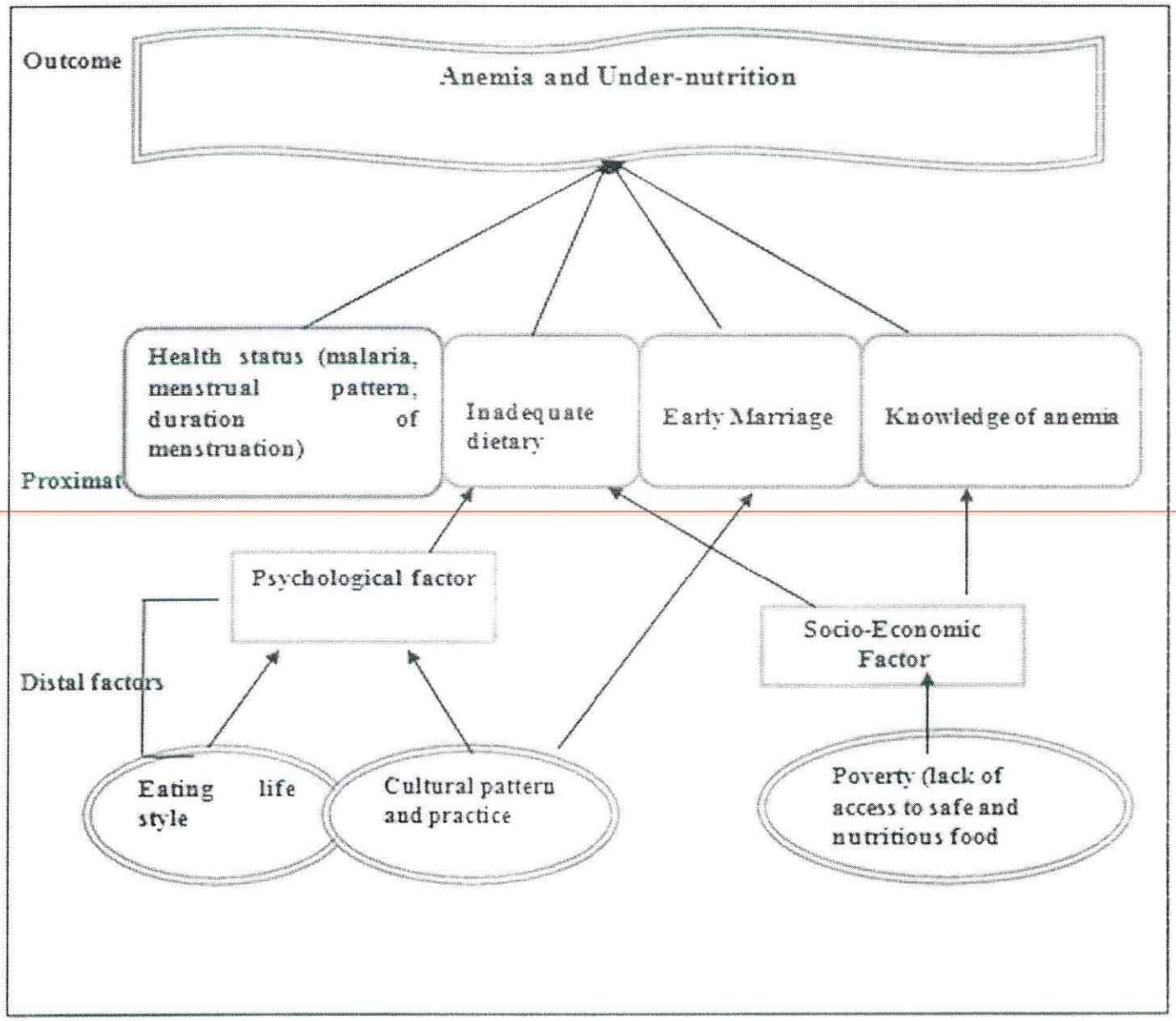


Figure2: Conceptual framework of nutritional problems and determinant factors in adolescence girls

CHAPTER THREE

3. Material and Method

3.1. Description of the Study Area

Shabele (Godey) and Jarar (Degehabor) are part of eleven administrative zones in Somali regional state, eastern Ethiopia. Godey located at latitude and longitude of 5°57N 43°27'E and an elevation 283m above sea level. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Zone has a total population of 464,253, of whom 258,558 are men and 205,695 women. While 89,593 or 19.3% are urban inhabitants, a further 118,608 or 25.55% were pastoralists. The largest ethnic groups reported in Godey were Somali (98.62%); all other ethnic groups made up 1.38% of the population (CSA, (2007). According to a May 24, 2004 World Bank memorandum, 2% of the inhabitants of Godey have access to electricity and 28.2% of the population is in non-farm related jobs (world bank, (2006). Forty two percent of all eligible children are enrolled in primary school, and 3% in secondary schools. 100% of the zone is exposed to Malaria, and none to Tsetse fly (world bank, (2006).

Degehabor located at latitude and longitude of 8°13N 43°34'E and an elevation 1078m above sea level. Based on the 2007 Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Zone has a total population of 478,168, of whom 268,006 are men and 210,162 women. While 62,584 or 13.01% are urban inhabitants, a further 223,778 or 46.8% were pastoralists. The largest ethnic groups reported in Jarar were Somali (98.92%); all other ethnic groups made up 1.08% of the population. According to a May 24, 2004 World Bank memorandum, 1% of the inhabitants have access to electricity and 28.2% of the population is in non-farm related jobs (world bank, (2006). 23% of all eligible children are enrolled in primary school, and 3% in secondary schools and 100% of the zone is exposed to Malaria, and none to Tsetse fly (world bank, (2006).

3.2. Study Design

A school based cross-sectional study was conducted in Godey and Degahbor councils, Somali region

3.3. Source of population

The sources of population was all adolescent girls attending public high schools in Godey and Degahbor councils, Somali region

3.4. Study population

Adolescent girls that randomly selected from two public high schools in Godey and Degahbor councils, Somali region

3.5. Study period

February-March 2019

3.6. Sample Size determination

Single population proportion formula (equation is indicated below) was used to determine sample size by considering anemia, wasting and stunting prevalence as 32% 21.6%, 15% respectively to reach a maximum sample size. In addition, a 5% margin of error, 95% confidence interval and 5% none response rate were also considered in the calculation.

$$n_o = \frac{\left(Z_{\alpha/2}\right)^2 \times P(1-P)}{d^2}$$

Where, Z=1.96 at 95% confidence interval

P=expected prevalence rate = (32%)

n=sample size q=1-p

d- Margin of error to be committed by the researcher (5%)

α=0.05

Total number of the adolescence girls in the two schools is 792; a final sample size was determined by Cochran's formula for calculating sample size when population size is finite:

$$n=\left[\frac{n}{1+(n-1)\div N}\right] = 335 / 1 + (335 - 1) / 792 = \mathbf{236}$$

By considering 5% non respondent rate (236*5%) and 1.5 designs effect final sample size was

$$\approx 372$$

3.7. Sampling procedure

A multi-stage sampling technique was employed primary; two councils (Godey and Degarbor) from two different zones (Shabele and Jarar) of Somali region were purposively selected and out of the total 6 public high schools, two were selected using the lottery method. Then, number of students from each school was proportionally allocated, the female students to include the study was determined by systematic random sampling method using student's registrations book as sampling frame.

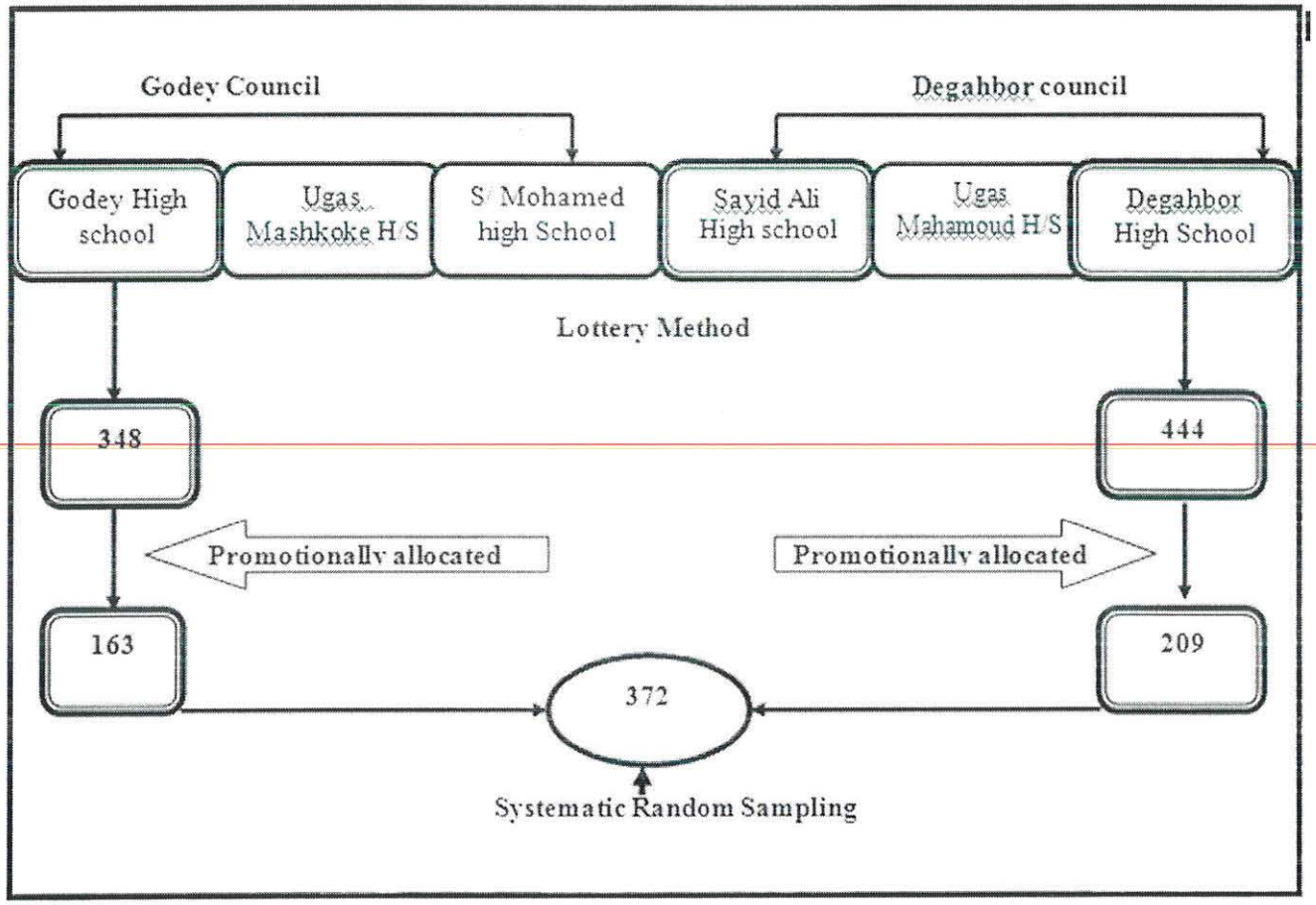


Figure 3: Schematic diagram of sampling procedure

3.8 Inclusion Criteria

- ✓ Adolescent school girls attending school at Godey and Degahbor councils

3.9. Exclusion criteria.

- ✓ Adolescent girls who were absent from school during the data collection period were excluded.
- ✓ Pregnant adolescent was not included because pregnancy is one factor that affect measurement of the nutritional status of the adolescence
- ✓ Adolescence who are not willing to participate the study

3.10. Study variables

Independent variable	Dependant variable
Socio-demographic variable	Haemoglobin concentration
Socio-economic variable	
Dietary diversity	Stunting, wasting and underweight
Knowledge of anemia	
Past health status	

3.11. Data collection technique

3.11.1. Socio-demographic and Socio-economic data

Standardize closed ended questionnaire with a few open ended questions was used to obtain information related to socio demographic, socio economic characteristics, past health status and anemia related knowledge among adolescents girls living in Somali region, eastern Ethiopia.

3.11.2. Anthropometry

3.11.2.1. Height and weight measurements

The body height of the study participants was measured to the nearest 0.1cm with a portable height scale, which was placed on firm flat ground to ensure accuracy, and with the participant standing erect. The Participants were asked to remove their shoes, heavy outer garments, and hair ornaments. They were made to stand straight with their back, head, buttocks, calves, and heels touching the height rule while the head was in Frankfurt's position and feet were together. The headpiece of the height scale or the sliding part of the measuring rod was lowered so that their hair was pressed firmly flat and readings were taken.

The study participants' body weights were measured to the nearest 0.1kg with a SECA, Hamburg, Germany) with a maximum weighing capacity of 130 kg. The participants were asked to be in minimal clothing, and they were asked to remove shoes, jackets and other heavy objects before standing on the scale. The digital scale was standardized by measuring various objects with the standard weight, just to ensure that the scale was giving accurate measurements. Height and weight measurement was taken twice or three times whenever the difference was > 0.5cm. Measurements were changed to height-for-age and weight-for-age z-scores, and BMI and those who have less than -2 scores were categorized as wasting, between >-2 and <+1 as normal (WHO, (2007). Having height for age z-score less than -2 was categorized as stunted (De Onis, (2006) and those who have ≤ 18.5 kg/m2.were categories as underweight (WHO, (2007).

3.11.3. Dietary characteristic of adolescent girls

An individual 24 hr recall method as recommended in FAO, (2010:2016) guideline to collect individual dietary diversity and food variety was followed to collect dietary data. Participating girls were asked to report any food and drinks consumed 24 hrs preceding the survey. The dietary diversity was calculated after the food items were grouped in to 9 categories: (i) starchy staples (ii) Dark green leafy vegetables (iii) Other fruits and vegetables (iv) organ meat (v) flesh meat (vi) eggs (vii) legumes and nut (viii) fish and (ix) milk and milk product.

3.11.4. Hemoglobin estimation

Adolescent hemoglobin status was measured by using a portable battery-operated photometer (HemoCue hg /301+Analyser). Capillary blood sample was taken by pricking the tip of the finger in an aseptic way. After rubbing the fingertip with sterile cotton, (immersed in alcohol) a 10 micro liter blood sample was collected by finger pricking with a sterile disposable lancet and the second blood drop was taken for hemoglobin measurement. Result was read within one minute. The photometer was calibrated before every session using provided standard. Hemoglobin level determination was done by trained laboratory technicians working out of the council. Anemia status of adolescent girls was assessed using the WHO classification. An individual adolescent girl was considered anaemic if the Hb value was below 12.0 g/dL. Girls having anaemia were further categorized into different grades such as mild (10-12 g/dL), moderate (7-9.9 g/dL) and severe (<7.0g/dl) (WHO, (1999).

3.11.5. Data quality control measures

To ensure the quality of data, data collectors were trained and the questionnaire was translated to Somali language and then back to English for consistency. The questionnaire was pretested in 5% of the sample size in a school other than the selected ones, but similar to the study participant. All laboratory activities were performed by strictly following manufacturers" instructions and specific standard operating procedures. Data was collect by diploma female data collectors (one lab technician and 3nurses) and one degree level supervisor.

3.12. Statistical analyze

Statistical analysis was conducted using SPSS software version 25. Tables, graphs, means and frequencies were used to present descriptive result. Odd Ratio (OR) was performed to test the association b/n hemoglobin and independent variable. Stepwise binary logistic regression model was applied to test association between hemoglobin and socio demographic, socioeconomic, dietary diversity, past medical history and anemia knowledge. $P < 0.05$ was considered to determine statistical significance. Before applying binary logistic regression, the presence of multi-co linearity among the independent variable was diagnosed using Variance Inflation Factor

(VIF) and Condition Index (CI). WHO-anthroPlus version 1.0.4 was used to analyze nutritional status of adolescent girls and magnitudes were determined using WHO 2007 references point.

3.13. Ethical consideration

Ethical approval for the study was obtained from the Ethical Review Board of College of Natural and Computational Sciences of Addis Ababa University. Support latter was also obtained from Somali Region State Health office. The purpose, benefit, potential harm and confidentiality of the study were explained to the participants and written consent was obtained from the participant.

Operational Definition

School Adolescents: are people aged 10-19 years who are attending secondary and preparatory schools in Godey and Degahbur councils.

Wasting: Is a form of acute malnutrition. It is defined by a MUAC < 125 mm (cut-off being debated) or a WFH < -2 z-score (WHO standards) or WFH < 80% of the median

Stunting: is a form of under-nutrition. It is defined by a height-for-age (HFA) z-score below two SDs of the median WHO standards). Stunting is a result of prolonged or repeated episodes of under-nutrition starting before birth.

Anemia: is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs, which vary by age, sex, altitude, smoking, and pregnancy status.

Hemoglobin: is a protein that is carried by red cells. It picks up oxygen in the lungs and delivers it to the peripheral tissues to maintain the viability of cells.

Dietary diversity score (DDS) was classified into low DDS (≤5 food groups), Normal DDS (≥5food groups).

Knowledge of anemia in the study was defined based on percentage, poor knowledge meant when girls don't heard/know about anemia

CHAPTER FOUR

4. Result

4.1. Socio demographic characteristics of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

A total of 372 school adolescents participated in this study with a response rate of 100%. The mean age with a standard deviation of the adolescent girls was 17.8(±1.2) years. The majority of the participants 98.7% were Somali followed by Amhara (1.3%). The majority (97.3%) of the respondents were not married. About half of the participants (53.8%) were from a household with a family size greater than five. A summary of demographic characteristics of the present study participants is indicated in table 1.

Table1: Socio-economic and demographic characteristics of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

Variables	n(%)
Age of adolescent	
17-19	308(82.8%)
15-17	64 (17.2%)
Religion	
Muslim	367 (98.7%)
Orthodox	5 (1.3%)
Ethnicity	
Amhara	5 (1.3%)
Somali	367(98.7%)
Marital status of adolescent	
Married	10(2.7%)
Not married	362(97.3%)
Grade level of adolescent	
9-10	219 (58.9%)
11-12	153 (41.1%)
Family size	
≤ 5	172(46.2 %)
≥5	200(53.8%)

Family's monthly Income	4(1.1%)
≤1500	368(98.9%)
≥1500	
Mother Education	
Illiterate	251(67.5%)
Informal Education	9(2.4%)
Formal Education	112(30.1%)
Farther education	103(27.7
Illiterate	25(6.7%)
Informal Education	242(65.6%)
Formal Education	

4.2. Prevalence of anemia among adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

The hemoglobin concentration was in the range of 7.3g/dl to 18.1g/dl, with mean value of 12.3±1.3g/dl. The overall prevalence of anemia was 31.5% in the present study. Out of the total samples, 25.5% and 5.9% were mildly and moderately anemic, respectively (Table 2).

Table: 2. Anemia prevalence among adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

S.N	Severity of anaemia	Prevalence
1	Moderate anemia	5.9%%
2	Mild Anemia	25.5%

4.3: Anthropometric characteristic of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

The weight of adolescent girls was in the range of 33kg- 86kg, with their mean value of 51.1 and their height was in the range of 134cm -178.2 cm, with their mean value of 162cm. The body mass index of adolescent girls was in the range of 11.9 kg/m^2 -19.4kg/m^2, with their mean value of 19.4kg/m^2. A summary of under-nutrition prevalence of the present study participants is indicated in Figure 5.

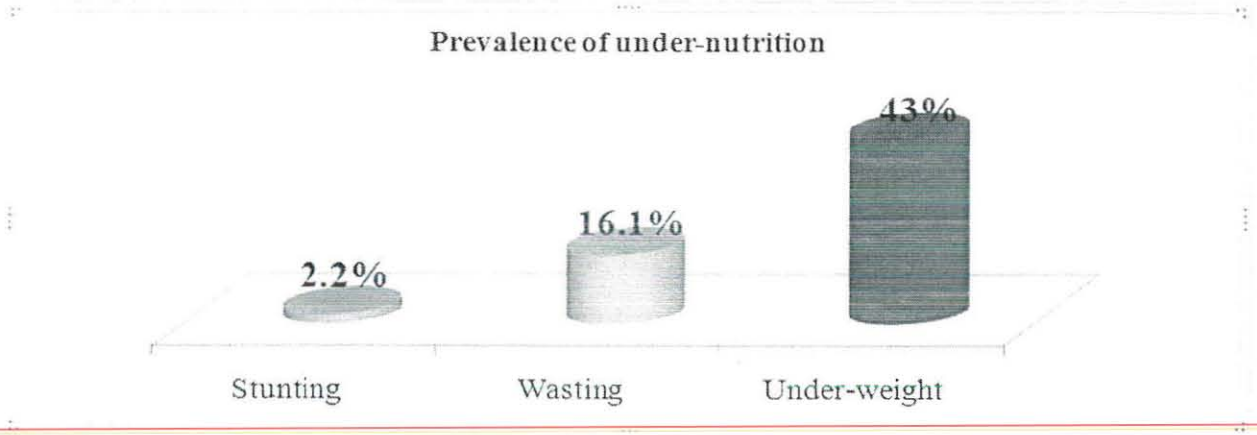


Figure5: Prevalence of under-nutrition among adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

4.4. Dietary characteristic of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

The mean dietary diversity of the present study participants was 4.2±0.8 with a range of 2 to 8, out of the 9 points.

All of the participants (100%) ate cereal based foods. In addition, (52.2%) of the adolescents ate legumes 24hours preceding the interview. Furthermore, 99.7%, 79.3%, 87.9%, 3.2%, 1.1%, and 1.6% of adolescent girls ate vegetables, fruit, flesh meat, organ meat, fish, and eggs; respectively (Table 3).

The present study found that (3.8%) of girls fulfilled the minimum recommended dietary diversity according (MDD-W $\geq$ 5 food groups). In addition, most adolescent girls had low consumption of animal source foods particularly organ meant, fish, eggs and milk.

Table: 3. Dietary characteristic of adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

Variables	n(%)
Cereals and tubers Yes	372(100%)
Legumes and nuts Yes	194(52.2%)
Vegetables Yes	371(99.7
Fruits Yes	295(79.3%)
Organ meat Yes	12(3.2%)
Flesh meat Yes	327(87.9%)
Fish Yes	4(1.1%)
Eggs Yes	6(1.6%)
Milk and Milk product Yes	15(4%)

4.5. Knowledge of anemia adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

In the present study, out of 372 adolescent girls, (52.7%) responded that they have heard about anemia. The main sources of information were from health professionals (51%) and family member (33.2%). The majority (91.3%) knew that anemia is a health problem. Out of girls who have heard about anemia, (74.5%) responded that poor diet is the only cause for anemia and (15.8%) participants didn't know the answer. In addition, (75%) of the girls having prior knowledge about anemia, answered that tiredness/body weakness is the only manifestation of anemia and (4%) answered anemia manifests shortness of breathing while (2.7%) answered anemia manifestation is difficult to learn. Fifty-six (15%) told anemia impacts on only growth and development and (81.5%) participants did not know the answer. Regarding anemia prevention and intervention, out of 372 girls, (17.5%) told green leaf vegetable are the only source of iron rich food and (8.3%) girls answered meat and poultry are rich of iron while (72%) girls did not know the answer (Table 4).

Table4: Knowledge of anemia adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

Variables	n(%)
Know/heard about anemia Yes	196(52.7%)
Source of information Teachers Health provisional Family members Media Friends	 11(4.1%) 100(51.0) 65(33.2%) 3(1.5%) 20(10.2%)
Is anemia a health problem? Yes	179(91.3%)
What are the causes of anemia? Poor diet Worm infestation Menstruation Bleeding from wound	 146(74.5%) 9(4.6%) 1(0.5%) 5(2.5%)

Pregnancy	4(2%)
Don't know	31(15.8)
How do you know if you have anemic?	
Tiredness/body weakness	147(75%)
Shortness of breathing	8(4%)
Difficult to learn	4(2%)
Don't know	37(19%)
What are the consequences of anaemia?	
Impact on growth and development	56(15%)
poor school performance	10(2.7%)
Decreased wok capacity	3(0.8%)
Don't know	303(91.5%
Which one of the following is Iron-rich food?	
Green leaf vegetable	65(17.5%)
Legumes	8(2.2%)
Meat and poultry	31(8.3%)
Don't know	268 (72%)

4.6. Factors associated to anemia among adolescent school girls in Godey and Degahbor council Somali region, Eastern Ethiopia

In bivariate analysis adolescent girls from age 15-16 [(COR=2.24), 95% CI: (1.15, 4.38)], family size ≥5 person [(COR=1.56), 95% CI: (1.00, 2.42)], irregular menstrual pattern [(COR=2.08), 95% CI :(0.24, 0.97)], duration of menstruation ≥5 days [(COR=1.61), 95% CI :(1.0,2.57)] and lack of anemia knowledge [(COR=1.78),95%CI:(1.13,2.78)] had statistically significant association with lower hemoglobin.

Results of the multivariate logistic regression showed that adolescent girls from family size ≥5 person were approximately two time more likely to be anemic [(AOR= 1.80), CI :(1.14, 2.85)] as compared to their counterpart; adolescent girl who never heard anemia were more likely to be anemic 1.6 [AOR=1.62), CI(1.01,2.59)] compared to those who know/heard anemia.

Tabale5: Factors associated to anemia among adolescent girls attending secondary and preparatory schools in Somali region, eastern Ethiopia

Variables	Responses	COR(95% CI)	AOR(95% CI)
Age	17-19	1	1
	15-16	2.24(1.15,4.38)	1.45(0.68, 3.08)
Family size	≤ 5	1	1
	≥5	1.56 (1.00, 2.42)	1.80(1.14, 2.85)
Family monthly Income	≤ 1500	1	1
	≥1500	0.72(0.75,7.0)	0.60(0.06, 6.16)
Menstrual pattern	Regular	1	1
	Irregular	2.08(0.24,0.97)	2.08(0.23, 1.02)
Duration of menstruation(days)	≤ 5	1	1
	≥5	1.61(1.01,2.57)	0.91(0.53, 1.55)
Malaria history last 14 days	Negative	1	1
	Positive	1.21(0.56,2.61)	1.29(0.55, 3.01)
Minimum dietary diversity	≤ 5	1.67(0.56,4.92)	1.76(0.57, 5.42)
	≥ 5	1	1
Knowledge of anaemia	Heard anaemia	1	1
	Never heard anaemia	1.78(1.13,2.78)	1.62 (1.01,2.59)
BMI-for -age	Wasting	1	1
	Normal	0.69(0.39,1.23)	0.71(0.39, 1.29)
Stunted	Normal	1	1
	Stunted	0.45(0.1,1.8)	0.594(0.14, 2.52)

COR: Crude odds ratio; AOR: Adjusted odds ratio; BMI: Body mass index.

5. Discussion

Under-nutrition, which includes micronutrient deficiency (iron), is a major public health concern for adolescent girls in developing countries, with negative implications for growth, brain development, birth outcomes, and long-term health. This study was designed to estimate the prevalence of anemia and under-nutrition among adolescent girls in the Somalia region (a region known for food insecurity thus high rate of anemia). Also, the study attempted to identify factors associated with low hemoglobin concentration. The hemoglobin concentration was in the range of 7.3g/dl to 18.1g/dl, with a mean value of 12.3±1.3 g/dl. Anemia was prevalent in 31.5% of the study participants. Family size ≥5 person and lack of anemia knowledge were associated with low hemoglobin concentration.

Adolescent girls, are vulnerable to anemia due to low intake and absorption of iron, and increased iron requirements for growth and replacement of menstrual blood losses (Brabin and Brabin, 1992), Malaria infection result either in the early stage of infection, rupture of parasitized red blood or hypersplenism that result clearance of both mature and not matured red blood cell (Phillips, (1992), worm infestation result chronic intestinal blood loss by release of anti-clotting agents(Crompton, (2000) and HIV infection cause anemia of inflammation which is characterized by decreased red blood cell production through a series of mechanisms(Means, (2000), Family histories mostly result from defects in genes producing hemoglobin (Olivieri, (1999), Traditional practice of early marriage and social pressure that often result not delaying first pregnancy (Kotadawala, (2000) and low socioeconomic status (Nilsen et al., (2009).

According to overall under-nutrition prevalence of stunting, wasting and underweight among adolescent school girls in Godey and Degahbor council Somali region was 2.2%, 16.1% and 43% respectively. Hence, underweight was the highest form of under- nutrition recorded in this study 43% and stunting was the lowest prevalence 2.2%. In addition, the prevalence of underweight was higher than finding of EDHS (2016) in Somali region 22%.but lower than prevalence reported Eastern Tigray, Ethiopia 55% (Gebremariam *et al.*, (2015). This might be due to difference in study design, sample size, residence area and dietary diversity pattern.

Generally, anemia prevalence in this study finding was 31.5%, this higher than the national average about (18%) (Ethiopian notational micronutrient survey (2016), and (24%) (EDHS, (2016). but lower than the ENMNS (2016) finding in the Somali region which showed (34.8%). however, approximately similar to the report of the study in Babile District, Eastern Ethiopia where the prevalence of anemia among adolescent girls was 32% (Kedir et al. 2016).

Increased family size may adversely affect the nutritional status of every member of the household, including adolescent girls, because it may be associated with decreased per capita human inputs. In other words, the allocation of food per household is likely to decrease with the increase in the number of family size, which, in turn, may adversely affect the nutritional status of adolescent girls. In line with this, the current study revealed that adolescent girls from family size ≥5 were approximately two times more likely to be anemic [(AOR= 1.80), CI:(1.14, 2.85)] compared to those who from ≤ 5 people.

A survey study in Misamis oriental province has shown that reducing family size can be more effective in preventing nutritional problems among the high-risk group (pregnant women, children and adolescent girls). The results indicate that decreases in family size will effectively improve the household's level of living and the expected sequence of influence may be that: first, a decrease in the number of family size makes it more possible to buy adequate food; second, these foods have enough nutrient content that they meet the daily recommended dietary requirements; and third, when adequate nutritious foods are available, the good health of family is improved (Magallanes,(1984).

Somali region 100% is exposed to Malaria (World Bank, (2006). Malaria has a range of manifestations but malaria-related anemia is one of the leading causes of death, with reproductive women and children being the most affected (Nussenblatt and Semba, (2002). Malaria infection causes anemia either in the early stage of infection, rupture of parasitized red blood or hypersplenism that result in clearance of both mature and not matured red blood cell (Phillips, (1992), however, the current study doesn't show significant association b/n malaria and hemoglobin concentration of adolescent girls. The First reason, malaria infection was based on verbal history from participants rather than any test of blood and this might have masked the actual status of the respondents. The second reason, Somali region is a stable endemic malaria

area (transmission of infection throughout the year) adolescent girls might develop high immunity.

Anemia was significantly associated level of knowledge of anemia among adolescent girls in this study. Adolescent girl who never heard anemia were 1.6 more likely to be anemic [AOR=1.62), CI (1.01, 2.59)] compared to those who heard anemia. The possible reason for the high prevalence of anemia among students who never heard/know anemia could be poor knowledge regarding iron-rich foods compare to girls with knowledge about anemia that consider the prevention and control mechanism of anemia.

This is similar to observation done in Tatah Makmur South Kalimantan Public Health Center by Tumanggor, & Tumanggor (2017), reported that the incidence of anemia was significantly associated level of knowledge of anemia among adolescent girls.

Menstruation is monthly endometrial shedding leading to the discharge of blood from the uterus occurring in every 8 ± 7 days and a part of normal reproductive cycle of female. The average menstrual bleeding lasts about 5 days (Dambhare, (2012). It is known that heavy as well as menstrual bleeding for prolonged period can lead to anemia (Premalatha *et al.*, (2012). The current study revealed that 62.6% adolescent girls had menstrual duration ≥5 days and 84.9% adolescent girls had irregular menstruation pattern. However, this study indicated that both irregular menstruation pattern and duration menstruation ≥5 days were not significant to hemoglobin concentration of adolescent girls. The possible reason behind more number of girls with irregular cycle in our study could be due to the higher percentage of young girls aged, as study suggest that normal cycle length is obtained around the chronological age of 19–20 (Diaz, 2006). Research result that are in line with this research is research conducted by Siahaan which Said that there is no significant relationship between the pattern of menstruation and the incidence of anemia in adolescent girls in Depok City Region in 2011 with a value of p = 0,756. However, this study mentioned adolescent girls' knowledge, protein intake, iron intake, father work, and mother's job as predicators of anemia (Sihaan, (2011)

Dietary diversity is the number of foods consumed across and within food groups over a reference period. It is widely recognized as being a key dimension of diet quality. It reflects the concept that increasing the variety of foods and food groups in the diet helps ensure adequate

intake of essential nutrients and promotes good health (Trumbo et al.(2001). However, none of the bivariate and multivariate logistic regression indicated significant association between hemoglobin concentration and dietary diversity. The possible confounding reason are tea consumption at the time of a meal that can significantly decrease iron absorption (Matthieu, (2009) and low consumption animal source food particularly meat, fish, and eggs, as study suggest that Individuals who eat a diet including meat, seafood, eggs, and iron-fortified foods are less likely to have low hemoglobin concentration(Haack and Byker (2014).In addition, Hurrel, (2006) reported that good source of iron like fish, meat and poultry contain not only the well observable heme iron but also contain a peptide called MPF factor that promote the non hemo iron from other foods eaten at the same meal. .

The strength of the study includes: The Hemoglobin (Hb) measurement used the recommended laboratory equipment (Hemocue HB 301 Analyzer) and procedures by trained laboratory technicians. The quality control issues were strictly followed as per the manual (guidelines). Height & weight measurements were done with possible accuracy by trained nurses and to reduce measurement errors, one day intensive training was given for data collectors and supervisors.

But this study might have some limitations; such only hemoglobin estimation was done other hematological parameters was not estimated due to economic constraints, this study does not represent rural part of the region due to difference in life style pattern and malaria infection were based on recall history in the last 14 days and not laboratory based which might compromise the accuracy of the data.

CHAPTER SIX

6. Conclusion and Recommendation

6. 1. Conclusion

The result of the study revealed that prevalence of anemia, stunting, wasting/thinness and underweight is 31.5, 2.2, 16.1% and 43% respectively. Prevalence of anemia among adolescent school girls in Godey and Degahbor council, Somali region is a moderate public health problem. Family size ≥5 people and lack of anemia knowledge were independent predictors of anemia. Therefore, iron rich and diversified food consumption, intermittent iron folic acid supplementation and family planning and nutrition education awareness at school level should be given attention with particular focus on female adolescents for improving nutritional status and health of adolescent girls.

6.2. Recommendation

The following recommendations are made based on the conclusion of this study:

- The study provides an indication to initiate anemia prophylaxis (Intermittent iron and folic acid supplementation) measures for adolescent girls in Somali region.
- To increase awareness about family planning at school level.
- To encourage eating iron-rich foods like (red meat and liver, eggs).

Further Research

- To conduct community based study supported hemoglobin with other haematological parameters, malaria and parasitic test in the region.

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Appendixes

Appendix1: Ethical clearance from college of natural and institutional review board (IRB)

COLLEGE OF NATURAL & COMPUTATIONAL SCIENCES
Addis Ababa University

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OFFICE OF THE DEAN
የዲኑ ጽ/ቤት

Ref. No.
ቁጥር CNSDO/318 /11/2019
Date
ቀን January 31, 2019

To Whom It may Concern

The College of Natural & Computational Science Institutional Review Board (CNS-IRB) Committee in its meeting held on 09/01/2019 Minute No. IRB/036/2018 has examined the project proposal entitled **"Assessment on hemoglobin Concentrations and nutritional status of adolescents' school girls in Godey and Degahbur council by Abdirahman Ahmed** from the Addis Ababa University.

The proposal is approved for implementation.

With regards,

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

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Please Quote our reference number in you correspondence
"Examine all things; hold fast that which is good"
"ሁሉን መርምሩ፡ መልካሙን ያዙ"

Appendix2: Support letter from Somali regional state

Dawlada Deegaanka Soomaalida
Xafiiska Caafimaadka

Somali Regional State
Health Bureau

Sum/Ref/ቁጥር: SRHB 18 3067
Taar/Date/ቀን: 31-1-2017

KU: GODAY COUNCIL

KU: DHAGAXBUR COUNCIL

Ujeedo: gacansiin

Sida ujedada sare ku xusan waxan idin la socodsinaynaa inaad gacan ku siisan Xubinka Magaciisa ah **Abdirahman Ahmed** oo ka tirsan Ardayda Jaamcada Addis abab darasadkan " **ASSESSMENT ON HEMOGLOBIN CONCENTRATION AND NUTRATIONAL STATUS OF ADOLESCENTS SCHOOLS GIRLS IN GODAY AND DHAGAXBUR COUNCIL, SOMALI REGIONAL STATE,ETHIOPIA** " uu ka samaynayo

Sida darted waxan Maamulka Degmooyinka 'dinia socodsinaynaa in aad Gacan Buuxda Ku siisaan xubinkan diyaarinayo darasaadka.

Wada shaqayn wacan

Jamiilah Sheikh Mohamed
Kuxigeenka Maareeyaha Xafiiska
Caafimaadka DDS

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Sections
Bureau Head Secretary
Curative
Planning & M&E
Deputy Bureau Head
PH Emergency
HRM
B.Bank

Logistics
Disease Prevention
Health Promotion
Health Extention
Finance Section
R.Lab

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Health For All

Appendix 4

Mixed English and Somali version

Annex 1:- letter of executive Director (Education) in Godey and Degahbur council and School principles.

To:-

1. Executive director Officer (Education)
2. Mr.
3. Mr.

Title of the study: Assessment on hemoglobin concentration and Nutritional status of adolescence girls in Godey and Degahbur councils, shabele zone Somali regional state.

Introduction: Adolescence is the age (10 – 19), between childhood & adulthood, and a formative period during which many life patterns are learned and established. It a crucial and dynamic time for young people as they begin to develop their capacity for empathy, abstract thinking and future-time perspective; a time when the close and dependent relationships with parents and older family members begin to give way to more intense relationships with peers and other adults. It is also a time when physiologically, adolescents begin to reach their adult size, their bodies become more sexually defined and reproductive capacity is established.

As in this age rapid physiological, biological and mental changes occur, which require an increased supply of food rich in vitamins and energy. This requirement is not sufficiently met and adolescent girls are prone to develop nutritional deficiencies. About 27% of adolescents are estimated to be anemic in developing countries, compared to 6% in developed ones. Girls are often expected to have higher rates of anemia than boys because of iron lost during menstruation and pregnancy.

Preventing under nutrition is of special importance for adolescent girls because it can result in poor pregnancy outcomes, in particular low birth weight and consequently increased risk of infant mortality.For prevention of these nutritional deficiencies we need to know about the present status of this group. No research to explore it has yet been carried out in Somali regional state and in fact very limited data is available even in developed and developing world.

I plan to undertake subject study for the completion of my thesis leading me to the degree of MSc (Community Nutrition) from Addis Ababa University, Ethiopia

You are please requested to cooperate in this regard by letting me to interview and examine the students from your schools.

Annex 2:- School Survey schedule

Particular	School 1	School 2
Name	Godey High School	Sayid High School
Location	Degahbur Councils	Degahbur Councils
Date of Visit	March 2018	February 2019
Time	8:00AM(Morning)	8:00AM(Morning)

Annex 3.Conset Form

I am a student of Addis Ababa University. I am conducting a research study for my MSc thesis. Your schools are selected for this survey. In this context I will be measuring your height and weight. For biochemical estimation your hemoglobin will be checked by taking a drop of blood from your finger tip through a prick by sterile disposable lancet. To carry out the dietary survey few questions regarding your dietary diversity will also be asked. I hope you are willing to participate in this study.

Benefits of the study: the participant will not get any direct benefit (in terms of money) for being participant, but

- We will provide nutritional counseling for those who are anemic.
- The result can be used to play a great role to provide a figurative data about anemia and nutritional status of adolescence school girls in Somali regional state Ethiopia.
- The result can be used as a baseline for further studies that can be done in this area.
- The result will be used to the governmental organization or non-governmental organizations, stake holders and policy makers to develop an intervention and prevention mechanism to alleviate the problems regarding anemia among adolescence school in Somali regional and the country.

Potential harm: the study has no any harm except that participant will spend up to 20-30 minutes in the interview and taking one drop of blood from your finger prick.

Confidentiality: the secrecy of any information forwarded will be maintained and we assure you that whatever answers you give us will be kept strictly secret.

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 to

The principle investigator: Abdirahman Ahmed Hassan

Cell phone: +25119235104

Email:abdirahmanahmed985@gmail.com

If you agree to participate in the study, please sign at the space provided below and I would like to thank you for your participation.

Code of the participant:_____

Name and Signature of the participant

Name:-_____

Signature of the participant; - _____

Name and signature of the data collector

Name:- _____

Signature: - _____

Date: _____

Somali language version

Foormka oglaaanshaha

Foomkaan waxaa loo akhrin doonaa ardayda kaqayb qaadan doona cilmi baadhistan.

Subax wanaagsan/galabwanaagsan Abaayo magacaygu waa _____waxaan kamid ahay dadka uruurin haya xogta cilmi baadhista ay samayn hayso jaamacada Addis Ababa, kuli yada saynsiga dabiiciga ah, waax deeda sayniska cuntada iyo nafaqada programka nafaqada bulshada. waxaan ku dooranay inaad kaqayb qaato cilmi baadhistan.Kadib Markaad fahanto warbixintan hadii aad ogolaato

Ciwaanka cilmi baadhista;- xalada nafaqada iyo dhiiga hablaha dhigta schoolka Dagahbur iyo Godey ee degaan somalida.

Hordhac ; dhaliayarnimadu waa waqtiga udhaxeya sanad ahaan 10-19 sano ama waa watiga udhaxeya carrurnimada iyo dadka waaweeyn;waqiga asaaga waa waqi xassaasi o aay dhalinyarada yeshaan caqliga aay wax kula garanayaan iyo mustaqbalkooda. Sodoo kale dhalinyarnimadu waa waqtiga aay xiriir dhaw iyo mid baanaan aay layeshaan walidlkood iyo qoyskooda iyo qasatan asxaabtooda.

Dhalinyarnimdu waa waqtiga si dagdag jir ahaan iyo masxkax ahaan is badal ku ymiado taaso kenta inuu korodha cuntada nafaqada leh aay ubahnyihiin.

In laga ilaaiyo nafaqa daro waxay si qaas muhimad uledahay gabdhah maxaa yeelay nafaqadarada ku dhacda gabdhah qasatan hadii horay loo guursada oo aay uur/ xaamilo noqoto waxaay sababi kartaa xalad caafimaad daro taas o noqon karta inaay dhasha ilma aan lahyn culyski loogu talagaly inuu yeesha ama cawaqib xuma sababi kartaa inuuu ilmaha yar ka dhinta.

Si looga hortaga xalada nafada darada waxaan u baahanahy inaaan ogano xalada nafaqo aay hada ku sugan yihiin gabdhahaan. mana jirta wax cilma baaris oo hada kahora lagu sameeyay degaanka somalida iyo xaqiiqdi warbxino xadidan ayaa laga helahaya wadamada horumaraya iyo kuwa hormayaba.

Habaka cilmibaadhista loo qaadaya

Aniga waxaan ahay arday dhigta jamcada **Adis Ababa.** Waxaan wada cilmi baaris. Schoolkina ayaan udoortay inuu ka qayb gala cilma baaristan. Waxaan cabiri dooona culyskina iyo dhererkina waxaan kalo idinka qaadi hal dhibic o dhig ah farta dhaxe ah si aan utijiabiyo xalada nafaqe aa aad kusugan tihiin sido kale waxaan idin weeydiin doonaa suaalo kusaabsan cuntada aad cuntiin.waxaan rajaaynayaa inaad diyaar tihiin inaad ka qayb qadatiin cilma barista.

Faaida laga helaya ka qaayqadashada cilmi baaristan

- ✓ Dhaliyadu waxay oganaay xaladooda nafaqa aay hada ku sugan yihiin
- ✓ Waxaan sii doona dhalinyarada latalin ku saabsan dhiig yaraan wax yaalaha keena sida looga hortaga iyo cawqib xumada ka dhalta dhiig yaraanta .
- ✓ Natijadaan waxaaay door muhiim ka ciyaari dontaa gabdhaha degaan somaliada in mustaqbalka dhaw inaay helaaan adeegyada cafimdaa e laga bxiaya schoolada.

Wax yeelada cilmi baadhistan:-

cilmi baadhistani wax wax yeela ah malahan oo aanka ahayn in kaqayb qaataha su aalo waydiinta lagaga lumiyo mudo 15 daqiiqo ah iyo in laga qaado dhibic dhiig ah farta dhaxe.

Sirta:- xogtani aad noo soo gudbiseen waan ilaalin doonaa waxaana idiin balan qaadaynaa sikasta oo ay yihiin jawaabihiinu in aan u ilaalin doono si haboon

Qofka lala soo xidhiidhi: hadii aad haysaan wax su aal ah haka labalabaynina in aad isoo waydiisaan xili kasta ama wixii kale ee khuseeya cilmi baadhistan hadaad rabtaan waxaad la soo xidhiidhi kartaan

Hogaamiyaha badhayasha: Abdirahman Ahmed Hassan

Tel numberkisa: +25119235104

Email:abdirahmanahmed985@gmail.com

Hadii aad ogolatay inaad ka u kaqayb qaato cilmi baadhistan fadlan waxaad ku qortaa magacaaga sixiixdaana meeshan banana ee hoose waanad ku mahadsan tahay kaqayb qaadashadaada.

Calamada ka qayqaataha; _____

Sixixa ka qaay qaataha _____

Magaca iyo sixiixa war qaadaha

Magaca: _____ Sixiixa: _____

Tariiqda

Annex (lifaaq):-4. Sualaha lagu baaraya xalada nafaqa dairida iyo dhiig laanta gabdha dhigta waxbrashada.

Questionnaire for assessing hemoglobin and nutritional status of adolescent's school girls in Godey and Degahbur councils).

A,qaybaha bulshada ,dhaqalaha iyo iyo warbixinta ka qaybqaataha

Socio-demographic and socio-economic status of the participants

S/N	Particular	Jawabo (Response)	Remark
101	Ethnicity	1.Amhara 2. Oromo 3.Tigray 4. Somali	
102	Religion		
101	Heerka waxbrasha ee ka qaaybqataha Grade level of the participant.	_____	
102	Xalada guurka Marital status of the respondent	1. Lagursanin (Unmarried) 2. Lagursday(Married) 3. Lafuray(Divorced) 4. Garoob(Widowed)	
103	Da'da ka qaybqataha o dhamestiran. Age (In completed) years.	_____	
104	Heerka waxbarshada abaha Father education.	1. Waxba mabaran(Illiterate) 2. Waxbrasha an caadi ahyn(Informal Education) 3. Waxbrasha caadi ah (Formal education) 3.1.Heerka waxbarashada (grade level)_____	
105	Shaqada abaha. Father work.	1. Muruq maal (Labour work) 2. Shaqala dowladeed(Civil	

		Servant) 3. Shaqa gaar ah (Private Worker(NGO) 4. Ganacsi (Trade) 5. Xirfadle (Professional (sida taqtar ,engirner,). 6. Arday(Student) 7. Shaqa la'an (Un employed) 8. Other_____	
106	Qiyas ahaan lacgta so gasha bishi abaha Estimated fathers monthly income	_____ Birr	
107	Heerka waxbarasha hoyada. Mather Education	1. Waxba mabaran(Illiterate) 2. Waxbrasha an caadi ahyn(Informal Education) 3. Waxbrasha caadi ah (Formal education)	
		3.1.Heerka waxbrasha (Grade level)_____	
108	Shaqada hoyada aay qabata. Mather work.	1. Guri jooga(House Wife)→ 2 Shaqaala dowladeed(Civil Servant) Shaqa gaar ah (Private Worker(NGO) 3 Ganacsi (Trade) 4 Xirfadle (Professional (sida taqtar ,engirner,). 5 Arday(Student)	Skip109

		6 Shaqa la'an (Un employed) 7 Other_____	
109	Qiyas ahaan lacgta so gasha bishi. Estimated mother monthly income.	_____Birr	
110			
111	Tirada qoyska ka koban yahay. Family Size.	_____	

B. Xalada cafimaaad ee isbuucyadi lasoo dhaafay(Past health status)

	Healthy Status			
S.N	Sualo(Question)		Coding categories	
201	Miyaad la dhiaatootay xanuunadan hoos ku xusun? (Did you suffer the following illness?)		Todobadii cisho ee u danbaysay (Last Seven days)	14 cisha u danbaaysay(Last 14 days)
	Shuban(Diarrhea)	1. Haa (Yes) 0. Maya (No)	◯	◯
	Xumad (Fever)	1. Haa (Yes) 0. Maya (No)	◯	◯
	Duuma (kaneenca)(Malaria)	1. Haa (Yes) 0. Maya (No)	◯	◯
	Duray (Cough)	1. Haa (Yes) 0. Maya (No)	◯	◯ ◯
	Others	_____	◯	
202	Xalda dhiga caadada Menstrual pattern	1. Si'aan joogta aheen(Irregular) 0. Si joogto ah		

		(Regular)	
203	Imisa bari ayaad ka socdaa dhiga caadada? For how long will continue menstruation?)	_____	

C. Individual dietary diversity questionnaire using 24 hour recall period.

S/N	Food Group	Waliga macuntay cuntadan ? Did you ever eat the following food? Yes=1 No=0	Hadeey haa suasha miyaad cuntay 24 saac ee laso dhaafay? If yes, did you eat the fallowing food items in the last 24hr? Yes=1 No=0	Hadi haa tahay imisa jeer ayd cuntaa maalinki? If yes, how many times per day?
301	Sorghum(Hadhuudh)	☐	☐	_____
302	Wheat (qamadi)	☐	☐	_____
303	Maize (galey)	☐	☐	_____
304	Barley(garbi)	☐	☐	_____
305	Rice (Bariisa)	☐	☐	_____
306	Pasta(Basta)	☐	☐	_____
307	Macaroni (basta gagab)	☐	☐	
308	Bean(digir)	☐	☐	_____
309	Lentil(misir)	☐	☐	_____
310	Nut(lows)	☐	☐	_____
311	Tomato(Yanaanyo)	☐	☐	_____
312	Salad(xabuub)	☐	☐	
313	Carrot (karoot)	☐	☐	_____
314	Green leafy vegetable Qudarta cagaran	☐	☐	_____
315	Onion (Basal)	☐	☐	_____
316	Garlic (toon)	☐	☐	_____
317	Pumpkin(bocorka)	☐	☐	

318	Potato (baradho)	☐	☐	_____
319	Cabbage(kabeech)	☐	☐	
320	Orange(Liin macaan)	☐	☐	
321	Lemom (liin dhanan)	☐	☐	
322	Mango (Canbo)	☐	☐	
323	Papaya (baabaay)	☐	☐	_____
324	Avocado (afokaadho)	☐	☐	_____
325	Banana(moos)	☐	☐	_____
326	Eggs (ukun)	☐	☐	_____
327	Fish (kaluun)	☐	☐	_____
328	Organ meat(liver, kidney, heart)(hiliobka sida beerkakilyaha, wadanaha)	☐	☐	_____
329	Meat(camel, lamb, goat)(hilibk lo'da,Gela,ariga).	☐	☐	_____
331	Salida, ama subaga.lagu daray cuntada Oil, and fat added to food(	☐	☐	_____
332	Milk(caano)	☐	☐	_____
333	Waxyaaba macaan sida sharabka Sweetened soda or sweetened juice drinks	☐	☐	_____

D. Aqoonta ay uleeyihin dumarka dhiig yaraanta (Knowledge toward anemia among adolescent girls)

Knowledge toward anaemia among adolescence girls		
NO	**Question and Filter**	**Coding categories**
401	Waligad maad maqashay ama maad taqaanaa dhiig yaraan? Have you ever heard or know about anaemia (blood deficient)?	1. Haa (Yes) 2. Maya (No)(skip up to 505)
402	Hadii aad maqashay halkeed ka maqashay? If yes, where do you get source of information	1. Macaliminta (Teachers) 2. Health provisional(Shaql Cafimadka) 3. Family members(Qoyska) 4. Media(Radio,Tv,New,Social(FB).(warbahinada) 5. Friends/neighbour(asaxabta amd Dariska?
403	Dhiigyaraantu mama cafimaad daraa? Is anaemia (blood deficient) a healthy problem?	1. Haa (Yes) 2. Maya (No)
404	Maxaa sababa dhiig yaraanta? What are the causes of anaemia (blood deficient)?	1. Cunta xummo(Poor diet) 2. (gooryaan (Worm infestation) 3. Dhiiga cadada (Menstruation) 4. Dhiig baxa booga (Bleeding from wound) 5. Uurka (Pregnancy) 99. Don't Know
405	Sideed ku garnaaysa hadii dhiig yaraan ku haaysa? How do you know if you have anaemia (blood deficient)?	1. Daaal iyo laciif jirka ah (Tiredness/body weakness) 2. Neefsashada oo idhibta (Shortness of breathing) 3. Waxbarshada oo an kari waya (Difficult to learn) 99. Don't know
406	Waa maxay cawaqibxumada ka dhalan karta dhiig yaraanta? What are the consequences of anaemia (blood deficient)?	1. Koriin yari(Impact on growth and development) 2. Waxbarsha ka dhacaan (poor school performance) 3. Shaqada kari wayaan(Decreased wok capacity) 99. Don't Know

407	Keeba cuntadan ku badantahay feerada? Which one of the following is Iron-rich food)	1. Qudaarta cagaaran (Green leaf vegetable) 2. Digirtta legumes) 3. Hilibka gela,lo'da. Ama digaaga) Meat and poultry 99. Don't Know

E:- Cabirka nafafaqadarada gabdhaha (ANTHROPOMETRIC MEASUREMENTS)

S/n	Measurement	Observed value
501	Dhereka(Height In cm)	_____,_____,_____,_____cm
502	Culayska(Wight In Kg(	_____,_____,_____,_____Kg
503	BMI for Age	
504	Hieght for age	
505	BMI	

F, Cabirka Dhiig (Hemoglobin measurement)

S/n	Test	Observed Value
601	**Haemoglobin mg/dl** (HemoCue hg 301+Analyser.)	_____
602	Altitude of each councils	_____