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ASSOCIATION BETWEEN DIETARY HABITS AND ANAEMIA AMONG PREGNANT ADOLESCENTS ATTENDING ANTENATAL CARE CLINICS IN THE UPPER EAST REGION

BY

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DECLARATION

I, Arafat Korlenya Hamid, declare that except the references and literature review of which has been duly acknowledged, this dissertation is a work I undertook under the supervision of Dr Adolphina A. Addo-Lartey. Furthermore, this work has not been submitted for any degree in any institution.

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Date: January 25, 2021

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Date: January 25, 2021

DEDICATION

I dedicate this work to my mother, Hajia Suweibatu Issah of blessed memory for her prayers, encouragement, and support of my pursuing the Master's programme while she was alive. She saw how it all started but not there to see its conclusion.

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I owe never-ending gratitude to the Almighty God for His grace and protection in the completion of this study.

Also, it has not been easy coming out with this work without the support given to me by all concerned. I say a very big thank you especially to my supervisor Dr Adolphina A. Addo-Lartey who guided me diligently with love, patience, care and also gave me suggestions and views to ensure the best is achieved with this work.

Special thanks go to the Regional Director of Health Services, District Directors of Health Services and Health Facility In-charges of the study locations as well as the Regional Nutrition Officer and her staff in the Upper East Region.

To all the Pregnant Adolescent Girls interviewed, Research Assistants, colleague health workers, and all who have in a way helped to make this work successful, I say thank you and I do appreciate the efforts contributed. May the Almighty God continue to bless us all.

ABSTRACT

The purpose of this study was to determine the prevalence of anaemia in pregnant adolescent girls (10-19 years of age) and dietary habits that affect this condition. This study also assessed the knowledge of the pregnant girls in the Upper East Region of Ghana. An analytical cross-sectional study design was employed between January and October 2020. A multistage sampling technique was used to identify the districts, health facilities and in the selection of study participants. In all, 331 pregnant adolescent girls were interviewed using a modified Food Frequency Questionnaire (FFQ). Capillary blood samples were taken from each respondent to test for anaemia using a portable HemoCue 301 analyser.

The collected data was cleaned, coded, and entered in Microsoft Excel 2016 and exported to STATA Version 15 for analysis. Frequencies and proportions were reported whiles associations between selected variables were explored using the Pearson's chi-square test at a significance level of P <0.05 at a 95% confidence interval.

A total of 331 pregnant adolescent girls from ages 13 – 19 years with a mean age of 17.94 ± 1.12 years took part in this study. The gestational ages of the pregnancies ranged from 8weeks to 42 weeks with the mean being 26.08±6.77 weeks. Anaemia prevalence based on the WHO classification for Haemoglobin (HB) concentration in the blood states that, for a pregnant woman, concentrations of less than 11.0g/dl indicates anaemia. Laboratory test done on the girls indicated that anaemia was high (65.86%). Moderately anaemic (HB less than 11.0g/dl to 7.0g/dl) girls were 34.14 % whiles 0.91% were severely anaemic (HB less

than 7.0g/dl). Consumption of meat ($p<0.001$), poultry ($p=0.001$), fish ($p<0.001$), liver ($p<0.001$), eggs ($p=0.007$), vegetables ($p<0.001$), fruits ($p<0.001$), legumes ($p<0.001$), tea ($p=0.001$), sweet beverages ($p<0.001$) and local juices ($p<0.001$) were found to be statistically associated with the prevalence of anaemia among the pregnant adolescent girls interviewed at the univariate level. However, at the multivariate level when all the factors were put in a model, consumption of meat (OR = 0.40; 95% CI [0.17, 0.88]), fish consumption (OR = 0.15; 95% CI [0.04, 0.51]), fruit consumption (OR = 0.35; 95% CI [0.13, 0.95]) and bread consumption (OR = 0.06; 95% CI [0.01, 0.62]) were found to be associated with anaemia prevalence. Meat and Fish consumption were found to be protective against contracting anaemia when consumed.

Knowledge on the causes, prevention, and complications of anaemia as well as the good sources of iron was generally high. However, knowledge of anaemia treatment strategies was low.

The findings of this study suggest that education of pregnant women should be an ongoing initiative to raise awareness and enhance compliance with supplementation. Complementary interventions such as fortification, dietary diversification, and the reduction of infections may also need to be scaled up to ensure that diverse iron sources are consumed as well as minimize iron losses.

These findings are of significance to public health practitioners in their efforts directed at the prevention of anaemia in the Upper East Region and Ghana as a whole.

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LIST OF ACRONYMS

ANC	Antenatal Care
ART	Antiretroviral Treatment
BMI	Body Mass Index
CDC	Center for Disease Control
DHIMS	District Health Information Management System
GDHS	Ghana Demographic and Health Survey
GHS	Ghana Health Service
GSS	Ghana Statistical Service
Hb	Haemoglobin
IDA	Iron Deficiency Anaemia
IFA	Iron Folic Acid
MOH	Ministry of Health
UNICEF	United Nations Children Fund
WHO	World Health Organisation

CHAPTER ONE

INTRODUCTION

1.1 Background

Adolescence as a period of human growth, ranging from 10 to 19 years of age (Ghongdemath, 2016). It is a critical stage in an individual's life marked by the onset of puberty (Ghahremani, Heydarnia, Babaie, Nazari, 2008) and also a transition period involving dramatic changes in physical, sexual, psychological, and social development, all of which take place simultaneously (Chauhan et al., 2015). It is also a significant phase of life when lifestyle behaviours, including dietary habits, are created and developed (Allafi et al., 2013). According to Allafi et al. (2013), adolescents are a segment of the population that is nutritionally vulnerable. The risk of nutritional deficiencies in adolescents increases with a rapid growth level combined with low nutrient intake (Allafi et al., 2013). The trace elements involved in the growth of adolescents include micronutrients such as iron and zinc (Urbano et al., 2002). During adolescence, especially for girls, there is a high demand for iron because of the onset of mensuration (Intiful et al., 2016), and a deficiency of it is a significant cause of anaemia (De Benoist & Mclean, 2008).

Anaemia is a disease in which the number of red blood cells or their oxygen-carrying capacity is inadequate to satisfy the needs of the human body (Goyal & Rawat, 2018). Anaemia has severe health and socio-economic consequences and affects low, middle and high-income countries across the globe (Munasinghe, 2014).

According to Intiful et al., (2016), anaemia has a lot of known causes, but anaemia due to deficiency of micronutrients like iron or vitamin B12 is the most common (Harika et al., 2017). This arises primarily due to insufficient dietary intake and/or insufficient absorption of the micronutrients, and/or due to frequent infections (Herrador et al., 2014). Malaria (Menendez et al., 2000); helminthic infestation, and inherited conditions like thalassemia and sickle cell trait (UNICEF, 2002) can all cause anaemia in an individual. Globally, iron deficiency is the major contributor to anaemia (Harika et al., 2017; Lubeya & Vwalika, 2017) and has been identified as the cause of approximately 90% of all anaemia cases (WHO, 2007) contributing to almost a million deaths annually; three-quarters of which occur in Africa and South-East Asia. (Stoltzfus et al., 2011).

Anaemia occurs in all age groups (Barragán-Ibañez et al., 2016) but the Ghana Demographic and Health Survey (2014) has shown it is most prevalent in pregnant women and young children under five years of age.

Known effects of anaemia during pregnancy are elevated risk of low birth weight, preterm birth, perinatal and neonatal mortality. (Rahman et al., 2016). According to Black et al., (2013), anaemia during pregnancy places the mother at increased risk of death during and after childbirth.

Dietary practices of individuals determine their nutritional and health status (Keding et al., 2011). This is crucial in adolescence because studies have shown that adolescents tend to lack an understanding of healthy dietary habits (Bester & Schnell, 2004; Fulkerson et al., 2008; Hassapidou et al., 2006; Onyiriuka et al., 2013). As a group, adolescents are

incredibly receptive to new foods and fast foods, mainly due to peer group influence (Salvy et al., 2012). As a result, their eating habits tend to be dynamic and alter over time which can expose them to a lot of diseases and conditions such as obesity as reported by Matthews, Wien, & Sabaté, (2011) and attempts in nations to address the eating behaviour and a myriad of others in this age group must include enhanced attention to proper dietary habits.

According to Allafi et al. (2013), lifestyle behaviour patterns developed in the early years can have significant health and well-being consequences in the future. Poor nutritional status during adolescence is an essential determinant of health outcomes at a later stage of life. Pregnant adolescent girls constitute an essential segment of the population whose nutritional needs are already increased by their physiological development. Also, their nutritional status affects that of the baby because as an adolescent mother struggles to complete her growth, she also needs more nutrition to support foetal growth (Gurung & Ghimire, 2016).

1.2 Problem Statement

According to the World Health Organisation, one of the most common and widespread disorders in the world, which is a public health problem in both industrialised and non-industrialised countries is anaemia. (WHO, 2005). De Benoist & Mclean, (2008) reported in the WHO Global Database on anaemia that, globally 1.62 billion people (25% of the population) are anaemic, among which 56 million are pregnant women. The World Health Organisation states that any country with anaemia prevalence rate greater than 40% is

considered to have a high prevalence rate (WHO, 2008). Anaemia affects 57% of pregnant women in Africa, and 48% of non-pregnant women (including teenagers) (Ayoya et al., 2012). Ayoya et al. (2012) also reported that anaemia prevalence among pregnant women was higher than 50% in other African countries like Benin, Gambia, Mali, Senegal, and Cameroon which has settings similar to Ghana.

Ghana also shares in the burden of nutritional problems like anaemia. According to the Ghana Demographic and Health Survey's report in 2014, 42.4% of Ghanaian women aged 15–49 years were anaemic, 32.2 per cent had mild anaemia, 9.8 per cent with moderate anaemia, and 0.4 per cent having severe forms of anaemia (GDHS, 2014). In a recent survey conducted by the University of Ghana, GroundWork, University of Wisconsin-Madison, KEMRI-Wellcome Trust, and UNICEF in 2017 to measure the prevalence and severity of anaemia in children 6-59 months of age, non-pregnant women of child-bearing age, and pregnant women based on blood haemoglobin concentrations found similarly high levels of anaemia (43.5%) among pregnant women in the Northern belt of Ghana (Ghana Micronutrient Survey, 2017).

A study carried out by Intiful et al., (2016) in Accra, Ghana involving pregnant adolescent girls found that 76.1% had anaemia, with 47.8% being mildly anaemic, 27.5% were moderately anaemic, and 0.8% were severely anaemic. In the Upper East Region, adolescent pregnancy is on the rise with data from the Ghana Health Service District Health Information Management System indicating that for every five pregnant women attending ANC, one is an adolescent. It further states that, for every two women registered for

antenatal care in the Upper East Region, one is anaemic (GHS DHIMS, 2019). These have been continuously reported for 2017, 2018, and the first half of 2019 in the Upper East Region.

Several other studies have also identified many factors that contribute to the prevalence of anaemia among women in the reproductive age group (15-49-year olds), Malaria and pica (Intiful et al., 2016), iron deficiency, and inadequate feeding practices (Santos Da Silva et al., 2018) have all been outlined as being risk factors associated with the high anaemia prevalence reported in those studies.

Anaemia is associated with adverse health outcomes for both mother and infant. According to Brabin, Premji, & Verhoeff, (2011), consequences of maternal anaemia include fatigue, decreased work capacity and poor pregnancy outcomes like preterm birth, low birth weight (Zhang et al., 2009), and increased risk of maternal death both during delivery and the postpartum period (Rasmussen, 2018). Anaemia in pregnant women is a catalyst for low birth weight and haemorrhage during and after delivery, which consequently escalates the possibility of maternal mortality (Rasmussen, 2018). Anaemia is still causing many deaths in maternities, even though it can be treated with regular intake of iron, as seen in Bangladesh, where it is improved by iron supplementation in pregnant women and non-pregnant women (Khambalia, Aimone, & Zlotkin, 2011).

1.3 Conceptual Framework

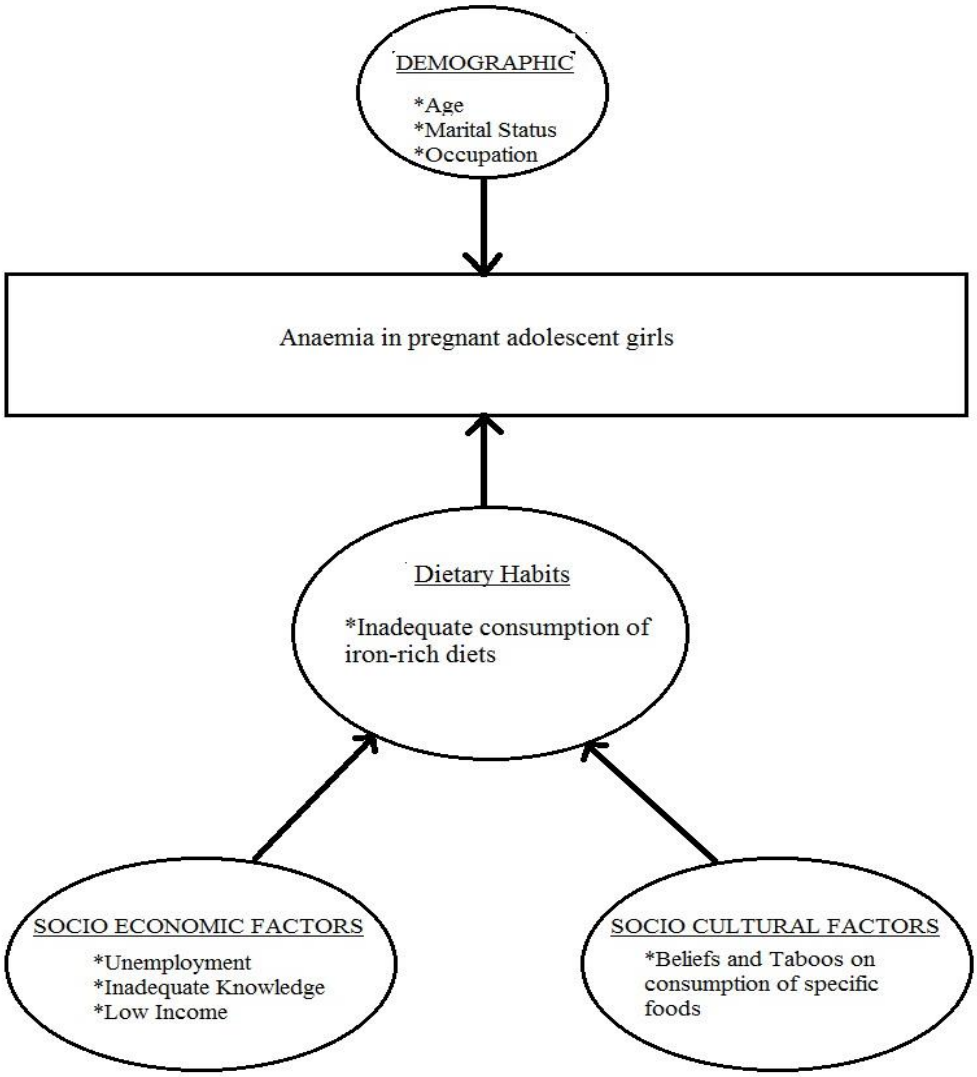

Figure 1.1: Conceptual Framework of factors influencing anaemia

1.3.1 Narrative on the conceptual framework

The framework attempts to explain the influence of various risk factors that lead to anaemia in pregnant adolescents. Dietary habits, socio-economic factors, socio-cultural factors, and demographic factors directly or indirectly lead to a pregnant adolescent girl being anaemic.

The educational level of a pregnant girl among socio-economic factors affects her level of anaemia awareness and her view of the risk of anaemia during pregnancy. Well informed teenagers have a better understanding of the risk of anaemia and would be aware of the possibility of anaemia during pregnancy (Messina, Mwandagalirwa, Taylor, & Meshnick, 2013).

Adolescents with some education are likely to be engaged in employment earn better incomes than those who have not acquired any education. Thus they can purchase the quantity and quality of foods that can continuously restore their depleted iron stores and further provide them with the essential micronutrients. The prevention of anaemia based on the household purchasing the right quantity and quality of foods also depends on the wealth status of that household. Adolescents living in houses where the heads have a robust economic capability can be supported to purchase foods rich in iron to boost their stores.

Inadequate or insufficient intake of iron-rich foods (Animal source foods, vitamin C rich fruits, and Iron Folic Acid Supplementation) or the consumption of iron inhibitors (teas, coffee, or high fibre foods like maize meal) in the diets of a pregnant adolescent can cause anaemia. Vitamin C has been shown to enhance iron absorption. It helps in making iron to be in a form that is more easily absorbed by the body. Hence, not consuming vitamin C rich foods can affect iron availability which can lead to anaemia. Coffee and other drinks containing caffeine can reduce iron absorption, which leads an individual to be anaemic (Hurrell & Egli, 2010).

The cultural beliefs and practices of an individual can expose them to anaemia during pregnancy (Messina *et al*., 2013). Food taboos are widespread in some cultures in Ghana. For instance, pregnant women are forbidden from eating snails, rats, snakes, hot foods, and animal lungs (Arzoaquoi et al., 2011). This directs the dietary habit of the pregnant woman and can expose her to anaemia. Also, other beliefs such as pregnant women should not take in fruits like mangoes during pregnancy shape the dietary pattern of the pregnant adolescent which can interfere with iron bioavailability in the diets and thereby leading to anaemia.

The age of a woman has a bearing on her need for iron and other minerals of which plays a crucial role in the person developing anaemia if there is a deficiency. An adolescent pregnant woman, first of all, will need iron to support her life processes and then to cater to the growing foetus. This double demand exposes them to being anaemic if care is not put in place.

1.4 Research Questions

1. What are the dietary habits of pregnant adolescents in the Upper East Region?
2. What is the prevalence of anaemia in pregnant adolescents in the Upper East Region?
3. What is the knowledge of pregnant adolescents on the causes, prevention, treatment, and complications of anaemia?
4. What dietary habits are associated with anaemia among pregnant adolescents?

1.5 Justification

Available service data from the Ghana Health Service District Health Information Management System reports for the Upper East Region indicates that more adolescents are getting pregnant (GHS DHIMS, 2019). Additionally, half of the pregnant women in antenatal clinics for the year 2017, 2018, and January to June of the year 2019 were anaemic (GHS DHIMS, 2019).

Dietary habits have been identified as a significant contributor to anaemia in studies conducted (Kao et al., 2019; WHO, 2011). Research into the prevalence and determinants of anaemia among pregnant adolescents is essential for deciding control strategies in this age group. While this has been studied in other regions and countries across the globe, not so much has been done in Ghana. Few studies conducted in Ghana on the prevalence of anaemia among women reported a very high prevalence among the study populations (GDHS 2014; Ghana Micronutrient Survey, 2017). In a study involving pregnant adolescent girls in Accra which is the most urbanised settlement in Ghana, a very high prevalence of anaemia was reported by Intiful et al., (2016) among the studied individuals.

Despite these few studies conducted in Ghana, no study has been seen to have focussed on pregnant adolescents in the Upper East Region of Northern Ghana.

Therefore, this present study aims at investigating dietary habits, intake of iron-rich foods among pregnant adolescent girls of the Upper East Region, with a particular focus on the prevalence of anaemia and appropriate knowledge about it among them.

This is particularly crucial because available literature indicates that in entirety, pregnant adolescents will need more iron to cater to their physiological development and the growth of the developing foetus.

The findings of this study could be critical in our understanding of the relationship between dietary habits and anaemia in adolescents which is vital to formulating the appropriate intervention programmes to solve nutritional problems among adolescent girls.

1.6 Research Objectives

1.6.1 Main Objective

To assess dietary habits and their association with anaemia in pregnant adolescent girls in the Upper East Region of Ghana

1.6.2 Specific Objectives

1. To assess the dietary habits of pregnant adolescent girls in the Upper East Region
2. To determine the prevalence of anaemia in pregnant adolescent girls in the Upper East Region
3. To assess the knowledge of pregnant adolescents on the causes, prevention, treatment, and complications of anaemia
4. To examine the association between dietary habits and anaemia among pregnant adolescents

CHAPTER TWO

LITERATURE REVIEW

The ultimate goal of reviewing the literature on the different concepts associated with this study is to ensure that the reader is up-to-date on the topic of the study. This chapter examines the statements and writings of other people in the field to help establish how dietary habits and anaemia are related in pregnant adolescent girls in the Upper East region. This study will examine the lessons learned. This chapter will highlight the concept of adolescent and adolescent pregnancy, dietary habits and anaemia will also be discussed.

2.1 Adolescence

An adolescent, according to the World Health Organization, is defined as an individual within ages 10-19 years (Chauhan et al., 2015). Adolescents are a heterogeneous population group with varied requirements, and their needs are determined by their age (early, middle, and late adolescence), gender (male/female), marital status, residence (urban/rural), educational, socio-cultural, and financial status (WHO, 2011a). Adolescence is a critical stage in the life of an individual and often characterised by the onset of puberty (Ghahremani et al., 2008) and the establishment of social independence (Steinberg, 2014).

2.1.1 Adolescent Pregnancy

Pregnant adolescents refer to girls from ages 10 – 19 years who have had the experience of being pregnant. Adolescent pregnancy is most often related to vulnerable social and economic conditions (Sedgh et al., 2015). Globally, adolescent pregnancies are seen as a

significant public health concern (WHO, 2018). About 21 million adolescent girls aged from 15-19 years in low-and middle-income countries are predicted to get pregnant and about 16 million of them are expected to give birth annually (Darroch J, Woog V, Bankole A, 2016).

According to Burton (2017), the highest rates of adolescent pregnancy are currently seen in Africa. Records available to Odimegwu & Mkwananzi, (2016), indicates that sub-Saharan Africa has the highest prevalence of adolescent pregnancy in Africa. From their report, Eastern Africa has an adolescent pregnancy rate of 16.3 per cent, Western Africa 27.9 per cent, and Southern Africa has 28.9 per cent adolescent pregnancy rate (Odimegwu & Mkwananzi, 2016).

Ghana, reported in the Demographic and Health Survey of 2014 that about 14 per cent of adolescent girls between 15 and 19 years of age had began bearing children while about 11 per cent off them have had live births.

2.1.2 Factors contributing to adolescent pregnancy

Adolescent pregnancy is the consequence of several causes, including the traditional norms of culture, such as early marriage (Gideon, 2013), the use of Child-bearing to assess how mature an individual is and also to obtain consideration from the community (Gyesaw & Ankomah, 2013), violence in communities and sexual abuse (Brahmbhatt et al., 2014), low levels of education (Faisal-Cury, Tabb, & Niciunovas, 2017; Dev Raj, Rabi, Amudha, Teijlingen Edwin, & Glyn, 2010), and peer pressure or influence from peers (Mushwana

et al., 2015). Additionally, according to Hindin & Fatusi, (2009), other factors that also cause adolescent pregnancies are the sexual behaviours of the adolescents. These include, indulging in unprotected sex and/or avoiding the use of contraceptives (Hindin & Fatusi, 2009), early start of sex, frequent intercourse, and consumption of alcohol (Panova et al., 2016). Also, family reasons such as divorce or broken homes (Panova et al., 2016), history of mothers or siblings being pregnant adolescents (Akella & Jordan, 2015; East, Reyes, & Horn, 2007), and economic status of the family (Akella & Jordan, 2015; Madise, Zulu, & Ciera, 2007) and influence by media on early sexual behaviour of adolescents as a risk factor of adolescent pregnancy (Martino, 2008) have all been found as contributing to adolescent pregnancies.

2.1.3 Implications of Adolescent Pregnancy

Adolescent pregnancies lead to many issues with health as teenagers enter maternity before they are physically and psycho-socially prepared (Godding, 2008; M.S.Richter, 2005). Adolescent pregnancy is correlated with a greater danger of maternal and neonatal problems (Abbas et al., 2017). Adolescent parents are in danger of problems such as hypertensive pregnancy disorders, spontaneous abortion, urinary tract infections, and early foetal membrane rupture (Azevedo et al., 2015). Others include a higher risk of malnutrition, anaemia, sexually acquired diseases, and a high rate of instrumental deliveries and caesarean section (Najati & Gojazadeh, 2010). Complications resulting from pregnancy and childbirth constitute a significant cause of mortality among teenage women globally (World Health Organization, 2016).

Furthermore, various studies in the world have shown that pregnant adolescents are more likely to have complications. The occurrence of eclampsia in the teens and increased caesarean section levels in India, Aznar & Bennett, (1961) have told. Four of the seven studies in developing countries, which were included in a study by Scholl, Hediger, & Belsky, (1994), showed an increased prevalence of anaemia in young pregnant women. A study by Wiesenfeld, Lowry, & Heine (2001) has shown that 1 in 5 adolescents had an unexplained Sexually Transmitted Infection. Similar other findings in global reports were higher vaginal operative delivery levels (Konje et al., 1992), higher induction levels (Jolly et al., 2000), lower oxytocin incidences in adolescents (Lubarsky et al., 1994). Among developed countries, among children born to teenage mothers, the incidence of low birth weight (LBW) was lower than in infants born to older mothers (Miller & Plant, 1996).

2.2 Anaemia

Anaemia is a reduction in the total amount of red blood cells (RBCs) or haemoglobin in the blood (Macdonald et al., 2007; Rodak et al., 2012). According to the World Health Organisation, (2001), anaemia is said to be a condition in which the amount of red blood cells or their oxygen-carrying capacity is inadequate to fulfil the physiological requirements of the body that differ in age, sex, altitude, smoking and pregnancy. (WHO, 2001).

2.3 Burden of Anaemia

Anaemia is a pervasive global public health problem affecting the world's population (WHO, 2001). In developed countries (mainly South Asia as well as Sub-Saharan Africa),

anaemia prevalence is high with about 36 per cent of the overall population in these countries estimated to be anaemic compared with 8 per cent of the population in developed countries (De Benoist & Mclean, 2008) with the most vulnerable group affected being females (Robinett et al., 1996).

2.4 Measurement of anaemia

Iron deficiency is frequently shown to be a progressive condition that starts with a normal iron status that becomes subnormal or deteriorates due to a low dietary intake of iron, inadequate absorption of iron, or increased loss of iron. Some common anaemia symptoms include exhaustion and weakness, rapid or irregular heartbeat, body pain, pale skin and lips, cold hands and feet, concentration disorders (American Pregnancy Association, 2019)

Worldwide, the most widely used method of screening individuals or populations for iron deficiency involves determining the prevalence of anaemia by measuring blood haemoglobin or haematocrit levels (WHO, 2001). According to the World Health Organisation (2001), there are globally accepted values of haemoglobin that determine anaemia in individuals. For pregnant women, anaemia is considered to exist when haemoglobin (Hb) level is below 11gm/dL, with Hb between 10.0 - 10.9 g / dL termed as mild, moderate anaemia being Hb between 7.0 - 9.9 g / dL. A pregnant woman with haemoglobin <7.0 g/dL is said to be severely anaemic and requires medical treatment. (WHO, 2001).

Severe anaemia is an important risk factor for pregnant women and has a significant increase in morbidity and death. Effectiveness in diagnosis and medical follow-up for individuals is critical in avoiding complications. In poor conditions where routine haemoglobin and haematocrit laboratory screening is not available, clinical signs should be routinely used to monitor people. This check should be used before life-threatening problems start to affect people at high risk. Subjects with severe anaemia can usually be detected by clinical examination for paleness of the eyelids (conjunctiva), Intraoral cavity, lips, nail beds, skin, and palms (Esper, 2015).

While watching the body, the clinician should look at the colour, texture, temperature, humidity, lesion and flexibility, and turgor changes throughout the entire skin surface (Esper, 2015). Skin-coloring is affected by blood flow, thickness, and melanin (Bickley & Szilagyi, 2012). Lip/tongue, mucous membranes, fingernails, palms, hands, and feet may be noticed with colour changes in the skin. In the overall appearance of the pallor (unusual skin lightness compared to a normal colour), the lower eyelid, nail beds, and language can be observed. These findings associate with vitamin deficiencies of iron and/or B-complexes as they are part of haematological processes.

According to Esper (2015), conditions that cause a decreased level of haemoglobin may cause paleness in the skin or mucous membranes and may occur under the following conditions: alcoholism, long-term parenteral nutrition (PN) support, and partial gastrectomy patients (Mueller, 2017). Nails Color, capillary refill, and texture should be examined. From the vascular nail bed, to which the nail plate is firmly attached, it gets a

pink colour (Bickley & Szilagyi, 2012). Anaemia may occur when the colour of the bed of the nail becomes pale or whitish (Sheth et al., 1997). A quick experiment is carried out by pressing the nail bed to check if the pinkish colour returns within 2 seconds.

2.5 Types of anaemia

Red blood cell size and the amount of haemoglobin in each cell can be used in the classification of anaemia (Janz et al., 2013). According to Janz et al., (2013), if the size of the red blood cells is small, it results in what is called microcytic anaemia; if the cells are large, the resulting form of anaemia is macrocytic anaemia; and if the cells are normal sized, it is called normocytic anaemia (Janz et al., 2013).

2.5.1 Microcytic Anaemia

Microcytic anaemia is due to the deficient synthesis of haemoglobin which may be due to inadequate heme production which may affect the 3 components of haemoglobin which are iron, globin, and porphyrin (Erber, 2011). Deficiency of iron results in iron-deficiency anaemia (Kumar, 2014) which is a condition where there is a reduced amount of haemoglobin and a decreased number of red blood cells in the body (WHO, 2017). Sometimes the word "anaemia" is synonymous with "iron deficiency anaemia." Anaemia results in less oxygen, reaching cells and tissues of the body, thereby affecting their function (Thoradeniya, Wickremasinghe, Ramanayake, & Atukorala, 2006). The most common cause of anaemia is iron deficiency (Erber, 2011). According to Milman (2011), Iron is an essential human mineral and a significant metalloprotein component involved in transporting oxygen and metabolism.

Nearly two-thirds of iron is found in haemoglobin, the red blood cell protein, which carries oxygen to the tissue of the body (Milman, 2011). Iron is compulsory in red blood cell progenitors for the production of haemoglobin (erythroblasts) and, where there's insufficient bone marrow iron, there is no production of haemoglobin, and the number of red blood cells decreases in the circulation. This then leads to the development of low-haemoglobin Iron Deficiency Anemia (IDA). A characteristic of the IDA is that it can be fixed or healed by iron therapy, either by oral or intravenous iron treatment (Milman, 2011). There are 2-5 times as many iron-deficient people as iron-deficient-anaemics and about 3.3 million women of childbearing age being iron deficient-anaemics (WHO, 2001).

Besides iron deficiency, there are also many causes of anaemia, especially in tropical areas. Globin reduction or its absence in the chains of haemoglobin results in thalassemia (Farashi & Harteveld, 2018). The thalassemias are typically found in patients originating from Africa, the Mediterranean, Middle East, Southeast Asia, and the Indian subcontinent. Thalassemias have a broad spectrum of presentation, depending on the severity of the globin chain defect. Patients with severe forms of this disorder are diagnosed in childhood. In adults, a diagnosis of thalassemia is usually considered when patients originating from one of the regions of the world mentioned previously are incidentally found to have hypochromic, microcytic anaemia but no evidence of iron deficiency (Erber, 2011).

Deficiency of porphyrin results in sideroblastic anaemia (Erber, 2011). Sideroblastic Anemias (SAs) are disorders of ineffective erythropoiesis, collectively characterized by

abnormal granules that encircle marrow erythroblast nuclei to form ringed sideroblast cells (Alcindor & Bridges, 2002). In sideroblastic anaemia, the body has an iron store available but cannot incorporate it into haemoglobin, which red blood cells need to transport oxygen efficiently (Erber, 2011).

2.5.2 Macrocytic Anaemia

Macrocytic anaemia occurs in two forms, megaloblastic (hyper-segmented neutrophils), and non-megaloblastic (Moore & Adil, 2018). The megaloblastic type is caused by a deficiency in DNA synthesis from folate and/or vitamin B12 (Brabin et al., 2018) because of a delay in cell division (Naeim et al., 2013), while the non-megaloblastic results from various mechanisms (Brabin et al., 2018; Válka & Čermák, 2018) such as consumption of alcohol, hereditary spherocytosis, hypothyroidism, and liver disease and marked reticulocytosis from excess RBC consumption such as hemolytic or pregnant turnover or bone marrow primary disorder (Moore & Adil, 2018).

2.5.3 Normocytic Anaemia

Normocytic anaemia is classified as being due to primary bone marrow involvement or a secondary marrow response due to an underlying disease. (Brill & Baumgardner, 2000) stated in their Normocytic anaemia evaluation paper that, Normocytic anaemias may be represented as any of the following: a decreased production of normal-sized red blood cells (e.g., anaemia of chronic disease, aplastic anaemia); increased destruction or loss of red blood cells (e.g., hemolysis, posthemorrhagic anaemia); an uncompensated increase in plasma volume (e.g., pregnancy, fluid overload); or a mixture of conditions producing

microcytic and macrocytic anaemias. Of all, the most common normocytic anaemia in the world is anaemia of chronic disease (Krantz, 1994) which is found in 6 per cent of adults attended to by medical professionals (Brill & Baumgardner, 2000). However, in the initial stage of anaemia, almost all are normocytic (Brill & Baumgardner, 2000). The aetiology of anaemia of chronic disease is multifactorial and is linked to bone marrow hypoactivity with a relatively weak erythropoietin production or an inadequate erythropoietin response, as well as a slightly reduced red blood cell survival (Brill & Baumgardner, 2000).

2.6 Knowledge on Anaemia

2.6.1 Causes of anaemia

The leading cause of anaemia among pregnant women and adolescents is the insufficient consumption of iron-rich diets (McClure et al., 2014; Ononge et al., 2014) and lack of intake of fruits (Alquaiz et al., 2015). Iron deficiency, micronutrient deficiencies like folate, vitamin B12, vitamin A, vitamin D (Özsoylu & Aytekin, 2011), vitamin C (Alexandrescu et al., 2009), parasitic infections such as malaria and hookworm, or chronic infections like TB and HIV (Brooker et al., 2008; Msuya et al., 2011; Okube et al., 2015), hereditary conditions such as thalassaemia (World Health Organization, 2005) and toxins like lead in the atmosphere (Choi & Kim, 2005) are other factors that cause anaemia.

In essence, insufficient dietary iron intake can cause iron deficiency. Dietary studies have found that the dietary intake of iron is too low in some populations, even in developed countries (Pedersen AN et al., 2010). The average nutritional intake of Danish women of

childbearing age, for example, is 9 mg daily iron (Pedersen AN et al., 2010); over 90% of women have lower intake than the suggested daily intake of about 18 mg (Rad, 2005).

According to Milman (2011), dietary iron is made up of heme iron and non-heme iron. Heme iron has good bio-availability leading to favourable absorption of gastrointestinal iron, while non-heme iron is poorly bioavailable suggesting poor absorption of iron. In animal foodstuffs (meat, poultry, fish), heme iron is available, while in plant foodstuffs (vegetables, cereals, grains, and legumes) non-heme iron is predominantly found. Furthermore, meat provides the so-called "meat factor" which increases non-heme iron absorption. Those who regularly eat animal foods are, therefore, less at risk of iron deficiency than those who primarily consume plant foods (Milman, 2011).

Folate deficiency in the body is primarily a diet issue and is caused by malabsorption, excess loss, increase in demand, drug effects, and metabolic defects (Naeim, 1998). The heat-labile folate is found in different green vegetables, yeast, mushrooms, kidney, and liver (Naeim et al., 2013).

Alexandrescu et al., (2009) state that deficiency in vitamin C can lead to iron deficiency and IDA as a result of iron absorption being impaired and profuse gastrointestinal bleeding (Alexandrescu et al., 2009). According to Pattnaik, Patnaik, Kumar, & Sahu, (2013), excessive menstrual bleeding can cause anaemia, especially in girls beginning menarche with severe menstrual bleeding (Pattnaik et al., 2013; Rati & Jawadagi, 2012).

Some other causes that could affect the occurrence of anaemia in pregnancy include demographic, cultural, and socioeconomic factors. Haemoglobin distributions vary with age and gender, being overweight, having a positive family history of IDA (Alquaiz et al., 2015), stage of pregnancy, and altitude and smoking (WHO, 2001). Education is a significant driver of teenage girls ' anaemia. A study on women's education and their diet indicated that low maternal educational attainment (Al Zabedi et al., 2014; Pattnaik et al., 2013; Premalatha et al., 2012) and women's socio-economic status (Alquaiz et al., 2015) were significant links to nutritional deficiency, anaemia, and disease prevalence. Adolescent girls with lower educational attainment also have a higher risk of anaemia (Kulkarni et al., 2012) and equally, there is evidence that parental educational status as well predicts anaemia among adolescent girls (Nelima, 2015). Household socio-economic status is also a risk factor for anaemia among adolescent girls (Seid Adem, 2015). Studies conducted across different countries support this finding (Al Zabedi et al., 2014; Pattnaik et al., 2013; Rati & Jawadagi, 2012). Women with low-incomes are more likely to have anaemia (Bilenko et al., 2004).

Studies conducted by Chauhan, Chauhan, & Bala (2015) indicate that the occurrence of anaemia in adolescents increases with age, and it corresponds with the highest acceleration of growth that occurs during adolescence. In a survey done by Singh et al., (2006) in sixteen districts of India, the prevalence of anaemia among adolescent girls was found to be as high as 90.1%. As women grow from puberty to menopause, additional iron is needed due to the increase in requirements due to the increased physiological changes they undergo and also due to blood loss during monthly menstruation.

2.6.2 Prevention and management of Anaemia

There is general agreement that sustained ingestion of bioavailable iron in foodstuffs and reducing iron losses throughout life-cycles are the most desirable, long-lasting, and safe strategies to control iron deficiency. According to the Maternal and Child Health Integrated Program, (MCHIP, 2019), existing scientific evidence shows that routine iron and folic acid (IFA) supplementation is effective for the prevention of anaemia, where there is a high prevalence. This supplementation can be either during the entire pregnancy period or pre-pregnancy (Howson et al., 1998). This was evident in a review of studies conducted from 1966 to 1989 by (Sloan et al., 1992) which indicated that iron supplementation during pregnancy reduced the prevalence of haemoglobin values less than 10.5g/dl drastically. According to Howson et al., (1998), if a woman enters into pregnancy with appropriate iron stores, she is more likely to go through pregnancy and the complete reproductive cycle without iron deficiency. The best potential for reduced iron deficiency is a preventive supplementation pre-and post-pregnancy (Howson et al., 1998).

In addition to IFA supplementation, a successful way to reduce the prevalence of anaemia among pregnant women and those in their reproductive age could be the inclusion of other important evidence-based interventions such as antimalarial and deworming (MCHIP, 2019). The routine administration of intestinal anthelmintic drugs has a positive effect on haemoglobin. This has been shown by Gulani, Nagpal, Osmond, & Sachdev, (2007) in their systematic review of randomised controlled trials where they found that the routine use of intestinal anthelmintic leads to an increase in haemoglobin that could lead to a

reduction of anaemia in populations with a relatively high prevalence of intestinal helminthiasis on a public health scale.

According to the World Health Organization (2001), nonheme dietary iron bioavailability can be enhanced by reducing the intake of inhibitors of absorption (e.g. phytates and polyphenols) while increasing intake of enhancers (e.g. ascorbate) by optimizing food preparation and food patterns. It is also recommended by the American Pregnancy Association (2019) that a pregnant woman eats enough foods such as lean, red meats and poultry, eggs, dark, leafy green vegetables (such as broccoli, kale, and spinach), nuts and seeds, beans, lentils, and tofu that are rich in iron each day and also adding vitamin C rich foods as they can help the body absorb more iron. Examples of foods rich in vitamin c are citrus fruits and juices, strawberries, oranges, kiwis, tomatoes, bell peppers (American Pregnancy Association, 2019).

Birth spacing is also an excellent measure to help prevent anaemia in women. Pregnant females are particularly vulnerable due to the double need for growth and reproduction (Osofsky et al., 1971). Birth spacing can thus be an efficient iron deficiency control prevention measure in adolescents and adult women. Multiparous women have more risk of iron deficiency and anaemia, as confirmed by epidemiological data (Andrade et al., 1991). According to Andrade et al., (1991), more menstrual flows are associated with multiparity and higher chronic iron losses. During the postpartum period, the lactation and associated amenorrhea favour a positive iron balance. Hormone contraceptives reduce menstrual flow by half (Cole et al., 1971)

2.6.3 Effects/Complications of anaemia

Anaemia is one of the most common nutritional problems, particularly in developed countries (World Health Organization, 2001) has the main health effects of impacting on cognitive and physical development in childhood (World Health Organization, 2001, 2005), thereby limiting their school achievement and eventually reducing educational investment benefits. Experimental studies have shown that iron deficiency in animals and people can cause cognitive disorders as a result of damage to the mitochondria of the brain (Tamura et al., 2002). The main issues relating to concentration, intellect and sensory perceptions, and those relating to emotion or conduct are the cognitive impairments caused by iron deficiency anaemia (Sandstead et al., 2000).

Additionally, the effects of anaemia include its ability to reduce adult work capacity and the risks of mother-and-child death, morbidity and poor pregnancy results (World Health Organization, 2005). Usually, there are no signs of complications with a mild case of anaemia. In a severe case, however, extreme fatigue and tiredness may occur. In a systematic review of the research literature on both animal and human studies to determine a causal relationship between iron deficiency and reduced work capacity, Haas & Brownlie (2001) found that there was enough evidence to suggest that a robust causal relationship exists between all levels of iron deficiency and voluntary physical activity. Women with mild anaemia have reduced work capacity during pregnancy. If the work involves manual work, they can't earn their living (Kalaivani, 2009). Women with moderate anaemia have

significantly reduced working capacity, and household tasks and childcare may be challenging to cope with.

Anaemia can lead to obstetric and foetal complications. Ivan & Mangaiarkkarasi (2013) stated in their work on the evaluation of anaemia in booked antenatal care mothers during the last trimester that obstetric and foetal complications were seen in 85% and 64% of anaemic mothers. Prolonged pregnancy, uterine fatigue, and postpartum bleeding, and a case of diffused intravascular coagulation are some of the maternal problems found. Foetal complications included low weights at birth low APGAR scores and asphyxia at birth. Perinatal mortality rates increase when maternal haemoglobin levels fall below 8g/dl. (Kalaivani, 2009). The information available from both India and others shows that maternal morbidity rates are higher in women with HB below 8gm/dl. (Prema et al., 1981). They are more likely to suffer from infections and can take longer to recover from infections. For women with mild anaemia, premature births are more likely. They give birth to babies with lower birth weight and higher perinatal mortality (Prema et al., 1981).

2.7 Dietary Habits

Dietary habits as part of the lifestyle of an individual is an essential determinant during childhood and adolescence (Baskova et al., 2014). The diets people eat, in all their cultural variety, define to a large extent people's health, growth, and development. Diet and nutrition are essential factors in the promotion and maintenance of good health throughout the entire life course (Abdel-Hady et al., 2014).

Literature reviews have consistently concluded that clear causal links exist between food intake and significant causes of morbidity and mortality. Changing dietary patterns are vital to understanding the development of anaemia. Nevertheless, teenagers are not just worried about dieting but also critical about their dietary habits and activities (Richard Shepherd & Dennison, 2018). Adolescents reinforce dietary behaviours and habits established during childhood and follow them to adulthood. Tracking the correlation between early measurements and measurements in later life as opined by Twisk, Kemper, & Mellenbergh, (1994) appears to be sustained in patterns of dietary consumption, although evidence suggests that habits formed in younger years remain till adulthood (Boulton et al., 1995; Nicklas, 1995).

Unhealthy eating behaviour, especially snacking (normally energy-dense foods), skipping meals (especially breakfast), erratic eating patterns, high consumption of fast foods and sweetened drinks as well as a low intake of fruit, vegetables, and dairy products were found to be linked to obesity and poor nutritional qualities. (Fulkerson et al., 2008; Greenwood & Stanford, 2008; Scully et al., 2009). In some adolescents, there are low nutrition values, fad diets, and vegetarian experiments (Bailey et al., 2001; Thomas-Ames, 2001).

Alcohol consumption, which is also a bad habit starts in many cultures in adolescence (often beginning with cigarettes and other medicines), with binge drinking becoming a problem (Stang et al., 2005). Consuming a healthy, high-quality diet will deliver optimal nutrition and health benefits to a person. Nevertheless, it is often not known how high a diet or how much nutrients are needed to deliver the right amount to the body. A high-

quality diet in the poorer countries has traditionally been equalled to a diet with sufficient energy and nutrients. However, with the global dietary patterns undergoing radical changes (concentration of sugar, salt, and saturated fats while low in fruit, vegetables, and cereals in whole grains), it should be stated that it is not only a shortage of food and food intake that results in malnutrition (overnutrition, undernutrition, and micronutrient deficits) but also a lack of high-quality diets. A healthy, high-quality diet should contain enough nutrients, very little saturated fat, trans fats, cholesterol, sodium, and added sugar but also many portions of fruit, vegetables, and whole grains (Hawkes et al., 2005).

2.8 Relationship between Dietary habits and anaemia

Unhealthy eating behaviour and habits have been found in several studies to be a significant contributor to the prevalence of anaemia and other undesirable health outcomes in the studied populations. For instance, in a study by Waters, Morley, & Rankin, (1966) on the effect of alcohol on haemopoiesis, they found that anaemia is common in persons with alcoholic cirrhosis. Additionally, Sharma, Soni, Murthy, & Malhotra, (2003) in a study on the effect of dietary habits on the prevalence of anaemia in pregnant women of Delhi found that as much as 96% of vegetarian women had anaemia. Similarly, Kabir, Shahjalal, Saleh, & Obaid, (2010) in a study involving adolescent college girls of Bangladesh found that there was inadequate consumption of milk, liver, and leafy vegetables among the study population and a lot of them were anaemic when the test was done.

Obesity has been reported to be associated with anaemia in individuals in several other studies. The relationship in obese young people who showed low serum iron levels

compared with healthy adolescents was identified back in 1962 by Wenzel, Stults, & Mayer, (1962). In comparison to healthy weight mates, an increased incidence of iron deficiency in obese children was also seen (Pinhas-Hamiel et al., 2003). Health and Nutrition Examination data III showed that obese children are two-fold higher than normal-weight peers at risk of iron deficiency (Nead et al., 2004). Hypoferremia (an abnormal deficiency of iron in the blood) in adults is more severe in the obese than the non-obese (Menzie et al., 2008; Yanoff et al., 2007), and among post-menopausal, positive associations have been reported between low iron status and obesity (Lecube et al., 2006) and Hispanic women (Chambers et al., 2006). Therefore, obesity could potentially add to the burden of anaemia in the Upper East Region, since Ghana has experienced an alarming increase in obesity over the past decade (Ghana Statistical Service, 2014)

CHAPTER THREE

METHODOLOGY

3.1 Study Design

This was an analytic cross-sectional study among pregnant adolescent girls aged 10-19 years who attend antenatal care clinics in health facilities in the Upper East Region of Ghana. Participants were recruited when they visited the selected health facility for antenatal care. Using a structured questionnaire socio-demographics, dietary intake habit and knowledge on anaemia was obtained from the pregnant adolescent girls by face-to-face interview alongside blood samples for laboratory investigation.

3.2 Description of the Study Area

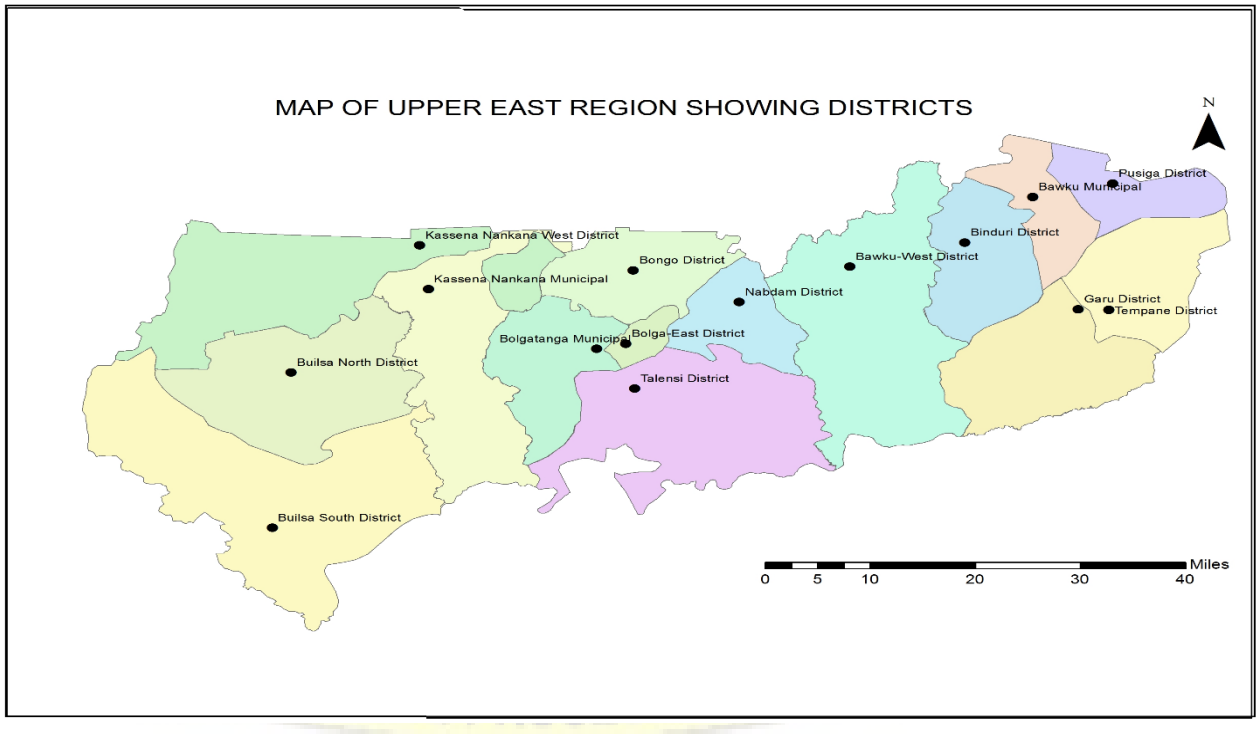

Figure 3.1: Map of Upper East Region showing Districts

The Upper East region is one of the 16 administrative regions of Ghana which is located in the North-Eastern corner of the country with Bolgatanga as its Regional capital. The region is found between longitude 0° and 1° West, as well as latitudes 10° 30′N and 11°N. The region has 3 Municipalities, 12 districts and shares international borders with Burkina Faso to the North and the Republic of Togo to the East; whiles sharing boundaries with the North East and Upper West Regions of Ghana. The Figure above presents a map of the Upper East Region, showing the various municipalities and districts. The rainy season starts from May-October and dry/harmattan, from November to April. Savannah forests are the natural vegetation of the region, with their short, dispersed dry-resistant trees and grass that is either burnt by bush fire or scorched by the sun during the long, dry season (Ghana Tourism Authority, 2019).

The Population and Housing Census of 2010 conducted in Ghana put the Upper East Region population at 1,046,545. Adolescents aged from 10–19 years were 253,016 whiles 121,253 were female adolescents. The Region is predominantly (79.0%) rural with about 68.9% of the populace into agriculture. Mole-Dagbani ethnicity is the largest in the region consisting of 74.7 per cent of the populace (Ghana Statistical Service, 2012). Among females aged 15-19 years old in the Upper East Region, almost a tenth (9.7%) of them have begun childbearing (Ghana Statistical Service, 2014). Agriculture, mainly livestock and crop production, are essential to the region's economy. The area is also known for its craftsmanship. The eight languages and main dialects of the region are Gurune (Frafra), Nankani, Kassem, Talen, Nabt, Kusal, Buli, and Bisah (Ghana Tourism Authority, 2019).

There are four hundred and eighty-nine (489) health facilities in the Upper East Region with about four hundred and forty-nine (449) out of these facilities providing antenatal and postnatal services to the populace. (GHS DHIMS, 2019)

3.3 Variables

The dependent variable for the study was anaemia prevalence. Two main categories of independent variables were analyzed – sociodemographic factors and behavioural factors.

3.3.1 Dependent Variable

The dependent variable for the study was anaemia prevalence among pregnant adolescent girls and this was determined by the Haemoglobin (HB) concentration in the blood of the adolescent girl obtained from the Hemocue 301 device. This was categorized as non-anaemic or anaemic based on the World Health Organisation (1968) classification for HB of pregnant women which states that, for a pregnant woman, an HB less than 11.0g/dl indicates that the person is anaemic. This variable was assessed by doing a blood test on every respondent.

3.3.2 Independent Variables

The independent variable comprises sociodemographic factors and behavioural factors. Sociodemographic factors included age, marital status, ethnicity, religion, occupation, level of formal education attained, gestational age, gravidity, parity, monthly income, and household characteristics.

Behavioural factors assessed included a Dietary recall for some selected foods consumed within a 7 day period, knowledge of anaemia causes, signs/complications, prevention, treatment, and good sources of iron. All independent variables were assessed by conducting an oral interview of every pregnant adolescent girl.

3.4 Sample Size

The sample size for the study was calculated using the sample size calculation formula for a one-sample proportion (Cochran, 1977) which is shown below:

$$n = \frac{z^2 pq}{d^2}$$

Where

n = minimum required sample size

z = score for 95% Confidence Interval which is 1.96

p = Prevalence of anaemia among pregnant adolescent girls which is 76.1% (Intiful et al., 2016) = 0.761

q =1 – p (proportion of pregnant adolescent girls without anaemia) is 23.9% = 0.239

d = tolerable error set at 5%.

Allowing for a non-response of 10% of the sample size becomes 0.10(279.48)

The sample size became 279.48 + 27.94 = 307.43

Therefore, approximately a minimum of 308 pregnant adolescent girls was required for the research.

3.5 Sampling Technique

Multistage sampling technique was adopted in carrying out the study. Districts were identified first, followed by the health facilities and then the pregnant adolescent girls to be involved in the study.

3.5.1 Selection of Districts

The Upper East Region has fifteen (15) districts that were zoned as Western, Central, and Eastern. The Western Zone of the region was made up of four (4) districts namely Builsa South, Builsa North, Kassena Nankana West, and Kassena Nankana Municipal. The Central Zone of the region was made up of five (5) districts namely Bongo, Bolga Municipal, Bolga East, Talensi, and Nabdam. The Eastern Zone comprised six (6) districts which included Bawku-West, Binduri, Bawku Municipal, Pusiga, Garu, and Tempane. The names of the districts in each of the zones were clearly written on small pieces of paper, were folded, and then placed in a bowl from which two (2) were randomly selected for the Western, three (3) from the Central, and another three (3) from the Western Zones. A total of eight (8) districts were randomly selected. These districts were; Builsa South, Kassena Nankana West, Bongo, Bolga Municipal, Bolga East, Bawku-West, Bawku Municipal, and Tempane Districts.

3.5.2 Selection of Health Facilities

In each of the eight selected districts, a review of the antenatal care registers was done for all health facilities (public and private) to identify those that had pregnant adolescent girls

aged from 10 – 19 years and the number of girls in each of them. Five (5) of the health facilities in each of the eight districts with the highest number of pregnant adolescents was purposively selected, and each considered as a stratum. In all, there were forty (40) strata consisting of five (5) health facilities from each of the eight (8) selected districts.

Table 3.1: List of Sampled Districts and Health Facilities

SELECTED DISTRICT	SELECTED HEALTH FACILITIES
Builsa South District	Doninga Health Centre, Fumbisi Health Centre, Gbedema CHPS, Kanjarga Health Centre, Uwasi CHPS
Kassena Nankana West District	Chiana Health Centre, Kandiga Health Centre, Nakolo Health Centre, Paga Health Centre, Martyrs of Uganda Health Centre
Bongo District	Dua Health Centre, Bongo Soe Health Centre, Namoo Health Centre, Vea Health Centre, Zorko Health Centre
Bolga Municipal	Coronation Health Centre, Bolga Health Centre, Sumbrungu Health Centre, Sherigu Health Centre, Sokabisi Health Centre
Bolga East District	Zuarungu Health Centre, Gambibgo Health Centre, Zuarungu Moshie Health Centre, Katanga CHPS, Yarigabisi CHPS
Bawku-West District	Binaba Health Centre, Googo Health Centre, Sapeliga Health Centre, Kobore CHPS, Zongoire Health Centre
Bawku Municipal	Urban Health Centre, Mognori Health Centre, Urban West Health Centre, Bugri Corner Health Centre, Presby Hospital
Tempane District	Basyonde Health Centre, Bugri Health Centre, Gagbiri CHPS, Sumaduri Clinic, Woriyanga Health Centre

3.5.3 Enrollment of Survey Participants

Proportionate Sampling was used in arriving at the number of participants to be interviewed from each health facility. Whiles Simple Random Sampling was used in selecting the research participants. The proportion of pregnant adolescent girls for each stratum in the entire population of pregnant adolescent girls from all the strata was determined. This was done by dividing the total number of pregnant adolescent girls in each stratum by the total number of pregnant adolescent girls from all the forty (40) strata put together and multiplied by the study sample size of 308. This gave the number of girls to be included in the study that will be proportional to the number of pregnant adolescent girls for each of the respective health facilities. In health facilities where the number obtained gave a decimal, the number was rounded up to the next whole number

On antenatal days in the health facilities, an equal number of 'Yes' and 'No' with each being the number of girls needed to be interviewed in that health facility was written on pieces of paper. These were folded and put into a bowl where it was mixed for the pregnant adolescent girls to pick. The pregnant adolescent girl that picks a 'Yes' was approached. The nature and scope of the research were explained to them and consent was obtained from them before they took part in the study.

When a pregnant adolescent girl declined after she picked a 'Yes' or does not meet the inclusion criteria to participate in the survey, the selected paper was folded again and mixed with the other folded pieces of paper for another pregnant adolescent girl to select. This

process of picking a 'Yes' from the bowl was continued until the number of study participants that are required for each chosen health facility was obtained.

3.6 Study Population

The study participants were chosen because they belong to the vulnerable group and will naturally be competing for nutrients to support their growth and also that of the developing fetus. The Upper East Region was chosen because it's among the deprived regions which are predominantly rural settlements in Ghana.

3.7 Study inclusion and exclusion criteria

3.7.1 Inclusion Criteria

All pregnant adolescent girls aged 10 to 19 years, permanently residing in the region and have made an antenatal visit, and consented were eligible to participate in the study. Also, for pregnant adolescent girls below 18 years, they were only eligible to participate in the study only after their parents have consented to the Parental Consent Forms in addition to the child assent form they sign.

3.7.2 Exclusion Criteria

Pregnant adolescent girls who are visibly sick and too weak to talk or were healthy to participate in the study were not enrolled. Also, pregnant adolescent girls who have been diagnosed with sickle cell disease were not included in the study.

3.8 Data collection tool

Data was collected from the study participants using a structured questionnaire (Appendix 2) designed in the English language but translated into the local language during administration for respondents to understand better. The approach and content of questionnaire translation into the local dialect was part of the enumerators' training, where the team discussed and reached common grounds on specific words, phrases, and jargon for capturing consistent, valid, reliable, and uniform data. The content of the questionnaire was categorized into 3 sections: socio-demographic data, dietary habits of pregnant adolescent girls, and knowledge on anaemia. Additionally, a separate form was added so that the results from anaemia test of respondents will be recorded.

3.9 Data collection

3.9.1 Questionnaire

An interviewer-administered semi-structured questionnaire was used. Eight (8) research assistants were engaged to carry out the data collection. All team members were responsible for quality checks at the field level. The principal investigator was the overall supervisor for the teams. Special codes were assigned to the participants. This was to ensure confidentiality since their names were not captured into the database.

Socio-demographic data: desired data on the socio-demographic characteristics of pregnant girls (age, marital status, occupation, religion, ethnicity, income and educational level, gestational age, gravidity, parity and size of household) were collected using the

questionnaire.

Dietary Habit: A modified Food Frequency Questionnaire (FFQ) that had foods that were iron-rich or could affect iron availability in the body was used. The foods were categorised into fourteen groups. The frequency of consumption was expected to be answered by the respondents based on a 24-hour recall and an additional 7-day recall. Participants were asked if they had consumed foods from a group 24 hours to the study. The responses were yes and no coded. They were further asked if they had consumed the same foods in the past one week (7 days) to the study which was equally coded yes and no. If an adolescent girl reports to have consumed the food item any day within the past week to the study, they were deemed to have consumed it within the week and then further asked how many days in the past 7 days they had consumed the foods. The frequency of consumption of the various foods from the groups was further analysed by grouping it into; Rarely (for those who consumed the foods for 1-2 days in the week), Sometimes (for those who consumed the foods for 3-5 days in the week) and Often (for those who consumed the foods for 6-7 days in the week).

Knowledge on anaemia: The awareness of anaemia among study participants was also evaluated in terms of symptoms, causes, prevention and treatment. The responses were yes and no coded to determine the level of understanding of the respondent. If an adolescent girl could mention at least one correct symptom, cause, mode of prevention and method of treating anaemia, the girl was classified as being knowledgeable on the symptoms, causes, prevention and treatment of anaemia.

3.9.2 Biochemical Measurements

Anaemia Test: Anaemia was assessed through a photometric method using a HemoCue (Hb-301) device which measured the Haemoglobin (Hb) concentration in the blood of the pregnant adolescent girls. A finger prick was done and immediately after obtaining 2-3 large drops of blood on the finger, the micro cuvette was placed into the blood at a 45-degree angle for the blood to draw in and fill it. Excess blood from the side of the micro cuvette was cleaned using a sterile wipe. Trained Laboratory Technicians were engaged to complete the outlined steps (from a finger prick to a photometer). The results obtained from the Hemocue device were recorded onto the form for the research team and on the blood haemoglobin test form designed by the researcher which is given to the pregnant adolescent girl. The results were explained to the girls while those with moderate and severe anaemia (Hb <11.0 g/dl) according to the World Health Organisation (1968) were given a referral slip to take to the nearest health facility for further attention.

3.10 Quality Assurance

Eight health workers were recruited and trained as Research Assistants (RAs) for the data collection. These persons included four nutrition officers, two midwives, and two laboratory technicians. Nutrition Officers and Midwives were recruited since they interact with clients and Laboratory Technicians were engaged since they have first-hand information by their training and work to properly conduct laboratory investigations.

Research assistants were given a one-day training which lasted about 8 hours at

Bolgatanga before the data collection started. The training included a classroom and practical field-based training and pilot on data collection. They were trained on questionnaire content and translation into the local language, how to administer the questionnaire and solicit information from the respondents to ensure uniformity throughout the conduct of the study, how to complete the informed consent forms, finger pricking, and the use of the HemoCue 301 devices. The study questionnaire was pretested among pregnant women attending antenatal clinic at Bolga Health Centre to ascertain its suitability. Afterwards, the necessary corrections and rewording of various sections of the questionnaire were done.

3.11 Data Management and Statistical Analysis

Data collected was cleaned, coded, and entered in Microsoft Excel 2016. The data was then validated by checking to ensure every response on the questionnaire for each respondent was captured. The data was then exported to STATA (statistical analysis software) Version 15 for analysis. Descriptive statistics such as frequencies and means were generated for the variables contained in the questionnaire. The analysis was guided by the specific objectives of the study.

The results were presented in the form of frequency tables with parametric summary measures (mean and standard deviation) provided for the variables. Categorical variables were summarized into frequencies and proportions and continuous variables were summarised into means with their respective standard deviations. Variables such as age, gestational age and Haemoglobin (HB) concentration in the blood which were obtained as

continuous variables were re-categorized into groups for further analysis. The dependent variable, anaemia prevalence among pregnant adolescent girls which was defined by the Haemoglobin (HB) concentration in the blood was categorized as non-anaemic and anaemic. Pearson's chi-square test was performed to establish any association between anaemia prevalence and dietary habits or other independent variables. Binary logistic regression was used to determine the significance of association observed between the foods in the fourteen main food groups and the prevalence of anaemia. The strength of association between these foods and anaemia prevalence were measured using odds ratios. These were all computed at a significance level of $P < 0.05$ and 95% confidence interval.

3.12 Ethical Consideration

Written approval for the study was obtained from the Ghana Health Service Ethics Review Committee (GHS- ERC) before the commencement of the study (GHS-ERC019/12/19). Permission was also sought from the Upper East Regional Director of Health Services, District Directors of Health Services as well as the Heads of the selected Health Facilities. Written individual informed consent forms that were approved by the GHS - ERC was used to obtain consent from each pregnant adolescent girl before being interviewed. In a case where the pregnant adolescent girl was below the age of 18 years, Parental consent was obtained from her parent while she signs the child assent form before being interviewed.

3.12.1 Confidentiality

Confidentiality was assured by the research team through written and signed forms. Identification codes were assigned to participants and used for data analysis throughout the study. Results presented were described as a whole and did not have any one's identification displayed.

3.12.2 Coercion

There was no coercion and deception of the respondents by the research team. Before the start of the study, nature and all the procedures to be carried out were explained adequately to the respondents. The respondents were told that they are permitted at any time to leave the study.

3.12.3 Data Storage

Data collected was used for the sole purpose of this study and only the principal investigator and supervisor had access to it. Confidentiality of all information was ensured. The information obtained from the study continues to be kept confidential and stored in files in a cabinet that is locked with a key. The softcopy of the data is stored on a computer which is encrypted with a password.

3.12.4 Conflict of interest

I declare no conflict of interest.

CHAPTER FOUR

RESULTS

4.1 Socio-Demographic Characteristics

A total of 331 pregnant adolescent girls from ages 13 – 19 years participated in the study with 329 (99.40%) being from age 15-19 years. The mean age was 17.94 ± 1.12 years. The majority of the respondents, 199 (60.12%) were married, 110 (33.23%) were single while 22 (6.65%) of the pregnant adolescent girls were not married but staying with their partners. Nearly half of them, 40.18% (133) were of Junior High School level of education while 76 (22.96%) were of Primary School level of education. Furthermore, 64 (19.34%) had no formal education. From the study, more than a third (38.97%) of the pregnant adolescent girls were unemployed. Among those employed, most were in the informal sector which mainly included farmers (22.66%) and 58 (17.52%) were into trading or owned their businesses. Respondents who were still in school or undergoing some vocational training were 65 (19.64%).

More than half of the pregnant adolescent girls did not earn any monthly income whiles none among those who earned monthly income got more than 500 Ghana cedis. The average household size of the study participants was 7.03±3.05 people whiles the number of people making a household ranged from 2 people to 16 people. One hundred and fourteen (114) of the adolescent girls came from households with 5 or fewer people whiles 53 (16.01%) came from households that have 11 or more members. Most of the households (35.95%) with pregnant adolescents were headed by the husbands of the girls' whiles 111 (33.53%) of the girls were in households headed

by their fathers.

The gestational age of the pregnancies ranged from 8 weeks to 42 weeks with the mean being 26.08±6.77 weeks. More than two-thirds (68.58%) of the pregnant adolescent girls interviewed were in their third trimester (28 weeks and more) of pregnancy whiles 14 (4.23%) were in their first trimester (1-13 weeks) of pregnancy. The mean gravidity of the pregnant girls was 1.20±0.49 times. Gravida one adolescent girls were 274 (82.78%) whiles 4 (1.21%) were gravida four which was the highest recorded number of pregnancies. From the study conducted, the highest number of times a girl had given birth was 2 times and this was reported by 8 (2.43%) of the pregnant adolescent girls. More than two-thirds of the girls (71.73%) had not had any past delivery. (Table 4.1).

Table 4.1: Socio-Demographic Characteristics of Pregnant Adolescent Girls

Characteristics	Number (N = 331)	Percentages (%)
Age		
10 – 14 years	2	0.60
15 – 19 years	329	99.40
Marital Status		
Single	110	33.23
Married	199	60.12
Cohabiting	22	6.65
Religion		
Christians	215	64.95
Muslims	97	29.31
Traditionalists	19	5.74
Occupation		
Unemployed	129	38.97
Farming	75	22.66

Trading/Business	31	9.37
Still in school	52	15.71
Others	44	13.29
Educational Level		
No formal education	64	19.34
Primary School	76	22.96
Junior High School	133	40.18
Senior High School	58	17.52
Gestation		
First Trimester (1-13 weeks)	14	4.23
Second Trimester (14-27 weeks)	90	27.19
Third Trimester (28-40 weeks)	227	68.58
Monthly Income (in Ghc)		
50-100	64	19.34
101-300	33	9.97
301-500	14	4.23
Not applicable	220	66.47

4.2 Anaemia Prevalence

The Haemoglobin (HB) concentration in the blood of the pregnant adolescent girls in the study ranged from 6.8g/dl to 14.8g/dl with the mean HB being 10.48±1.32g/dl. Anaemia (HB less than 11.0g/dl) was found in 218 (65.86%) of the pregnant adolescent girls while 113 (34.14%) were not anaemic (Figure 4.1).

Furthermore, as shown in Figure 4.1, among the pregnant adolescent girls interviewed, 102 (30.82%) had mild anaemia (HB from 10.0g/dl to 10.9g/dl), 113 (34.14%) had moderate

anaemia (HB from 10.9g/dl to 7.0g/dl) and 3 (0.91%) had severe anaemia (HB less than 7.0g/dl).

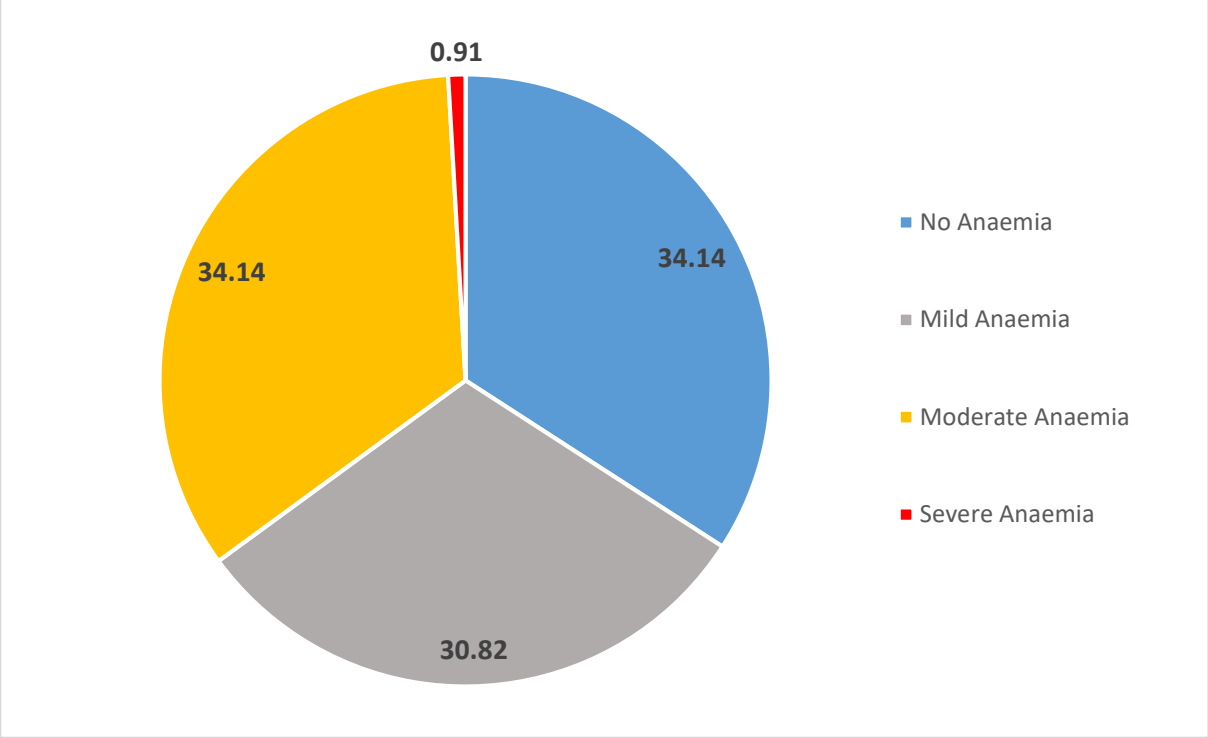

Figure 4.1: Prevalence of Anaemia and classification

4.3 Dietary Habits of Pregnant adolescent girls

4.3.1 Consumption of foods believed to affect iron availability in the body

A food frequency questionnaire which had a 24-hour recall and a 7-day recall of the same foods was used to find out how often they were consumed by the pregnant adolescent girls. Fourteen main food groups were used to classify the various foods that were consumed. Participants were asked whether they had consumed any of the foods belonging to a group in the past 24 hours before the study and then how often they consumed any of the various foods listed from the same group in a week. The responses obtained were first grouped into

those who had consumed on any day of the week and those who never consumed in the week. Reference was made to the immediate past week before the study so that participants can easily recall. Frequencies of consumption for the 7-day recall were grouped as Never (for those who never consumed in the week), Rarely (for those who consumed for 1-2 days in the week), Sometimes (for those who consumed for 3-5 days in the week), and Often (for those who consumed for 6-7 days in the week) respectively.

Bivariate analysis was used to establish the association between the prevalence of anaemia among the pregnant girls and each of the fourteen main food groups used to classify the various foods that were consumed within 24 hours and within 7 days before the study.

4.3.1.1 Consumption of Meat

The consumption of meat such as beef, pork, lamb, goat, wild game among the pregnant adolescent girls within 7 days prior to the study was high (73.41%) with a majority (51.06%) of them consuming the meat for about 3 – 5 days within the week. Significant associations were found between the prevalence of anaemia among the pregnant girls and meat consumption within a week ($p<0.001$) as well as the number of days meat was consumed in the week ($p<0.001$) while using logistic regression analysis. The table below (Table 4.2) summarizes the findings related to meat consumption of pregnant adolescent girls.

Table 4.2: Consumption of Meat by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Meat consumption within the week				**< 0.001**
Did not consume	88 (26.59)	75 (85.23)	13 (14.77)	
Consumed	243 (73.41)	143 (58.85)	100 (41.15)	
Meat consumption frequency within the week				**< 0.001**
Rarely (1-2 days/week)	30 (9.06)	15 (50.00)	15 (50.00)	
Sometimes (3-5 days/week)	169 (51.06)	128 (75.74)	41 (24.26)	
Often (6-7 days/week)	44 (13.29)	0 (0.00)	44 (100.00)	

4.3.1.2 Consumption of Poultry

More than half (51.36%) of the girls had consumed poultry or white meat such as chicken, duck, turkeys, Guinea fowl, or other birds for at least a day within the week before the study with more than ninety per cent of them consuming poultry for just 1 – 2 days in the week. Upon running a logistic regression analysis, significant associations were found between the prevalence of anaemia among the pregnant girls and poultry consumption within a week ($p=0.001$) as well as the number of days poultry was consumed in the week ($p<0.001$). This is shown in Table 4.3 below.

Table 4.3: Consumption of Poultry by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Poultry consumption within the week				**0.001**
Did not consume	161 (48.64)	92 (57.14)	69 (42.86)	
Consumed	170 (51.36)	126 (74.12)	44 (25.88)	

Poultry consumption frequency within the week				**< 0.001**
Rarely (1-2 days/week)	154 (90.59)	125 (81.17)	29 (18.83)	
Sometimes (3-5 days/week)	16 (9.41)	1 (6.25)	15 (93.75)	

4.3.1.3 Consumption of Fish

Fish consumption of the adolescent girls within a week of the study low (38.07%). However, none of those who consumed fish within the week ate it for less than three days in the week. Significant associations were found between fish consumption in a week ($p<0.001$) and the prevalence of anaemia among the pregnant girls. (Table 4.4)

Table 4.4: Consumption of Fish by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Fish consumption within the week				**< 0.001**
Did not consume	205 (61.93)	195 (95.12)	10 (4.88)	
Consumed	126 (38.07)	23 (18.25)	103 (81.75)	
Fish consumption frequency within the week				**0.072**
Sometimes (3-5 days/week)	72 (57.14)	17 (23.61)	55 (76.39)	
Often (6-7 days/week)	54 (42.86)	6 (11.11)	48 (88.89)	

4.3.1.4 Consumption of Liver

Animal liver consumption within 7 days (18.73%) before the study among pregnant adolescent girls was generally low. Additionally, 79.18% of the pregnant girls that did not

eat liver in any day within 7 days to the study had anaemia. Furthermore, among those who consumed the liver during the week to the study, none had eaten it for more than five days in the week.

Significant associations were found between the prevalence of anaemia among the pregnant girls and liver consumption within 7 days ($p<0.001$). This is shown in Table 4.5 below.

Table 4.5: Consumption of Liver by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Liver consumption within the week				**< 0.001**
Did not consume	269 (81.27)	213 (79.18)	56 (20.82)	
Consumed	62 (18.73)	5 (8.06)	57 (91.94)	
Liver consumption frequency within the week				**1.000**
Rarely (1-2 days/week)	41 (66.13)	3 (7.32	38 (92.68)	
Sometimes (3-5 days/week)	21 (33.87)	2 (9.52)	19 (90.48)	

4.3.1.5 Consumption of Eggs

Within the week of the study, more than seven in every ten of the girls had eaten an egg. Among those who had consumed an egg in the week, 72.29% had eaten an egg for days ranging from three to five within the week. Significant associations were found between anaemia prevalence and egg consumption within the week ($p=0.007$), and frequency of

consumption of egg within the week (p=0.038). Table 4.6 below shows the corresponding frequencies, percentages, and significant values.

Table 4.6: Consumption of Eggs by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Egg consumption within the week				**0.007**
Did not consume	82 (24.77)	64 (78.05)	18 (21.95)	
Consumed	249 (75.23)	154 (61.85)	95 (38.15)	
Egg consumption frequency within the week				**0.038**
Rarely (1-2 days/week)	65 (26.10)	42 (64.62)	23 (35.38)	
Sometimes (3-5 days/week)	180 (72.29)	112 (62.22)	68 (37.78)	
Often (6-7 days/week)	4 (1.61)	0 (0.00)	4 (100.00)	

4.3.1.6 Consumption of Vegetables

Green leafy vegetables such as alefu, kontonmire, ayoyo, bittor, bean leaves, gboma, pumpkin leaves, or spinach were consumed by a little above half of the pregnant adolescent girls within a week before the study. Furthermore, more than half of those found to have consumed vegetables did not have anaemia. Significant associations were found between the prevalence of anaemia and vegetable consumption within the week (p<0.001). The corresponding frequencies, percentages, and significant values are shown in Table 4.7 below.

Table 4.7: Consumption of Vegetables by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Vegetable consumption within the week				**< 0.001**
Did not consume	110 (33.23)	110 (100.00)	0 (0.00)	
Consumed	221 (66.77)	108 (48.87)	113 (51.13)	
Vegetable consumption frequency within the week				**0.090**
Sometimes (3-5 days/week)	114 (51.58)	62 (54.39)	52 (45.61)	
Often (6-7 days/week)	107 (48.42)	46 (42.99)	61 (57.01)	

4.3.1.7 Consumption of Fruits

Fruits such as Oranges, lemons, sour sap (Aluguntugui), African star fruit (Alasa), mango, or baobab pulp consumption over one-week period was 59.82% with a majority (54.55%) of them not being anaemic. Prevalence of anaemia and fruit consumption within the week recorded some significant associations ($p<0.001$). The corresponding frequencies, percentages, and significant values are shown in Table 4.8 below.

Table 4.8: Consumption of Fruits by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Fruit consumption within the week				**< 0.001**
Did not consume	133 (40.18)	128 (96.24)	5 (3.76)	
Consumed	198 (59.82)	90 (45.45)	108 (54.55)	
Fruit consumption frequency within the week				**0.134**
Rarely (1-2 days/week)	52 (26.26)	22 (42.31)	30 (57.69)	
Sometimes (3-5 days/week)	79 (39.90)	31 (39.24)	48 (60.76)	

Often (6-7 days/week)	67 (33.84)	37 (55.22)	30 (44.78)

4.3.1.8 Consumption of Legumes

Consumption of legumes such as Cowpea, pigeon pea, soya beans, groundnuts, or melon seeds (agushie) among the pregnant girls within the 7-day period prior to the study was 65.26%. A majority (51.39%) of them who took any legume within the week of the study took it for less than 3 days in the week. Significant associations were found between the prevalence of anaemia and legume consumption within the week ($p<0.001$), and frequency of consumption within the week ($p<0.001$). The corresponding frequencies, percentages, and significant values are shown in Table 4.9 below.

Table 4.9: Consumption of Legumes by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Legume consumption within the week				**< 0.001**
Did not consume	115 (34.74)	110 (95.65)	5 (4.35)	
Consumed	216 (65.26)	108 (50.00)	108 (50.00)	
Legume consumption frequency within the week				**< 0.001**
Rarely (1-2 days/week)	111 (51.39)	76 (34.86)	35 (30.97)	
Sometimes (3-5 days/week)	95 (43.98)	26 (11.93)	69 (61.06)	
Often (6-7 days/week)	10 (4.63)	6 (2.75)	4 (3.54)	

4.3.1.9 Consumption of Bread

Bread or flour products like brofrot, atsormor, polo, meat pie, cake, or tart were found to be consumed by more than half of the respondents within a week to the study. The majority (78.77%) consumed the flour products for less than three days of the week. Most of the respondents (66.15%) who consumed the bread or flour products were found to be anaemic. Also, there was no significant associations between the prevalence of anaemia and the consumption of bread or flour products within the week (p=0.414). The corresponding frequencies, percentages, and significant values are shown in Table 4.10 below.

Table 4.10: Consumption of Bread by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Bread consumption within the week				**0.414**
Did not consume	6 (1.81)	3 (50.00)	3 (50.00)	
Consumed	325 (98.19)	215 (66.15)	110 (33.85)	
Bread consumption frequency within the week				**< 0.001**
Rarely (1-2 days/week)	256 (78.77)	212 (82.81)	44 (17.19)	
Sometimes (3-5 days/week)	61 (18.77)	3 (4.92)	58 (95.08)	
Often (6-7 days/week)	8 (2.46)	0 (0.00)	8 (100.00)	

4.3.1.10 Consumption of Tea

Tea consumption was found to be low among the pregnant girls with a greater majority of those found to have consumed tea being anaemic. Significant associations were found to exist between anaemia prevalence and tea consumption within seven days before the study as well as the frequency of consumption within the week. (Table 4.11)

Table 4.11: Consumption of Tea by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Tea consumption within the week				**0.001**
Did not consume	179 (54.08)	132 (73.74)	47 (26.26)	
Consumed	152 (45.92)	86 (56.58)	66 (43.42)	
Tea consumption frequency within the week				**< 0.001**
Rarely (1-2 days/week)	89 (58.55)	31 (34.83)	58 (65.17)	
Sometimes (3-5 days/week)	62 (40.79)	55 (88.71)	7 (11.29)	
Often (6-7 days/week)	1 (0.66)	0 (0.00)	1 (100.00)	

4.3.1.11 Consumption of Sweet beverages

Consumption of sweet beverages such as Milo, chocolin, or Ovaltine was found to be low among pregnant girls. Among those who consumed it, a greater majority did not have anaemia. Significant associations were found to exist between anaemia prevalence and consumption of sweet beverages within seven days before the study as well as the frequency of consumption within the week. (Table 4.12)

Table 4.12 Consumption of Sweet beverages by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Consumption of sweet beverages within the week				< 0.001
Did not consume	228 (68.88)	211 (92.54)	17 (7.46)	
Consumed	103 (31.12)	7 (6.80)	96 (93.20)	
Frequency of consumption of sweet beverages within the week				**0.041**
Rarely (1-2 days/week)	16 (15.53)	3 (18.75)	13 (81.25)	

Sometimes (3-5 days/week)	63 (61.17)	2 (3.17)	61 (96.83)
Often (6-7 days/week)	24 (23.30)	2 (8.33)	22 (91.67)

4.3.1.12 Consumption of Local Juices

Local juices such as Hausa beer, Sobolo, Tamarind juice, Asaana, or other locally prepared sugary drinks were consumed by more than half (70.69%) of the respondents within the week before the study with more than fifty per cent of those who have consumed the same found to be anaemic. Significant associations were found between the prevalence of anaemia and consumption of local juices within seven days ($p<0.001$) and the frequency of consumption of local juices within the week ($p<0.001$). This is detailed in Table 4.13 shown below.

Table 4.13: Consumption of Local Juices by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Consumption of local juices within the week				< 0.001
Did not consume	97 (29.31)	80 (82.47)	17 (17.53)	
Consumed	234 (70.69)	138 (58.97)	96 (41.03)	
Frequency of consumption of local juices within the week				< 0.001
Rarely (1-2 days/week)	17 (7.26)	14 (82.35)	3 (17.65)	
Sometimes (3-5 days/week)	187 (79.91)	122 (65.24)	65 (34.76)	
Often (6-7 days/week)	30 (12.82)	2 (6.67)	28 (93.33)	

4.3.1.13 Consumption of Fried Foods

More than half (80.36%) of the adolescent girls interviewed consumed Fried foods such as Fried plantain chips, yam chips, Flour products (atsormor, polo, brofrot), Koose (fried blackeyed peas pastry), or meat pies within the week prior to the study. Among those found to have consumed the fried foods, anaemia was found in more than sixty per cent of them. Additionally, no significant association was observed between anaemia prevalence and consumption of fried foods (p=0.221) within 7 days. However, there was significant association between anaemia prevalence and the frequency of consumption of fried foods within the week to the study (p<0.001). This is shown in Table 4.14 below.

Table 4.14: Consumption of Fried Foods by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Consumption of fried foods within the week				0.221
Did not consume	65 (19.64)	47 (72.31)	18 (27.69)	
Consumed	266 (80.36)	171 (64.29)	95 (35.71)	
Frequency of consumption of fried foods within the week				**< 0.001**
Rarely (1-2 days/week)	90 (33.83)	44 (48.89)	46 (51.11)	
Sometimes (3-5 days/week)	174 (65.41)	127 (72.99)	47 (27.01)	
Often (6-7 days/week)	2 (0.75)	0 (0.00)	2 (100.00)	

4.3.1.14 Consumption of Non-Nutritive Substances

Among the 331 pregnant adolescent girls interviewed, 317 (95.77%) of them did not consume earth or soil-like substances such as sand, clay, or chalk within the week prior to the study. (Figure 4.2). All those who consumed substances such as sand, clay, or chalk

within the week before the study were found to have anaemia. Among the girls who consumed within the week, a majority (78.57%) of them took it for 3 – 5 days in the week. Significant associations were found between the prevalence of anaemia among the pregnant girls and consumption of Non-nutritive substances within 7 days (p=0.003) while using logistic regression analysis. Table 4.15 shown below gives details of the results.

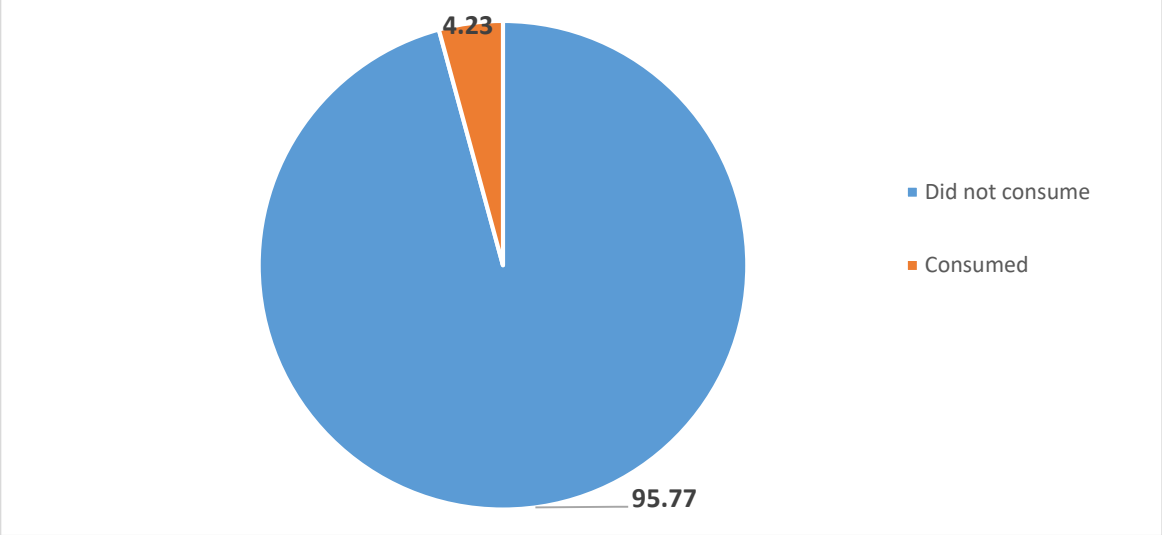

Figure 4.2: One-week recall of consumption of non-nutritive items

Table 4.15: Consumption of Non-nutritive items by Pregnant Adolescent Girls

Foods	N (%)	Anaemia (%)	No anaemia (%)	P-value
Consumption of Non-nutritive substances within the week				**0.003**
Did not consume	317 (95.77)	204 (64.35)	113 (35.65)	
Consumed	14 (4.23)	14 (100.00)	0 (0.00)	
Frequency of consumption of Non-nutritive substances within the week				
Rarely (1-2 days/week)	1 (7.14)	1 (100.00)	0 (0.00)	
Sometimes (3-5 days/week)	11 (78.57)	11 (100.00)	0 (0.00)	
Often (6-7 days/week)	2 (14.29)	2 (100.00)	0 (0.00)	

4.3.2 Multivariate analysis between anaemia prevalence and Consumption of foods

For the consumption of foods within the week to the study, all factors found to be statically associated with the prevalence of anaemia in the bivariate model (with no predictors) were put in a model to determine which factors will be statistically significant.

The overall model was also found to be statistically significant, χ^2 (13) = 380.93, p< 0.001 indicating that the model was good enough in distinguishing which factors were associated with the prevalence of anaemia among the pregnant girls. The model explained 92.24% (Pseudo R square) of the variance in anaemia prevalence.

Shown in Table 4.16 below, four of the fourteen dietary factors tested in the model made significant contribution to the model. These were; meat consumption (OR = 0.40; 95% CI [0.17, 0.88]), fish consumption (OR = 0.15; 95% CI [0.04, 0.51]), fruit consumption (OR = 0.35; 95% CI [0.13, 0.95]) and bread consumption (OR = 0.06; 95% CI [0.01, 0.62]). These findings suggest that consumption of meat, consumption of fish, consumption of fruits and consumption of bread within the week to the study was protective against anaemia. This means that the adolescent girls who ate meat, fish, fruits or bread within the week to the study were less likely to have anaemia. The study further suggests that consumption of liver (OR = 10.44; 95% CI [1.17, 93.55]) within a week was a risk factor to being anaemic. This means that pregnant adolescent girls who took in liver within the week to the study were about ten times more likely to have anaemia.

Table 4.16: Multivariate logistic regression for anaemia prevalence and Consumption of foods

Foods	OR	P-value	95% CI	
Meat	**0.40**	**0.023**	**0.17**	**0.88**
Poultry	2.27	0.463	0.25	20.26
Fish	**0.15**	**0.002**	**0.04**	**0.51**
Liver	**10.44**	**0.036**	**1.17**	**93.55**
Egg	1.24	0.592	0.56	2.71
Vegetables	0.19	0.104	0.03	1.39
Fruits	**0.35**	**0.039**	**0.13**	**0.95**
Legumes	2.86	0.065	0.94	8.76
Bread	**0.06**	**0.019**	**0.01**	**0.62**
Tea	1.38	0.698	0.27	7.05
Sweet Beverages	0.44	0.252	0.11	1.80
Local Juices	0.60	0.298	0.23	1.57
Fried Foods	1.36	0.743	0.21	8.68
Non-Nutritive Substances	1	-	-	-

4.4 Knowledge of pregnant adolescents on anaemia

Out of the 331 pregnant adolescent girls interviewed for the study, 281 (84.89%) could mention at least one cause of anaemia. Two hundred and sixty-seven (80.66%) of the girls could name a sign or complication of anaemia whiles 291 (87.92%) could tell how anaemia can be prevented in an individual. However, more than half (57.10%) of the respondents did not know any strategy used to treat anaemia. Among the pregnant adolescents, 259 (78.25%) of them were able to name a good source of iron (Table 4.17)

Table 4.17: Knowledge of Pregnant Adolescent Girls on Anaemia

Characteristics	Number of Respondents	Percentages (%)
Knowledge on causes of anaemia.		
Knew a cause of anaemia	281	84.89
Did not know any cause of anaemia	50	15.11
Knowledge of signs/complications of anaemia.		
Knew a sign/complication of anaemia	267	80.66
Did not know any sign/complication of anaemia	64	19.34
Knowledge on prevention of anaemia.		
Knew an anaemia prevention strategy	291	87.92
Did not know any anaemia prevention strategy	40	12.08
Knowledge of the treatment of anaemia.		
Knew an anaemia treatment strategy	142	42.90
Did not know any anaemia treatment strategy	189	57.10
Knowledge of good sources of iron.		
Knew a good source of iron	259	78.25
Did not know any good source of iron	72	21.75

4.4.1 Causes of Anaemia

Among the pregnant adolescent girls that could name at least a cause of anaemia, 243 (86.48%) reported that consumption of Poor diets can cause anaemia while just 54 (19.22%) of the girls thought that eating soil/clay can cause anaemia. Heavy blood loss was reported by 72.95% of the adolescent girls as being a cause of anaemia while malaria and worm/parasite infestation was recounted by 50.18% and 33.81% of the girls respectively (Figure 4.3).

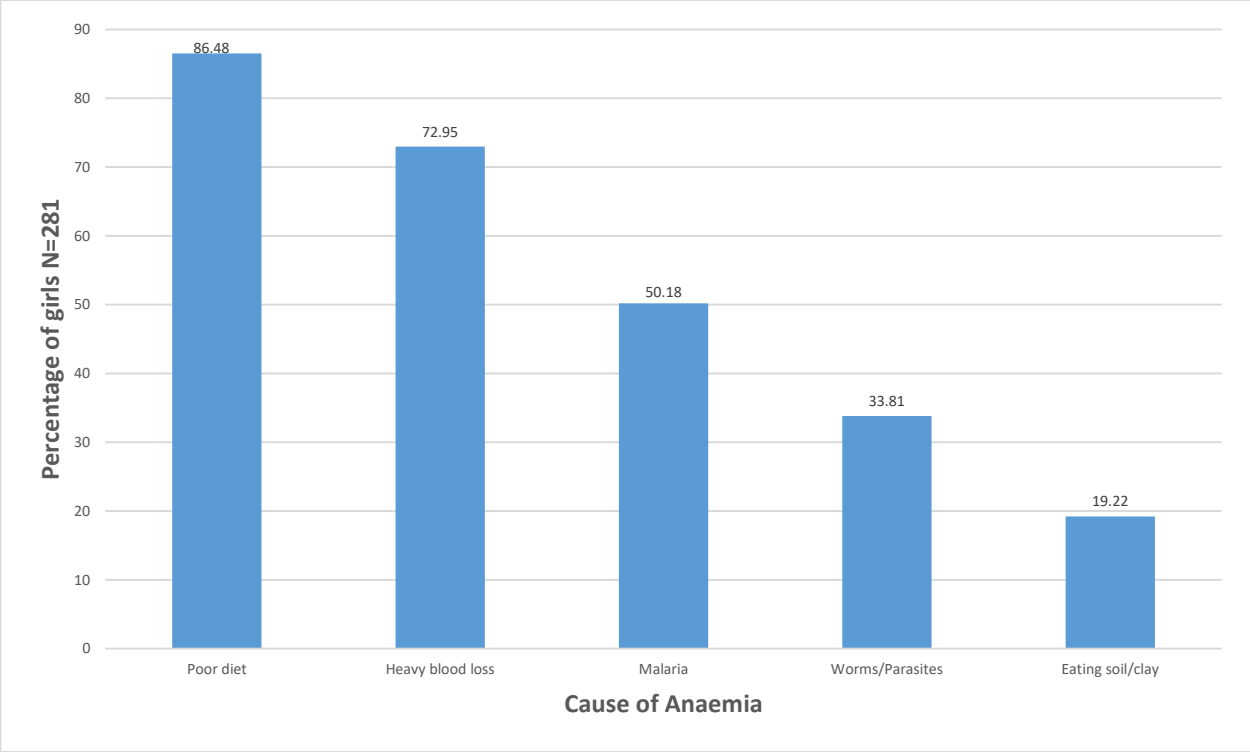

Figure 4.3: Causes of Anaemia

4.4.2 Signs or complications of anaemia

From the survey that was conducted, 237 (88.76%) of the pregnant girls indicated that lack of concentration/weakness/dizziness/sleepy was a sign/complication of anaemia in an individual. Pale eyes/nails/tongue and repeated infections were reported by 196 (72.66%) and 74 (27.72%) respectively. However, 27 (10.11%) and 69 (25.84%) of the girls indicated that shortness of breath was a sign/complication of anaemia in an individual (Figure 4.4).

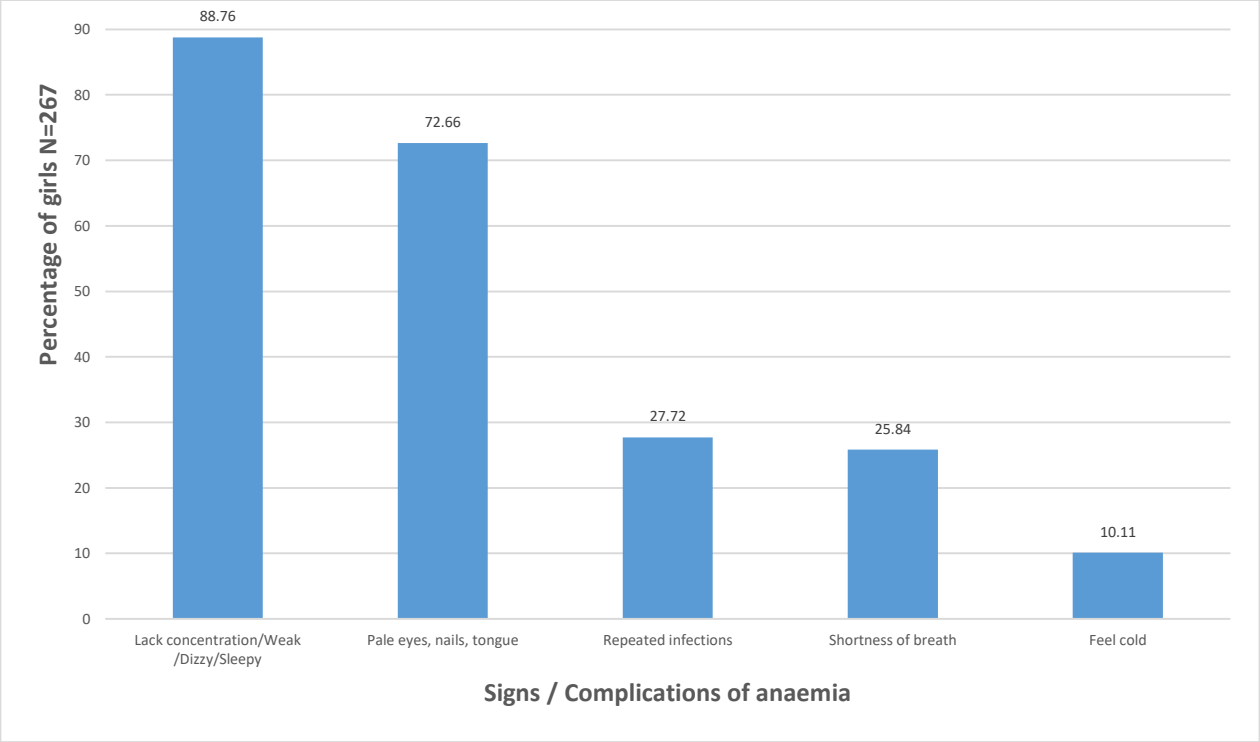

Figure 4.4: Signs / Complications of Anaemia

4.4.3 Prevention of anaemia

Pregnant adolescent girls were asked to mention what they thought could help in anaemia prevention in an individual. Consumption of green leafy vegetables and the eating of meat/liver was mentioned by 240 (82.47%) and 193 (66.32%) of the pregnant girls who knew any anaemia prevention strategy respectively. Additionally, 210 (72.16%) reported that a person should seek healthcare/take Iron Folic Acid Supplements/deworm to prevent anaemia. An individual can also prevent anaemia by preventing malaria/using an insecticide-treated bed net or having enough rest. This was reported by 161 (55.33%) and 43 (14.78%) of the pregnant girls spoken to in the study (Figure 4.5).

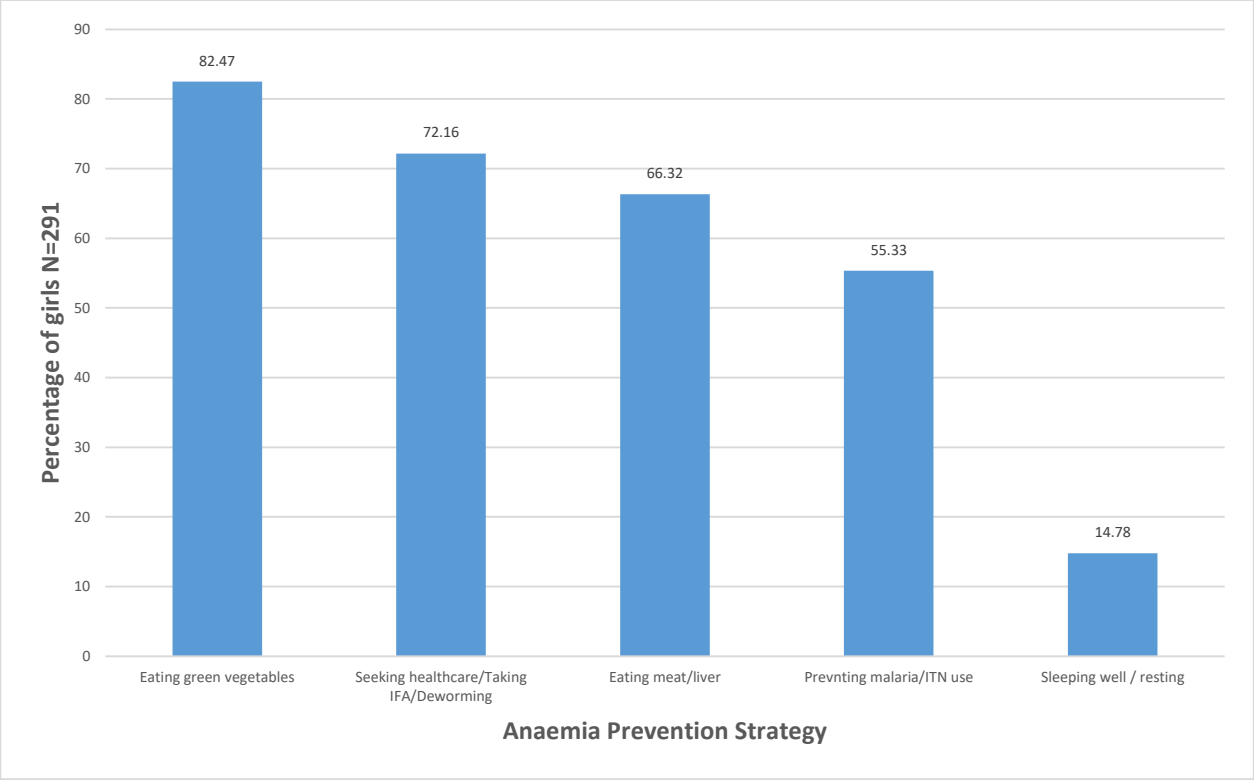

Figure 4.5: Anaemia Prevention Strategy

4.4.4 Treatment of anaemia

Taking of Iron Supplements was reported by 112 (78.87%) of the pregnant adolescent girls as being a way of treating anaemia while 87 (61.27%) indicated that adhering to dietary instructions such as eating beans, eggs, meat, liver, etc. is a way of treating anaemia. Less than half (48) of the 142 pregnant adolescent girls who could tell what they thought could be used to treat anaemia stated that blood transfusion (33.80%) could be used in treating anaemia (Figure 4.6).

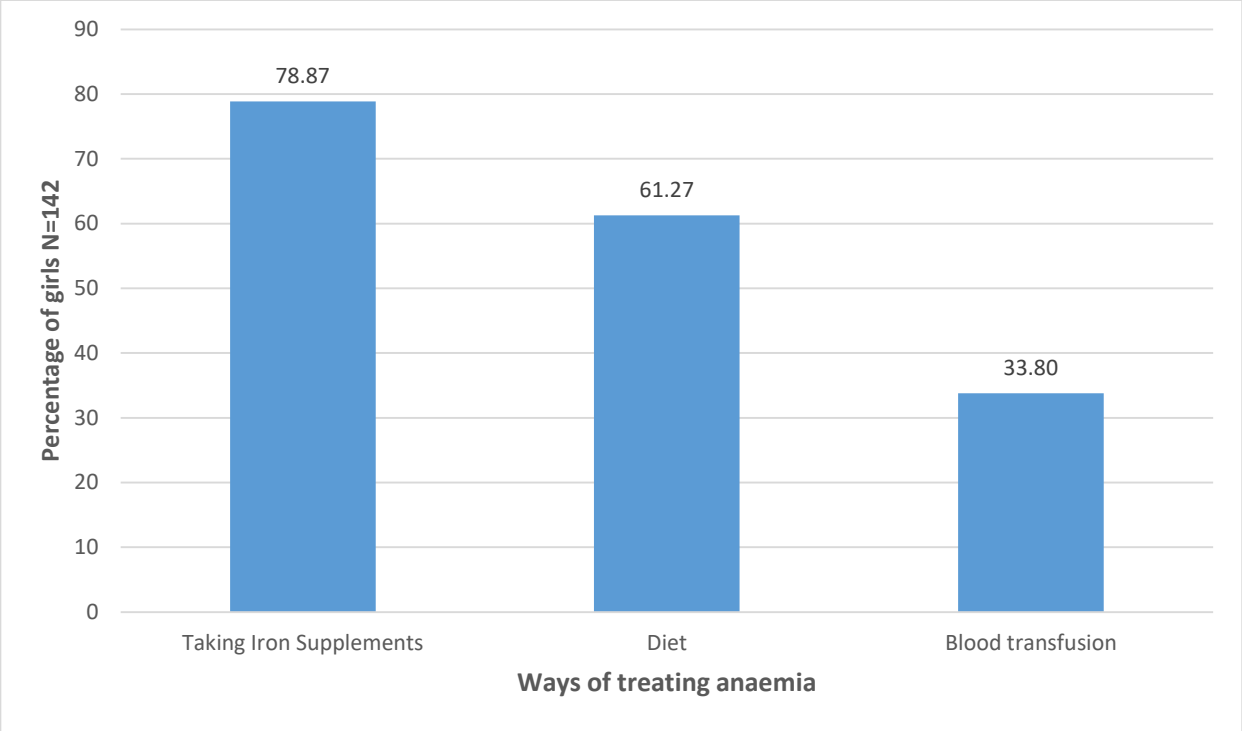

Figure 4.6: Ways of treating Anaemia

4.4.5 Vitamin-Mineral deficiency cause of anaemia

Iron, Folate, and Vitamin B12 were recalled by 193 (91.90%), 98 (46.67%), and 69 (32.86%) of the 210 pregnant adolescent girls as being the vitamin-mineral which when deficient in the human body can cause anaemia whereas 65 (30.95%), 65 (30.95%), 63 (30.00%) and 53 (25.24%) of the 210 girls responded by saying that Zinc, Vitamin A, Vitamin C and Vitamin D deficiency in the human body can cause anaemia (Figure 4.7).

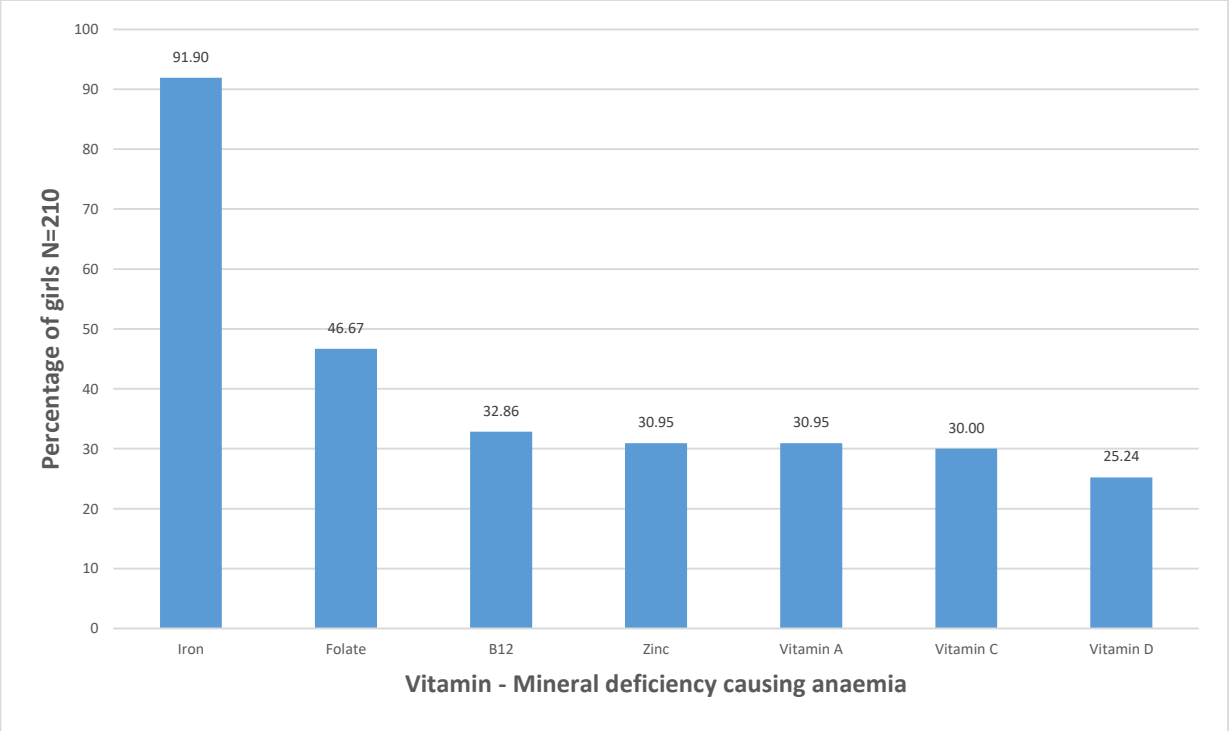

Figure 4.7: Vitamin – Mineral Deficiency Causing Anaemia

4.4.6 Sources of iron

From the study, 259 pregnant adolescent girls could mention a good source of iron for the human body. From this number, 213 (82.24%) and 169 (65.25%) indicated that green leafy vegetables and iron supplements were good sources of iron. Additionally, 175 (67.57%), 161 (62.16%), and 146 (56.37) of the adolescent girls also reported that red meat, fish, and liver were good sources of iron respectively (Figure 4.8).

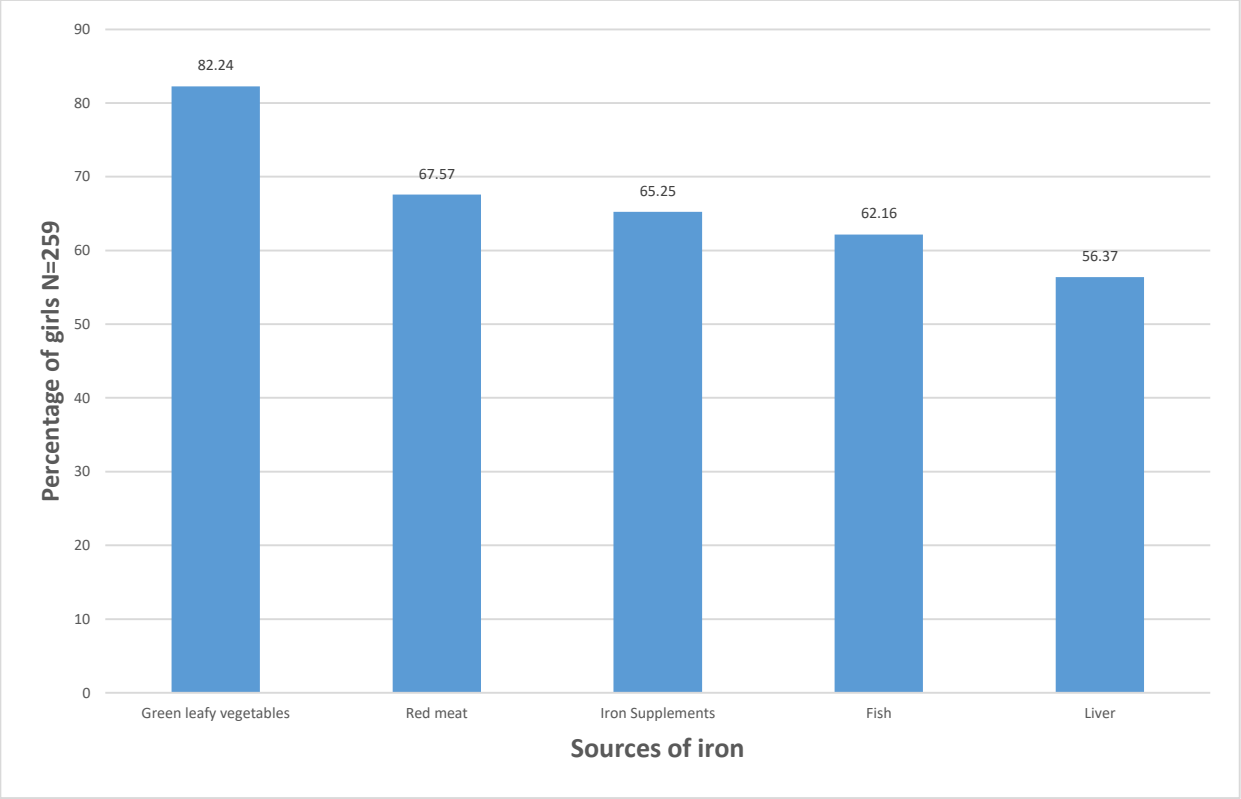

Figure 4.8: Sources of Iron

CHAPTER FIVE

DISCUSSIONS

5.1 Introduction

The objectives of the study were to assess the dietary habits and the prevalence of anaemia among pregnant adolescent girls and to explore the knowledge of the girls on anaemia, as well as the dietary habits associated with the prevalence of anaemia among these girls in the Upper East Region of Ghana.

5.2 Prevalence of Anaemia in Pregnant Adolescent Girls

The results from the study revealed that, in the Upper East Region, anaemia was a severe public health problem and persistent among pregnant adolescent girls. This was established based on the results that, out of the 331 pregnant adolescent girls recruited for the study, anaemia was found in 218 (65.86%) of them while 113 (34.14%) were not anaemic when the WHO classification for pregnant women was used. Anaemia is a public health concern where more than 5% of the population is anaemic and where a prevalence of more than 20% occurs, a major public health problem that needs urgent attention. Anaemia becomes a serious public health issue if the prevalence reaches 40% (De Benoist & Mclean, 2008). This prevalence of anaemia (65.86%) found in the study in comparison with similar studies in other low- and middle-income countries, even though some of those studies sighted indicate a relatively high prevalence ranging from 36 – 76.1 per cent (Bopape et al., 2008; Intiful et al., 2016; Mistry et al., 2017; Pinho-Pompeu et al.,

2017; Sowayi & Kagwiria, 2013) is equally high. Additionally, this finding is higher than that reported in the 2014 Ghana Demographic and Health Survey (GDHS) where, overall, 44.6% of pregnant women in Ghana suffered from anaemia (Ghana Statistical Service, 2014). Despite the high anaemia prevalence found in this present study, it is still lower than the 86.4% prevalence found by Viveki et al., (2010) among pregnant women less than 18 years in their study on the Prevalence of Anaemia and Its Epidemiological Determinants in Pregnant Women of Belgaum, Karnataka in India and the 76.1% prevalence found in Ghana by Intiful et al., (2016).

5.3 Dietary Habits of Pregnant Adolescent Girls

The diets people eat, in all their cultural variety, define to a large extent people's health, growth, and development. Diet and nutrition are essential factors in the promotion and maintenance of good health throughout the entire life course (Abdel-Hady et al., 2014). Consumption of foods such as meats, poultry, fish, liver, and eggs within the week to the study was low among the pregnant girls. Additionally, vegetable consumption as well as the consumption of fruits which has been established by literature to facilitate the absorption of iron is low among the girls. This low consumption pattern of these vital nutrients has been reported in several other studies. Notably among them is the study by Alaofè, Zee, Dossa, & Turgeon O'brien, (2020) on the Iron status of adolescent girls from two boarding schools in southern Benin. In this study, they found that the majority of adolescent girls had a low consumption frequency of meat, poultry, legumes, vegetables, and fruits (Alaofè et al., 2020). Meat is a healthy source of high-quality protein, iron, zinc, and all B vitamins except folic acid (Anand Rao et al., 2016).

Additionally, from the responses of the girls, bread or flour products were the most consumed food by the pregnant girls within the week before the interview. Findings of this nature are not surprising because several other studies have shown that diets in most developing countries are predominantly cereal-based (Ekesa et al., 2011; Kennedy et al., 2007). The findings of this study lend evidence to this claim.

In this present study, fried foods examples of which have been listed earlier in the results of this study were found to be consumed by three out of every four of the pregnant adolescent girls within the week to the study. Similar results were found by Siega-Riz, Bodnar, & Savitz, (2002) in a population of pregnant women of a different race. Consumption of high-fat diets may be of concern to pregnant women, given not only their propensity to gain weight above the weight gain expectations, but also the issue of postpartum weight retention (Cogswell et al., 1999; Keppel & Taffel, 1993).

Additionally, consumption of tea among the respondents was not so low as a little below half of the girls were found to have indulged in tea taking within the week prior to the study. This finding is less than the one reported by Lu et al., (2017) in their study of tea consumption in pregnant women. In that study, a low prevalence (only 16%) of tea drinking was observed in the study population. Persistent consumption of tea during pregnancy should be discouraged since it is associated with an increased risk of pre-eclampsia (Wei et al., 2009). Additionally, geophagy, which is defined as the deliberate eating of earth/clay by Nchito, Wenzel Geissler, Mubila, Friis, & Olsen, (2004) is not a good practice since it

has been found by several cross-sectional studies to be associated with iron deficiency or anaemia (Danford, 1982; Geissler et al., 1998; Lacey, 1990; Rainville, 1998) and also found in this present study.

5.4 Knowledge of Pregnant Adolescent Girls on anaemia

The anaemia - related knowledge of the pregnant adolescent girls studied were investigated and found to be generally adequate. In the results of this study, for every ten pregnant adolescent girls interviewed, eight could mention at least one cause of anaemia. The causes of anaemia outlined by the pregnant girls were mainly poor diets which were deficient in iron, heavy blood loss from menstruation or injuries, malaria, worm infestation, and the eating of soil/clay. These findings on the causes of anaemia in this present study are similar to what was found in several other studies among the pregnant populace or women of reproductive ages. In some of these studies, the leading cause of anaemia among pregnant women and adolescents was reported as being the insufficient consumption of iron-rich diets, excessive menstrual bleeding, parasitic infections such as malaria and hookworm infestation (Brooker et al., 2008; Keding et al., 2011; McClure et al., 2014; Okube et al., 2015; Ononge et al., 2014; Pattnaik et al., 2013)

Additionally, in every ten pregnant adolescent girls interviewed, eight could name a sign or complication that could occur due to anaemia. This finding is a shortfall of what was reported by Dwumfour-Asare & Kwapong, (2014) in a study among pregnant women at Brosankro community in Ghana. In their study, they found that all respondents were able to name at least one sign or symptom that indicates anaemia in pregnancy. In this study,

among the signs or symptoms or complications of anaemia which was reported by the respondents in this study are lack of concentration, weakness, dizziness, paleness of eyes, nail beds and tongue, repeated infections, shortness of breath, fainting, and feeling cold. Paleness of eyes, nail beds and tongue in this present study was reported by more than 70 per cent of the girls. This is also similar to the findings of Dwumfour-Asare & Kwapong, (2014) where it was found that 70 per cent of respondents were more familiar with signs like pale palm & conjunctiva. These symptoms are among conditions widely accepted in the literature to be associated with anaemia (Dwumfour-Asare & Kwapong, 2014).

Furthermore, it was found from this present study that 87.92% of the pregnant adolescent girls could tell how anaemia can be prevented in an individual. This finding is similar to the results found from a study on the knowledge and practice of mothers regarding the prevention of anaemia during pregnancy in a teaching hospital in Kathmandu which seems to be satisfactory (Ghimire & Pandey, 2013). From this study, dietary approaches were accounting for more than 65 per cent of the responses on how to prevent anaemia. These are above the findings by Anitha, (2005) where she found that 56.27% of pregnant mothers knew diet as being a preventive strategy for anaemia.

In the present study, most pregnant adolescents have identified the main iron-containing food sources. This result is supported by a study done in Sri Lanka (Hewawaduge et al., 2019) and Palestine (Moradi et al., 2007). According to this study, green leafy vegetables, red meat, fish and liver are the best-known sources of iron. These findings corroborate the findings of Hewawaduge et al., (2019) in their study among pregnant women.

Knowledge about the ways of treating anaemia was generally low among pregnant girls. This finding contradicts that of Kabir et al., (2010) where perceptions regarding anaemia treatment were found to be high among adolescent girls. However, in the present study, the taking of iron supplements was ranked the highest anaemia treatment strategy among the respondents. This goes to corroborate the findings of a similar study done among adolescent girls in Dhaka, Bangladesh (Kabir et al., 2010)

In the present study, the high knowledge on the causes, signs/complications, prevention, vitamin/mineral cause, and good sources of anaemia could be attributed to high levels of nutritional knowledge and formal education. More than 80 per cent of the girls interviewed had attained some level of formal education and assumed to be able to read the information on health education provided in their maternal health record books (ANC cards). Additionally, the girls interviewed were clients who had started ante-natal care, and therefore they might have received some form of nutrition education from the health care workers.

5.5 Strengths of the study

The greatest strength of this study is that interviews were conducted in local languages well-spoken and understood by the pregnant adolescent girls because most of the study locations were in rural communities. The study independently carried out haemoglobin estimation on the day of the interview with the pregnant adolescent girls using the same standard equipment to ensure uniformity. Lastly, the processes of conducting the

laboratory tests and dietary recall employed trained individuals to avoid disparities in reporting.

5.6 Limitations of the study

This study has some limitations. Key among which is recall bias by respondents during the dietary recall assessments, some may have forgotten the exact number of days in a week they might be consuming some foods. Additionally, in the assessment of the consumption of some foods, a 7-day recall of the immediate past week of the study was conducted, and this may not be representative of the usual consumption patterns of the girls. This study did not have information on the quantity of the foods consumed by the pregnant girls and so a mere assertion that a portion of food was eaten, was counted as haven been consumed for that day. Furthermore, this study only targeted pregnant adolescent girls who attended health facilities for antenatal care. Despite these limitations, this study gives us some important insights into the level of anaemia in pregnant adolescent girls and its associated food consumption factors in the Upper East Region.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study concludes that the overall prevalence of anaemia among pregnant adolescent girls in the Upper East Region was higher than that recorded for the country in the Demographic and Health Survey of 2014 and this can be classified as a significant public health issue. Consumption of meat, poultry, eggs, fruits and vegetables, legumes, as well as non-nutritive substances such as sand and clay were some of the factors that were found to be associated with anaemia prevalence at the univariate level. However, at the multivariate level when all the factors were put in a model, consumption of meat and the consumption of fish were found to be associated with anaemia prevalence. They were found to be protective against being anaemic. The study result showed that knowledge regarding the cause of anaemia, signs/complications of anaemia, anaemia prevention measures, vitamin/mineral deficiency causing anaemia, as well as the good sources of iron, was good among pregnant adolescent girls. However, knowledge regarding the treatment of anaemia was poor. The findings of this study is of significant importance to public health practitioners in their efforts at the prevention of anaemia in the region and the country as a whole.

6.2 Recommendations

Based on the study findings the following recommendations are provided:

1. The Ministry of Health should formulate National policies to encourage the consumption of diversified foods in the populations must be fully implemented. This policy would enhance the food consumption and nutritional condition of pregnant women.
2. There is the need to sustain the education of antenatal attendees by the Midwives, Nutrition Officers and Community Health Officers since some women could forget or miss concepts altogether.
3. Although the education of pregnant women should be an ongoing initiative to raise awareness and enhance compliance with supplementation. Also, more complementary interventions such as fortification, dietary diversification, and the reduction of infections need to be scaled up by the Food and Drugs Authority and Ghana Standards Authority. Such a strategy is likely to ensure diverse iron sources are consumed as well as minimize iron losses.
4. Nutrition screening carried out by the Midwives, Nutrition Officers and Community Health Officers for pregnant women accessing antenatal care services is important during pregnancy to identify those at nutritional risk in time for correction. It should be strictly adhered to.
5. To obtain more accurate estimates of anaemia prevalence, future research by individuals should take into account other causes of the disease that could have affected the prevalence of anaemia.

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APPENDICES

Appendix 1: Information Sheet

INFORMATION SHEET

ASSOCIATION BETWEEN DIETARY HABITS AND ANAEMIA AMONG PREGNANT ADOLESCENTS ATTENDING ANTENATAL CARE CLINICS IN THE UPPER EAST REGION

Background and Purpose of the research: Dietary habits of individuals have been identified as a significant contributor to their health and wellbeing. Research into the prevalence and determinants of anaemia among pregnant adolescents is important for deciding control strategies in this age group.

The purpose of this research is to assess the dietary habits and their association with anaemia in pregnant adolescent girls in the Upper East Region of Ghana. This study is my Master project work as the Principal Investigator (PI) and has the support of the University of Ghana, and Ghana Health Service, Upper East Regional Health Directorate.

The results of this study will also help healthcare providers to develop and tailor specific health information to improve on the general wellbeing of pregnant adolescents in the region and country at large.

Nature of research: We have planned to include 308 Pregnant Adolescent Girls in the Upper East Region of Ghana in this study. The study will be a onetime engagement where

socio-demographic and diet-related data will be collected through interview, as well as haemoglobin test is done by pricking your finger, drawing blood to check if you have anaemia or not after your consent.

Duration /what is involved: The entire process is expected to last not more than 30 minutes. During the one-on-one interview, some socio-demographic information (age, occupation, marital status, religion, income, ethnicity and level of education, gravidity, parity, gestational age, household size etc.) will be obtained. Adolescent Dietary Habit information and information on the consumption of iron and iron-rich foods will be asked. Knowledge of the research respondents will be tested in questions concerning symptoms, causes, anaemia prevention and treatment. This will be done by a trained Nutritionist/Nurse. Anaemia will be assessed by measuring haemoglobin (Hb) concentration in your blood using a HemoCue (Hb-301) device. This will be carried out by a Trained Laboratory Technician and expected to be done within a minute.

Potential Risks: There is no risk involved. Taking blood from the finger of your adolescent girl using a prick for tests may cause slight physical pain or discomfort, but this will be very brief and precautions will be used to ensure that the finger prick is conducted safely.

Benefits: There will probably be little or no direct benefit to you for taking part in this study. However, our test may detect anaemia (Hb <11 g/dl) which can affect you which might not have been otherwise detected. This early detection could result in earlier treatment and improved health care.

Costs: You will not incur any cost for agreeing to take part in this survey. All costs in doing the test will be borne by the Principal Investigator.

Compensation: There will be no monetary compensation for taking part in this study because the research is solely for academic purpose.

Confidentiality: All information related to your participation in this study will be kept confidential and will not be revealed to anyone apart from those who are directly involved in the study. Any information obtained from this study will be kept confidential by storing the files in a cabinet which will be locked with a key. Soft copy of the data to be generated from this survey will be stored on a computer which will be encrypted with a password. Analysis of the data will be done using identification codes and no identity will be revealed in any reports or publications resulting from this study.

Voluntary participation/withdrawal: Taking part in the study is purely voluntary. If you do not want to take part in this study, you are obliged to withdraw. You may also withdraw from the study at any time and for any reason without being affected.

Provision of Information and Consent for participants: You will be given a copy each of this information sheet and consent forms after you have signed or thumb printed to keep for any reference.

Who to Contact for Further Clarification/Questions: If you want any more information at any time during the study, you can please contact the interviewer or any of the following:

- The principal investigator Arafat Korlenya Hamid at the Department of Epidemiology & Disease Control, School of Public Health of the University of

Ghana, Legon on any of the following contact numbers: 0209348114 or email: akhamid@st.ug.edu.gh

- Dr Adolphina Addo-Lartey (PhD), Lecturer, Department of Epidemiology & Disease Control, School of Public Health at the University of Ghana, Legon, on contact number: 0504522987 or email: aaddo.lartey@gmail.com
- If you have any questions about this study or your rights as a participant, you may contact Nana Abena Apatu (Administrator, Ghana Health Service Ethics Review Committee) on Tel: 0503539896.

Appendix 2: Participant Consent Form

PARTICIPANT CONSENT FORM

ASSOCIATION BETWEEN DIETARY HABITS AND ANAEMIA AMONG PREGNANT ADOLESCENTS GIRLS ATTENDING ANTENATAL CARE CLINICS IN THE UPPER EAST REGION

PARTICIPANTS ' STATEMENT

I acknowledge that I have read or have had the purpose and contents of the Information Sheet satisfactorily read and explained to me in a language I understand (English, Gurune, Nankani, Kassem, Talen, Nabt, Kusal, Buli, Bisah). I fully understand the contents and any potential implications as well as my right to change my mind (ie withdraw from the research) even after I have signed this form. I have had the opportunity to make clarifications about the study and any question I have asked has been answered to my satisfaction.

I voluntarily agree to take part in this research.

Name or Initials of Participant …….. ID Code …….

Participants' Signature/Thumbprint …… Date: …….

INTERPRETERS' STATEMENT (where applicable)

I interpreted the purpose and contents of the Information Sheet to the aforenamed participant to the best of my ability in the (English, Gurune, Nankani, Kassem, Talen, Nabt, Kusal, Buli, Bisah) language to his proper understanding.

All questions, appropriate clarifications sort by the participant and answers were also duly interpreted to his/her satisfaction.

Name of Interpreter ……..……

Signature of Interpreter ……..….. Date: ……

Contact Details …..……

STATEMENT OF WITNESS (where applicable)

I was present when the purpose and contents of the Information Sheet was read and explained satisfactorily to the participant in the language he/she understood (English, Gurune, Nankani, Kassem, Talen, Nabt, Kusal, Buli, Bisah)

I confirm that he/she was allowed to ask questions/seek clarifications and the same were duly answered to his/her satisfaction before voluntarily agreeing to be part of the research.

Name: ……

Signature/Thumbprint ……..……. Date: ……

INVESTIGATOR STATEMENT AND SIGNATURE

I certify that the information (the nature and purpose, the potential benefits, and possible risks) on the information sheet has been duly explained to the respondent and that she understood what was said. All questions and clarifications raised by the participant have been addressed and she has agreed that she would take part in the study.

Researcher's name ……..…….

Signature …….

Date …….

Appendix 3: Parental Consent Form

PARENTAL CONSENT FORM

ASSOCIATION BETWEEN DIETARY HABITS AND ANAEMIA AMONG PREGNANT ADOLESCENTS GIRLS ATTENDING ANTENATAL CARE CLINICS IN THE UPPER EAST REGION

PARENTS ' STATEMENT

I acknowledge that I have read or have had the purpose and contents of the Information Sheet satisfactorily read and explained to me in a language I understand (English, Gurune, Nankani, Kassem, Talen, Nabt, Kusal, Buli, Bisah). I fully understand the contents and any potential implications as well as my right to change my mind (ie withdraw my child from the research) even after I have signed this form. I have had the opportunity to make clarifications about the study and any question I have asked has been answered to my satisfaction.

I voluntarily agree that my child takes part in this research.

Name or Initials of Parent …….. ID Code …….

Parents' Signature/Thumbprint …….…… Date: …….

INTERPRETERS' STATEMENT (where applicable)

I interpreted the purpose and contents of the Information Sheet to the aforenamed parent of the participant to the best of my ability in the (English, Gurune, Nankani, Kassem, Talen, Nabt, Kusal, Buli, Bisah) language to his proper understanding.

All questions, appropriate clarifications sort by him/her and answers were also duly interpreted to his/her satisfaction.

Name of Interpreter ……

Signature of Interpreter ……..…….. Date: ……

Contact Details …..……

STATEMENT OF WITNESS (where applicable)

I was present when the purpose and contents of the Information Sheet was read and explained satisfactorily to the participants' parent in the language he/she understood (English, Gurune, Nankani, Kassem, Talen, Nabt, Kusal, Buli, Bisah)

I confirm that he/she was allowed to ask questions/seek clarifications and the same were duly answered to his/her satisfaction before voluntarily agreeing that his/her child be part of the research.

Name: ……

Signature/Thumbprint ……..……. Date: ……

INVESTIGATOR STATEMENT AND SIGNATURE

I certify that the parent of the participants has been adequately informed about the nature and intent of the information, potential benefits, and possible risks. Clarifications needed and questions asked by the participant's parent has been answered and he/she has decided that his/her child should take part in the study.

Researcher's name ……..……

Signature …….

Date …….

Appendix 4: Child Assent Form

CHILD ASSENT FORM

ASSOCIATION BETWEEN DIETARY HABITS AND ANAEMIA AMONG PREGNANT ADOLESCENTS GIRLS ATTENDING ANTENATAL CARE CLINICS IN THE UPPER EAST REGION

VOLUNTARY AGREEMENT

By printing a mark or thumb below, you understand and know the issues of this study and you want to be part of it. Please don't sign this approval form if you don't want to participate in this report. A copy of the information sheet explained to you and this form will be provided to you and your parents after you have signed.

The Information Sheet which describes the benefits, risks and procedures for the research titled **"Association between Dietary Habits and Anaemia among Pregnant Adolescents Girls Attending Antenatal Care Clinics in the Upper East Region"** has been read and or explained to me. I have been allowed to have any questions about the research answered to my satisfaction. I agree to participate in the research.

Name or Initials of Participant …….. ID Code …….

Participants' Signature/Thumbprint ……

Date: …….

Researcher's name ……..…….

Signature …….

Date …….

Appendix 5: Questionnaire

QUESTIONNAIRE FOR PREGNANT ADOLESCENT GIRLS

DEPARTMENT OF EPIDEMIOLOGY AND DISEASE CONTROL

SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF GHANA, LEGON.

ASSOCIATION BETWEEN DIETARY HABITS AND ANAEMIA AMONG PREGNANT ADOLESCENTS GIRLS ATTENDING ANTENATAL CARE CLINICS IN THE UPPER EAST REGION

Questionnaire No: …… Municipality/District: …….

Health Facility: …… Name of community……

Date ……/……..… /20…….

Socio-Demographic Data			
S1	Age *(In completed years)* (confirm from any valid ID)		
S2	Marital status	Single [ ] Married [ ] Divorced [ ] Widowed [ ] Co-habiting [ ]	01 02 03 04 05

S3	Ethnicity		
S4	Religion	Christian [ ] Muslim [ ] Traditionalist [ ] Others (Specify) [ ] ……	01 02 03 04
S5	Occupation	Unemployed [ ] Farmer [ ] Trader/Business [ ] Others (Specify) [ ] ……	01 02 03 04
S6	Level of formal education	No formal education [ ] Primary [ ] Junior High School [ ] Senior High School [ ] Tertiary [ ]	01 02 03 04 05
S7	Age of current pregnancy (weeks) (Confirm from ANC card)		
S8	How many times have you been pregnant?		
S9	How many past deliveries have you had?		
S10	What is your monthly income? *(in Ghc)*		
S11	How many people live in your household?		

S12	Who is the head of your household?	My father [ ] My husband [ ] Father-in-law [ ] Mother-in-law [ ] Others (Specify) [ ] ……	01 02 03 04 05

Adolescent Food Habit Checklist

"Now we are going to talk about your food habits. The different foods you consume and how you often prefer it.

A1	If you are having lunch away from home, do you often choose a low-fat option?	Yes [ ] No [ ] N/A [ ]	01 02 03
A2	Do you usually avoid eating fried foods?	Yes [ ] No [ ]	01 02
A3	Do you usually eat a dessert or pudding if there is one available?	Yes [ ] No [ ]	01 02
A4	Do you make sure you eat at least one serving of fruit a day?	Yes [ ] No [ ]	01 02
A5	Do you try to keep your overall fat intake down?	Yes [ ] No [ ]	01 02
A6	If you are buying crisps, do you often choose a low-fat brand?	Yes [ ] No [ ] N/A [ ]	01 02 03

A7	Do you avoid eating lots of sausages and burgers?	Yes [ ] No [ ] N/A [ ]	01 02 03
A8	Do you often buy pastries or cakes?	Yes [ ] No [ ]	01 02
A9	Do you try to keep your overall sugar intake down?	Yes [ ] No [ ]	01 02
A10	Do you make sure you eat at least one serving of vegetables or salad a day?	Yes [ ] No [ ]	01 02
A11	If you are having a dessert at home, do you try to have something low in fat?	Yes [ ] No [ ] N/A [ ]	01 02 03
A12	Do you rarely eat takeaway meals?	Yes [ ] No [ ]	01 02
A13	Do you try to ensure that you eat plenty of fruit and vegetables?	Yes [ ] No [ ]	01 02
A14	Do you often eat sweet snacks between meals?	Yes [ ] No [ ]	01 02
A15	Do you usually eat at least one serving of vegetables (excluding potatoes) or salad with your evening meal?	Yes [ ] No [ ]	01 02
A16	When you are buying a soft drink, do you usually choose a diet drink?	Yes [ ] No [ ]	01 02

A17	When you put butter or margarine on bread, do you usually spread it on thinly?	Yes [ ] No [ ] N/A [ ]	01 02 03
A18	If you have a packed lunch, do you usually include some chocolate and/or biscuits?	Yes [ ] No [ ] N/A [ ]	01 02 03
A19	When you have a snack between meals, do you often choose fruit?	Yes [ ] No [ ] N/A [ ]	01 02 03
A20	If you are having a dessert or pudding in a restaurant, do you usually choose the healthiest one?	Yes [ ] No [ ] N/A [ ]	01 02 03
A21	Do you often have cream on desserts?	Yes [ ] No [ ] N/A [ ]	01 02 03
A22	Do you eat at least 3 servings of fruit on most days?	Yes [ ] No [ ]	01 02
A23	Do you generally try to have a healthy diet?	Yes [ ] No [ ]	01 02
Dietary habits			
"Now we are going to talk about the different foods you might have consumed yesterday from the time you woke up, throughout the day, during the night until you finally went to sleep. I am going to			

read to you a list of foods and I would like you to tell me if or not you consumed those foods yesterday. Afterwards, you will tell me how many days in the past 7 days did you eat it.			
D1	Any meats such as beef, pork, lamb, goat, wild game?	Yes [ ] No [ ]	01 02
D1a	How many days in the past 7 days did you eat it?		
D2	Any chicken, duck, turkey, Guinea fowl or other birds, or meat products like sausage or kebabs?	Yes [ ] No [ ]	01 02
D2a	How many days in the past 7 days did you eat it?		
D3	Any fish?	Yes [ ] No [ ]	01 02
D3a	How many days in the past 7 days did you eat it?		
D4	Any liver, kidney, heart or other organ meats?	Yes [ ] No [ ]	01 02
D4a	How many days in the past 7 days did you eat it?		
D5	Any eggs?	Yes [ ] No [ ]	01 02
D5a	How many days in the past 7 days did you eat it?		
D6	Any dark green leafy vegetables or dishes made with dark green leafy vegetables such as cocoyam leaves, cassava leaves, bean leaves, pumpkin leaves, or spinach?	Yes [ ] No [ ]	01 02
D6a	How many days in the past 7 days did you eat it?		
D7	Any oranges, lemons, sour sap (Aluguntugui), African star fruit (Alasa), pineapple, sweet apple (sweet sup), pawpaw, mango, or baobab pulp?	Yes [ ] No [ ]	01 02

D7a	How many days in the past 7 days did you eat it?		
D8	Any cowpea, soya beans, groundnuts, or melon seeds?	Yes [ ] No [ ]	01 02
D8a	How many days in the past 7 days did you eat it?		
D9	Any bread or flour products like brofrot, atsomor, polo, meat pie, cake, or tart?	Yes [ ] No [ ]	01 02
D9a	How many days in the past 7 days did you eat it?		
D10	Any tea such as Lipton?	Yes [ ] No [ ]	01 02
D10a	How many days in the past 7 days did you have it?		
D11	Any Milo, Ovaltine, Cerelac, Yumvita or Nido?	Yes [ ] No [ ]	01 02
D11a	How many days in the past 7 days did you have it?		
D12	Any local juices such as Hausa beer, sobolo, tamarind juice, rice water, or other juice?	Yes [ ] No [ ]	01 02
D12a	How many days in the past 7 days did you have it?		
D13	Any foods that were fried such as plantain chips, yam chips, achumo, polo, brofrot, koose, or meat pies?	Yes [ ] No [ ]	01 02
D13a	How many days in the past 7 days did you have it?		
D14	Any soil or clay?	Yes [ ] No [ ]	01 02
D14a	How many days in the past 7 days did you have it?		
Household Hunger Scale			

H1	In the past [4 weeks/30 days], was there ever no food to eat of any kind in your house because of a lack of resources to get food?	No [ ] Yes [ ]	00 01
H1a	How often did this happen in the past [4 weeks/30 days]?	Rarely (1–2 times) [ ] Sometimes (3–10 times) [ ] Often (more than 10 times) [ ]	01 02 03
H2	In the past [4 weeks/30 days], did you or any household member go to sleep at night hungry because there was not enough food?	No [ ] Yes [ ]	00 01
H2a	How often did this happen in the past [4 weeks/30 days]?	Rarely (1–2 times) [ ] Sometimes (3–10 times) [ ] Often (more than 10 times) [ ]	01 02 03
H3	In the past [4 weeks/30 days], did you or any household member go a whole day and night without eating anything at all because there was not enough food?	No [ ] Yes [ ]	00 01
H3a	How often did this happen in the past [4 weeks/30 days]?	Rarely (1–2 times) [ ] Sometimes (3–10 times) [ ] Often (more than 10 times) [ ]	01 02 03
Knowledge of Anemia causes, prevention, treatment, complications			
K1	Have you ever heard about anaemia or [USE LOCAL TERM]?	Yes [ ] No [ ]	01 02 skip to K9

K2	How can you tell if a person has anaemia? *[select all responses given]*	Lack of concentration [ ] Weakness/ unable to work [ ] Shortness of breath [ ] Repeated infections [ ] Pale eyes, nails, tongue [ ] Dizziness/ Easy to faint [ ] Sleepy/ Fatigue/ Tired [ ] Feel cold [ ] Other (specify) [ ] ……. Don't know [ ]	01 02 03 04 05 06 07 08 98 99
K3	What do you think causes anaemia? *[select all responses given]*	Heavy loss of blood [ ] Poor diet [ ] Diet lacks iron [ ] Diet lacks vitamins [ ] Malaria [ ] Parasites [ ] Lack of red meat in the diet [ ] Eating soil/clay [ ] Other (specify) [ ] …… Don't know [ ]	01 02 03 04 05 06 07 08 98 99
K4	What do you think can prevent anaemia? *[select all responses given]*	Eating meat/liver [ ] Eating green vegetables [ ] Preventing malaria [ ]	01 02 03

		Sleeping under a bed net [ ] Deworming [ ] Taking Iron medicines [ ] Seeking health care [ ] Sleeping well/ resting [ ] Other (specify) [ ] …… Don't know [ ]	04 05 06 07 08 98 99
K5	Which vitamin-mineral deficiency in the body causes anaemia? *[select all responses given]*	Iron [ ] Zinc [ ] Folate [ ] B12 [ ] Vitamin A [ ] Vitamin C [ ] Vitamin D [ ] Other (specify) [ ] …… Don't know [ ]	01 02 03 04 05 06 07 98 99
K6	Have you ever had/experienced anaemia or [LOCAL NAME]?	Yes [ ] No [ ]	01 02 skip to QK9
K7	Did you seek help for treating anaemia?	Yes [ ] No [ ]	01 02 skip to QK9

K8	What were you given to treat the anaemia?	Iron/folic acid supplements [ ] Blood transfusion [ ] Dietary instructions [ ] Nothing [ ] Other (specify) [ ] …… Don't know [ ]	01 02 03 04 98 99
K9	Have you ever heard of Iron Folic Acid (IFA) tablets?	Yes [ ] No [ ]	01 02 skip to QK11
K10	What do Iron Folic Acid (IFA) tablets do? *[select all responses given]*	More energy [ ] More alert/learn better [ ] Improves your blood [ ] Fights/avoids infection [ ] Prevents birth defects [ ] Avoids anaemia [ ] Other (specify) [ ] …… Don't know [ ]	01 02 03 04 05 06 98 99
K11	Did you take any supplements/vitamins that contain iron in the last 7 days?	Yes [ ] No [ ]	01 02
K12	What are good sources of iron? *[select all responses given]*	Red meat [ ] Liver [ ] Green leafy vegetables [ ]	01 02 03

		Fish [ ] Iron supplements [ ] Other (specify) [ ] …… Don't know [ ]	04 05 98 99
Blood Haemoglobin Test			
	Haemoglobin (HB)	___ ___.___ g/dl	

Appendix 6: Haemoglobin Test Form

BLOOD HAEMOGLOBIN TEST FORM

RESPONDENT QUESTIONNAIRE NUMBER: _____

Municipality/District: _____

Health Facility: _____

Name of community: _____

Date	___ ___ : ___ ___ : ___ ___	
Time of collection	___ ___ : ___ ___ am/pm	
Haemoglobin (HB)	___ ___.___ g/dl	
Classification	Any anaemia [ ] No anaemia [ ]	01 02
Action to be taken	Will need a referral [ ] No need for referral [ ]	01 02

Appendix 7: Referral Form

MEDICAL REFERRAL FORM

Date: ……

Name of Patient: ……

Date of Birth: …….

Dear Dr. .....,

The above named pregnant adolescent was recently involved in a research project to assess her dietary habit and anaemia using Adolescent Food Habit Checklist and a HemoCue 301 device. It was observed that she recorded the haemoglobin value …… g/dl.

We are therefore referring her to your facility for appropriate medical care. We are most grateful for your assistance.

Sincerely,

Mr Arafat Korlenya Hamid

Principal Investigator

School of Public Health University of Ghana, Legon

Appendix 8: Ethical Approval Letter

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

In case of reply the number and date of this Letter should be quoted

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Mob: 0503539896
Email: ethics.research@ghsmail.org

MyRef. GHS/RDD/ERC/Admin/App|19|705
Your Ref. No.

19th December, 2019

Arafat Korlenya Hamid
University of Ghana
School of Public Health
Legon, Accra

The Ghana Health Service Ethics Review Committee has reviewed and given approval for the implementation of your Study Protocol.

GHS-ERC Number	**GHS-ERC019/12/19**
Project Title	Association between Dietary Habits and Anaemia among Pregnant Adolescents Attending Antenatal Care Clinics in the Upper East Region
Approval Date	19th December, 2019
Expiry Date	18th December, 2020
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of yearly progress report of the study to the Ethics Review Committee (ERC)
- Renewal of ethical approval if the study lasts for more than 12 months,
- Reporting of all serious adverse events related to this study to the ERC within three days verbally and seven days in writing.
- Submission of a final report **after completion** of the study
- Informing ERC if study cannot be implemented or is discontinued and reasons why
- Informing the ERC and your sponsor (where applicable) before any publication of the research findings.

Please note that any modification of the study without ERC approval of the amendment is invalid.

The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Kindly quote the protocol identification number in all future correspondence in relation to this approved protocol

SIGNED.....
DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra