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PREVALENCE AND RISK FACTORS OF ANAEMIA AMONG ANTENATAL CARE (ANC) ATTENDANTS AT THE KINTAMPO NORTH MUNICIPAL HOSPITAL

BY

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DECLARATION

I certify that this dissertation proposal has not been submitted for any degree and is not being submitted as part of candidature for any other degree. I also certify that the proposal has been written by me and any help received in writing this proposal and all resources used, have been duly acknowledged under the supervision of Dr. Alexander Manu in the Department of Epidemiology and Disease Control of the School of Public Health, University of Ghana.

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DEDICATION

This work is dedicated to almighty Allah, the lord of the worlds, Prophet Muhammad (s.a.w.a) and his household for their divine guidance in my life. Then to Alhaji Alifa Sumaila Abubakar and Hajia Khadijatu Iddris for their continuous prayer and endless support. May Allah grant them long life in this world and paradise on the day of reckoning.

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ABSTRACT

INTRODUCTION: Anaemia in pregnant women is a common global phenomenon. It is endemic in developing countries and often results in complications for both the mother and the foetus (born or unborn). Neonates born to iron-deficient mothers are more susceptible to anaemia, are low birthweight or preterm and have higher mortality. WHO estimates showed that Sub-Saharan Africa has the highest prevalence of 57.1%. The objective of the study was to estimate the prevalence and assess the factors associated with anaemia among antenatal care attendants at Kintampo North Municipal Hospital (KMH).

METHODS: A cross-sectional study was carried out among 496 pregnant women, who attended KMH between May and June 2019, to estimate the prevalence of anaemia and its associated factors among them. Structured questionnaires were used to obtain information on socio-demographic factors, medical history and key dietary consumption patterns of participants. The main outcome of interest is anaemia in pregnancy defined as a haemoglobin concentration of 11.0g/dl or less. Test of associations between independent variables thus age, marital status, parity and occupation, and the dependent variable (anaemia) was examined using chi-squared/exact tests. Binary logistic regression models were also fitted after dichotomizing the outcome by whether the woman had anaemia or not. Statistical significance was assessed at the 5% level and 95% confidence intervals were constructed around estimates where applicable.

RESULTS: In total, 496 participants were enrolled in the study. The mean (±sd) age of the subjects was 28.3 ± 5.6 years. The prevalence of anaemia was 28.4% (21.1% mild and 7.3% moderate). Maternal anaemia was significantly associated with mother's educational level ($p<0.001$), occupation ($p<0.001$), vegetable/fruit consumption ($p<0.001$) and pica

(p<0.001). Results of binary logistic regression analysis showed that maternal anaemia was also significantly associated with educational level: (basic, p=0.015; junior high school, p=0.049), occupation (self-employed, p=0.002; unemployed, p=0.014, other, p<0.001) frequency of vegetable consumption (once a week, p=0.009; twice a week, p<0.001) and pica (yes, p<0.001).

CONCLUSION: Prevalence of anaemia in pregnant women was 28.4%. Pica, educational level, occupation and frequency of intake of dark green leafy vegetables and fruits were associated with anaemia among pregnant women. It is therefore important to continue health promotion on adequate intake of vegetables, fruits and avoidance of pica, especially during pregnancy.

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LIST OF ABBREVIATIONS

ANC	Antenatal Clinic
AOR	Adjusted Odds Ratio
COR	Crude Odds Ratio
CI	Confidence Interval
GDHS	Ghana Demographic Health Survey
GHS	Ghana Health Service
GSS	Ghana Statistical Service
Hb	Haemoglobin
H/C	Health Centre
CHPS	Community-based Health Planning and Services
ITNs	Insecticide-Treated Mosquito Nets
KMH	Kintampo North Municipal Hospital
KNMHD	Kintampo North Municipal Health Directorate
LMICs	Low and Middle Income Countries
RBC	Red Blood Cell
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

The demand for iron in the blood increases with pregnancy. This leads to increased risk of iron deficiency in pregnant women with 57.1% of them in developing countries suffering from anaemia (Abu Hashim, Foda, & Ghayaty, 2017). In 2014, a study by Shill *et al.*, indicated that it is abnormal for haemoglobin levels to drop below 11g/dL at any time during pregnancy. Anaemia is low haemoglobin levels in the blood and is a global nutritional complication that is considered an epidemic because it affects about half of pregnant women in many developing countries (Shubair, 2014). It is classified according to levels of haemoglobin. Iron deficiency should be considered anytime anaemia is diagnosed (Shill *et al.*, 2014). A full blood count that shows anomalies in red blood cells usually precedes the development of low levels of haemoglobin (Burke, Leon, & Suchdev, 2014). The development of iron deficiency is a gradual process that may not be easily diagnosed. Iron absorption is effective with increasing demand. After absorption, red blood cells are then produced from protein-bound irons that are transported to the bone marrow (J.-O. Lee *et al.*, 2014).

About 50% of reported cases of anaemia in developing countries are related to nutritional anaemias and they occur because of insufficient iron intake (Kassebaum *et al.*, 2014). Diet restriction, growth spurt and heavy blood loss in any form are risk factors for developing anaemia (Abbaspour, Hurrell, & Kelishadi, 2015). Age, ethnicity, parity, and education are but a few of many determinants of anaemia in pregnant women (Gaillard *et al.*, 2014). For

instance, pregnant teenagers are at an increased risk of being anaemic mainly because of increased demand in nutritional requirement due to the pregnancy and their own growth spurts (Dainty, Berry, Lynch, Harvey, & Fairweather-Tait, 2014). Unplanned teenage pregnancies, coupled with poor nutritional status before conception exposes them to even higher risk of developing anaemia (Kefiyalew, Zemene, Asres, & Gedefaw, 2015).

Pallor, fatigue, apathy, fainting, and breathlessness are the most common presentations of iron deficiency anaemia (Abbaspour *et al.*, 2015). Hair loss, headaches, palpitations, and tinnitus are additional signs of anaemia in pregnancy (Shill et al., 2014).

Throughout pregnancy, anaemia does not only adversely affect maternal and foetal well-being but is also linked to increased morbidity and foetal death. Affected women experience all or a combination of symptoms viz apnoea, fainting, palpitations, tiredness, and sleeping difficulties (Lee, Zaffke, & Baratte-Beebe, 2001). Anaemic pregnant women have an increased risk of bleeding, developing perinatal infection and pre-eclampsia.

Some adverse perinatal effects of anaemia in pregnancy may include but not limited to intrauterine death or growth retardation, low birth weight and prematurity. A significant association has been established between birth asphyxia, intrauterine growth retardation, low birth weight, neonatal anaemia and premature labour (Satyam & Khushbu, 2015). Anaemia in the first trimester has a devastating impact on foetal growth compared to other trimesters (Gautam, Saha, Sekhri, & Saha, 2008).

Different parts of the world have varying estimates for the prevalence of maternal anaemia. Reports from developed countries indicate 2.0% - 45.0% of pregnant women are diagnosed with anaemia which is generally higher in developing countries (5.0% - 90.0%) (Tomar,

Singhal, & Shukla, 2017). The worldwide prevalence of in anaemic pregnant women according to World Health Organization (WHO) report was 55.9% (WHO, 2014). India was reported to have a prevalence range of 33.0% - 89.0 % (Tomar *et al.*, 2017).

The highest prevalence of maternal anaemia was recorded in sub-Saharan Africa (SSA). But it is declining slowly over the years compared to other regions (Adamu *et al.*, 2017). Using WHO cut off points and definitions for anaemia makes the condition an urgent public health problem in both pregnant and non-pregnant women in SSA. Disparities are within the SSA but West and Central Africa have the highest prevalence and lowest improvement for pregnant women (Stevens *et al.*, 2013). The burden of anaemia in SSA is primarily driven by a mixture of ageing population structure, population growth, infectious diseases and iron deficiency (Kassebaum *et al.*, 2014).

WHO classifies maternal anaemia to be mild if the prevalence is 5–19%, moderate if the prevalence is 20–39%, and a severe if it is at least 40% (Klemm *et al.*, 2011). According to a WHO report, 62% of pregnant women in Ghana have blood Hb concentration of <110 g/L, and this according to the same report is an issue of severe public health importance (WHO, 2015). A multinational study which compared anaemia prevalence, access and usage of antenatal care and anaemia reduction interventions, estimated the maternal prevalence of anaemia in Ghana to be 70%, this figure exceeds the WHO "severe public health problem" threshold (Klemm *et al.*, 2011).

None of such study has been conducted in the Kintampo North Municipality to estimate the prevalence of maternal anaemia and its associated risk factors. Therefore, to bridge this gap, the present study was designed to estimate the prevalence of anaemia, demographic

characteristics of those at risk and the major causes in support of interventions to decrease the incidence of anaemia in pregnant women within the Kintampo Municipality.

1.2 Problem statement

Anaemia during pregnancy is a crucial global challenge of public health importance. According to McLean et al, (2009), anaemia affects about 2 billion people worldwide, which leads to 750,000 deaths annually in Africa and South-East Asia. Studies across the globe demonstrate a high prevalence of anaemia in pregnancy (Qureshi, Arlappa, & Qureshi, 2014). In Ghana, the most common condition pregnant women present with at the health facilities is anaemia. This may increase morbidity and mortality in both pregnant women and their unborn or newly born children. In the year 2003, the Ghana Health Service (GHS) estimated that 200 women die during pregnancy and childbirth due to anaemia-related complications (Ghana Statistical Service, 2015). The GDHS in 2008 projected the prevalence of anaemia in Ghana to be 59% (GSS, 2009). Meanwhile, countries with anaemia prevalence of more than 40% are classified as those with a severe public health problem (WHO, 2013). This classification puts Ghana beyond the upper cut off limit of WHO's classification of anaemia as a problem of public health concern. The GHS also attributes 20% of maternal deaths to anaemia.

Iron deficiency and haemolysis are the common cause of anemia in pregnancy resulting from malaria infection and helminthic infestation (Port et al., 2012). These are preventable causes and the WHO has proposed that countires incorporate measures into their ANC package to help prevent these causes of anemia among pregnant women. Interventions include: routine iron supplementation and the use of insecticide treated bed nets (ITNs)

during pregnancy, use of sulphadoxine pyrimethamine (SP) as intermittent preventive pregnancy treatment (IPTp) and second trimester pregnancy antihelmintics. Because the causes of anemia for which these target interventions coexist, the WHO advises that these interventions should not be carried out in isolation as they are proven to substantially prevent anamia in pregnancy (Emmanuel, Olusegun, Rachel, & Sunday, 2014). Daily supplementation with iron decreases maternal anaemia by 70% (Burke et al., 2014). It is known that IPTp with SP prevents maternal anaemia by 55% and decreases malaria by 90% (Stephen et al., 2018).

These estimates are aggregates but inequalities exist in the distribution of anaemia between regions and districts of the country. No study has been done in settings like Kintampo to quantify empirically the burden of anaemia at sub-national levels in Ghana. With Kintampo in the exact geographical middle between the southern rainforest and the semi-arid north of Ghana, findings may be largely representative of the average of the country.

1.3 Conceptual framework

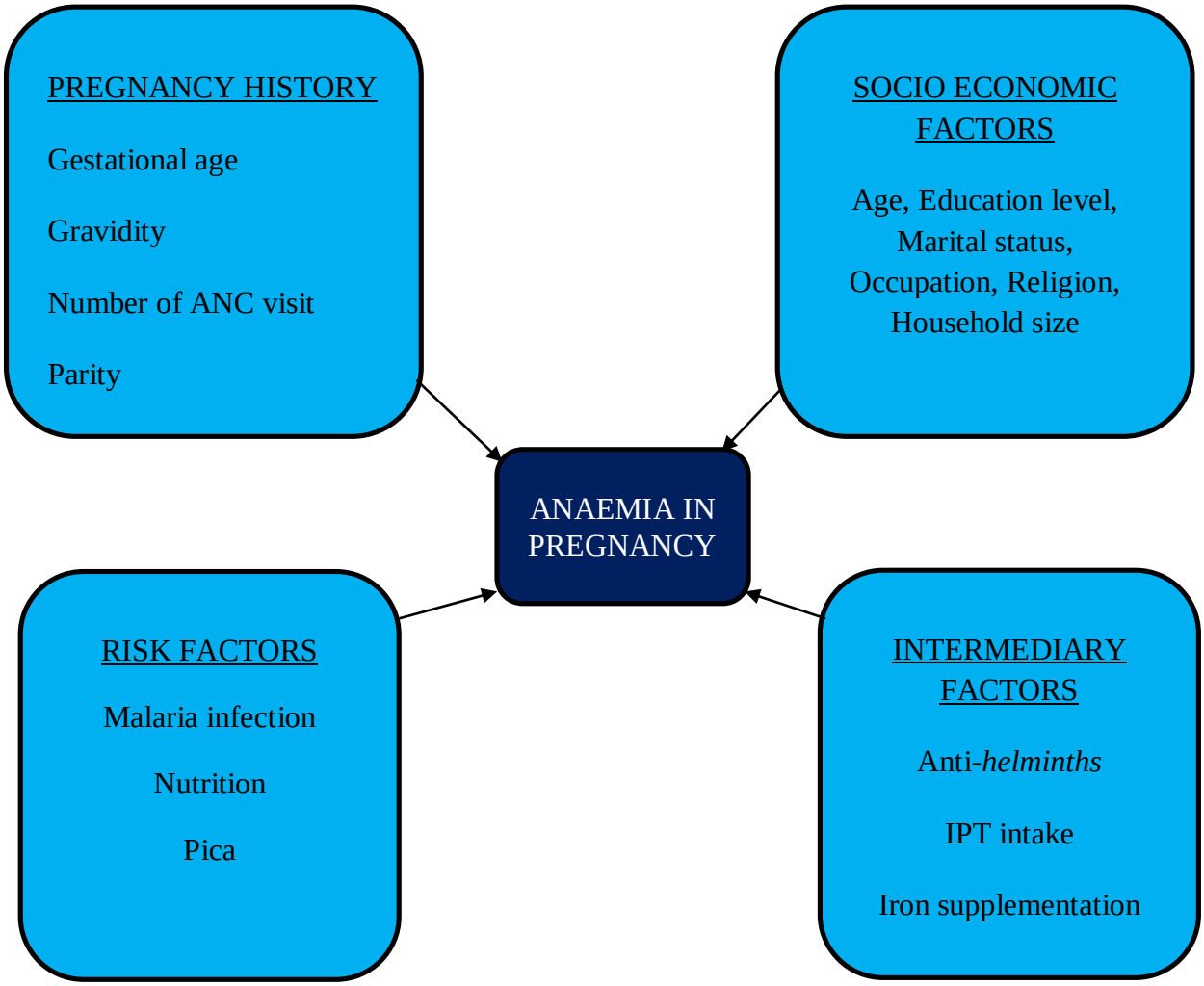

Figure 1: Conceptual framework of factors associated with anaemia in pregnancy

1.3.1 Narrative on conceptual framework

Figure 1 shows the relationship between individual factors (age, sex, marital status, religion, educational level, occupation and income) that predispose pregnant women to anaemia. Socio-economic factors like large household size, lower educational level, marital status (single parenthood) and occupation (unemployment), have the tendency to negatively affect the purchasing power of household heads, leading to anaemia in pregnancy. Socio-demographic factors, such as gestational age, gravidity, maternal age, number of antenatal

care (ANC) visit and parity have direct negative effect on Hb levels of pregnant women, leading to anaemia in pregnancy. Infections of malaria and helminths, poor nutritional status prior to conception, geophagia, lack of iron and/or folic acid tablet supplementation during pregnancy are some of the risk factors that predispose pregnant women to anaemia. Whether a pregnant woman will be at high or low risk of being anaemic during pregnancy will depend on these individual factors.

1.4 Justification of study

In Ghana, anaemia (Hb<11g/dl) among pregnant women is a public health problem. It is a leading cause of death in women and babies. The population of Kintampo is estimated to be about 95,480 (GSS, 2010). Anaemia among antenatal attendants is a major morbidity issue facing the municipality presently. Therefore, determining factors associated with anaemia in pregnancy will help stakeholders to institute timely intervention to avert this problem. This timely intervention may be in the areas of proper maternal education, adequate iron, and multivitamin supplementation and ensuring quality of care of pregnant women.

1.5 General objective

To determine factors associated with anaemia in pregnancy among antenatal attendants at the Kintampo North Municipal Hospital.

1.5.1 Specific Objectives

1. To estimate the prevalence of anaemia (Hb<11.0g/dl) in pregnancy among ANC attendants at the Kintampo Municipal Hospital.
2. To determine factors associated with anaemia in pregnancy among antenatal attendants at the Kintampo Municipal Hospital.

3. To assess the impact of antenatal interventions on anaemia in pregnancy by determining the difference between anaemia at booking and current visit of attendants to the Kintampo North Municipal Hospital.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Anaemia is a disorder characterized by a decrease in the count of red cells per unit of blood volume or a decline in the haemoglobin (Hb) of the blood to below the level of usual physiologic need (Emmanuel et al., 2014). Anaemia is a manifestation of various conditions, including excessive loss of blood and breakdown of blood cells, or reduced blood cell formation (Mahan & Raymond, 2017). According to the United Nations (UN), about half of pregnant women suffer from anaemia across the globe (Karaoglu et al., 2010). Developed countries have very low prevalence (18%) of anaemia during pregnancy compared to developing countries (75%). Globally, iron deficiency is the main cause of nutritional anaemias which is the most prevalent in pregnant women and women of reproductive age (McLean et al., 2009). The volume of blood expands during pregnancy. This expansion in the volume of blood subsequently increases iron demand by at least six times during the advanced stage of the pregnancy (Karaoglu et al., 2010).

It is cost-effective and easy to manage anaemia in pregnancy in order to reduce foetal, maternal, perinatal morbidity and mortality (Olatunbosun *et al.*, 2014).

2.2 Prevalence of anaemia

According to WHO, (2014), anaemia in pregnancy is defined as haemoglobin (Hb) concentration less than 11g/dl. A report by WHO showed that anaemia affects more than five hundred million women across the globe. And of this, 38% were anaemic pregnant women (WHO, 2014). Globally, 41.8% of pregnant women present with anaemia at the

health facilities; Africa and Asia, however, are the most affected continents (Rajagopal *et al.*, 2017). About 56% of the total population of pregnant African women are anaemic. (Gebreweld, Bekele, & Tsegaye, 2018). The underlying cause of maternal and prenatal mortality among women may be anaemia. The management of anaemia has been done by many countries using folic acid and iron supplementation and fortifying common foods like bread and flour. According to Green and Amanya (2016), the use of folic acid has reduced the level of folic acid deficiency and thus the risk of developing megaloblastic anaemia in many developed countries. However, Nelms *et al.* (2010) still insist that pregnant women with poor dietary choices and low socioeconomic status have higher prevalence of anaemia.

2.3 Classification of anaemia

The two main methods used to classify anaemia in pregnancy are morphological and aetiological.

2.3.1 Classification by morphology

There are different ways of classifying anaemia and the most common form of classification is morphology. This procedure includes the description of colour, shape and size of red blood cells (RBCs). Information on the appearance of RBC is dependent on the measurements of Hb, RBC indices and haematocrit. The indices of RBCs include mean Hb, mean corpuscular Hb concentration, mean corpuscular volume, and the distribution of RBC width. In addition, serum ferritin concentration is used to measure iron storage. It is vital to measure the ferritin concentration if iron deficiency anaemia is to be diagnosed. Transferrin saturation also measures the absorption and transport of dietary iron. Iron binds to transferrin for transport within the body (Goonewardene, Shehata, & Hamad, 2012).

2.3.2 Classification by aetiology

Anaemia is caused by genetic factors, infections, and nutritional deficiencies. These causes are usually interlinked but can also occur separately. The main causes of anaemia in pregnancy include but not limited to iron deficiency chronic blood loss, haemolytic diseases, folate deficiency, malaria, worm infestation, and vitamins A and B_{12} deficiency. Iron deficiency, however, accounts for more than 90% of all anaemic cases during pregnancy (Stephen *et al.*, 2018).

2.3.2.1 Aplastic anaemia

Aplastic anaemia is a rare condition that results in severe reduction of blood cell production due to damage of bone marrow. Red blood cell synthesis in the bone marrow is, however, significantly lower compared to other types of blood cells. Aplastic anaemia in adults is not so different in appearance to other chronic anaemias. Although a rare condition, aplastic anaemia is increasing in developing countries. Fanconi's anaemia (FA) is the most common form of congenital aplastic anaemia. FA occurs due to abnormalities in DNA repair, evidenced by high proportion of chromatid breaks, gaps and rearrangements (Kenneth & Howard, 2008).

2.3.2.2 Haemolytic anaemia

Haemolytic anaemia is due to abnormal destruction of RBCs faster than they can be replaced, which leads to accelerated erythropoiesis. This destruction may be induced by autoimmune or hereditary disorders, hepatitis, vitamin E deficiency, sports anaemia or transfusion reactions, (Nelms, Sucher, Lacey, & Roth, 2010). RBCs have a lifespan of about 120 days; however, some physical and immune-mediated causes may greatly reduce this lifespan. This type of anaemia is either acquired or inherited. Acquired haemolytic anaemia

may result from abnormal immune response, chemical agents and infection. Inherited haemolytic anaemia occurs through abnormalities in cellular membranes or enzymes that influence haemoglobin production, (Nadarajan, 2014).

2.3.2.3 Macrocytic anaemia

Depending on bone marrow findings, macrocytic anaemia may be categorised into two groups; macrocytosis and megaloblastic.

2.3.2.3.1 Macrocytosis

Macrocytosis is a form of megaloblastic anaemia that occurs when the erythrocytes and bone marrow are larger than normal. In macrocytosis, both the concentration of haemoglobin and the size of the red cells increase; and this occurs because of B_{12} (cobalamin) and folate deficiency. Cobalamin is a water-soluble vitamin needed to convert the inactive folate, 5-methyltetrahydrofolate (5-methyl THFA) to the active form, tetrahydrofolate (THFA) in a process called demethylation. The deficiency of folate during pregnancy may result in birth defects known as neural tube defects (NTDs). Folate deficiency is diagnosed when serum folate level drops below 2.0 mg/L, and when folate concentration of red blood cells drops below 160 mg/L, (Goonewardene, 2012).

2.3.2.3.2 Megaloblastic anaemia

Megaloblastic refers to an immature, large red blood cell that is oval in shape, irregular and immature with a decreased capacity for oxygen transfer. These cells are both in circulation and in the bone marrow. These types of anaemias are often caused by nutritional deficiencies of cyanocobalamin (vitamin B_{12}) and folate. Pregnant women with insufficient stores of

folate and cyanocobalamin for pregnancy are mostly affected due to malabsorption or decreased intake of the folate and or B_{12}, (Nelms *et al.,* 2010).

2.3.2.4 Normocytic anaemia

Normochromic normocytic, are anaemias that have normal size red blood cells and haemoglobin content without any outstanding morphological features. Though the red blood cells have no structural deformities, diverse reports have been made of distorted red blood cells, severe anaemia, and chronic haemolysis related to metabolic imbalances in these patients,(Mahan & Raymond, 2017). Normochromic normocytic red cell morphology, in the absence of malaria parasitaemia and with Hb < 11 g/dl is regarded as physiological anaemia of pregnancy, (Kimbi *et al.*, 2017).

2.3.2.5 Pregnancy related anaemia

Pregnancy is associated with numerous behavioural, physical and psychological changes. These changes include the expansion in the plasma volume of pregnant women by 50% or more from the baseline and the volume of normal red blood cells increases from 20% to 30%. This elevated blood volume causes decreased concentration of haemoglobin, water-soluble vitamins, and serum albumin, mainly after the end of the first trimester. It also results in increased volume of both maternal blood supply during pregnancy and increased foetal needs; leading to significant increase for iron demand. However, serum concentrations of triglycerides, cholesterol, free fatty acids and fat-soluble vitamins increase to ensure enough supply to the foetus. The total estimate of iron requirement during pregnancy is 1190 mg; however, with the presence of amenorrhoea, the mean net deficit is 580 mg. A pregnant woman would be required to absorb an additional 17mg of iron per day in addition to their

daily requirements. The human body would usually absorb between 1-2 mg/day from a normal diet and 3-5 mg/day from iron-rich foods.

Accretion normally peaks after twenty weeks of gestation due to increased foetal and maternal demands. Women with insufficient body iron, poor nutritional intake, short inter-conceptual periods, those with impaired absorption, including those with history of antacids chronic use or bariatric surgery, those who experience heavy menstrual flow or experienced red blood cell destruction from malaria or previous hookworm infections are those at greatest risk of iron deficiency anaemia (IDA) (Mahan & Raymond, 2017).

2.3.3 Causes of anaemia in pregnancy

Genetics, infections and nutrition are the three main factors that are linked to anaemia in pregnancy.

2.3.3.1 Nutritional anaemias

There are various definitions of nutritional anaemia by different researchers. The WHO and cited by Goonewardene *et al. (*2012) defined nutritional anaemia as a state in which the concentration of haemoglobin is lower than reference interval because of deficiency of one or more essential nutrients, irrespective of cause(s). In addition, Kassa, Muche, Berhe and Fekadu (2017) posited that nutritional anaemias are the most common type and mainly include iron, folate and B12 deficiencies. These makeup about 75% of all anaemia in pregnancy.

There are researchers who attribute the cause of anaemia to natural biological factors. As indicated by Chowdhury, Rahman and Abm (2014), anaemia in pregnant women is highly prevalent because prior to conception, they lose iron during menstruation; consequently,

most of them enter pregnancy with already depleting iron stores especially in low and middle-income countries. Meanwhile, the high requirement of iron that is needed to facilitate synthesis of maternal tissue and for transport to the foetus, only exacerbate their iron deficiency (Chowdhury, Rahman, & Abm, 2014).

The increase in demand for iron by the foetus during pregnancy leads to a reduction in bioavailability of iron. According to Kimbi *et al.* (2017), the deficiencies in iron cause three types of anaemia which are characterised by; depletion of iron stored by reduce serum iron level, decrease transferrin saturation and low haemoglobin and haematocrit level.

The development of foetus depends on maternal nutrition. As indicated by Mahan and Raymond (2017), foetal growth is affected by dietary deficiencies of its mother during the early phase of development. There is the presence of iron in diets such as red meat, snails, fish, eggs and green vegetables and its absorption depends largely on its balance in the body.

2.3.3.2 Pica

Pica, a common occurrence in pregnancy involves the consumption of any substance that has no nutritional value. Pica in pregnant women often includes the consumption of amylophagia (laundry starch), geophagia (clay), or pagophagia (ice). Other substances that women crave during pregnancy include bleach, baking soda, burnt matches, charcoal, cigarette ashes, coffee grounds, gravel or stone, paper, soap, and tyre. Though some of the substances are not of great concern, others could be deleterious to the mother's health. Pica is not restricted to a particular culture, geographic area, race, or social status, yet it has a cultural component that determines the chosen substances (Childress & Myles, 2013).

Not much is known about the causes of pica in pregnant women. According to one school of thought, pica sooths nausea and vomiting, though pica frequently occurs later in

pregnancy when the prevalence of nausea and vomiting are low. Another school of thought attributes it to essential nutrient deficiency, iron but calcium, potassium, and zinc have also been stated. It is postulated that the craving causes pregnant women to eat non-food substances that contain the missing nutrients; however, that is rarely the case. Craving for smell, texture or taste constitutes pica. Taste perceptions varies regularly, but whether it is associated with low body zinc concentration is unknown (Cardwell, 2013).

Pica can result in malnutrition when non-food substances displace diet with essential nutrients. Some of the substances contain poisonous compounds or heavy metals (eg. lead) or pathogens. This may lead to interference in the absorption of iron or other minerals. Pica (geophagia) is associated with intestinal obstruction or perforation and iron deficiency anaemia , but whether the pica is a result, a cause, or a marker of other concurrent deficiencies is unknown. However, treatment with very high iron foods often decreases the cravings (Young, 2011).

2.3.3.3 Genetic factors

There are certain factors that can cause haemolysis of the red blood cells which results in diseases like thalassemia and sickle cell anaemia found frequently in black Africans. In Ghana, sickle cell anaemia is more prevalent compared to the thalassemia. Ghana Health Service (GHS) puts priority on cases of sickle cell in almost all districts in Ghana. This is done to identify new cases of sickle cell diseases (SCD), (Ghana Statistical Service, 2015). Evidence shows that it is difficult to manage sickle cell especially among women who are pregnant. Changes in blood indices during pregnancy may lead to increased painful crisis (Salhab, Hsu, Ryer, Appiah, & Switzer, 2017). The impact of this predicament on a woman's pregnancy is enormous because of the vaso-occlusion that results in multi-organ complications. The risk of poor pregnancy outcomes including spontaneous miscarriages,

intrauterine deaths and stillbirths are increased (GSS/GHS, 2015). Due to vaso-occlusion thromboembolic events, pre-eclampsia and intrauterine growth restriction are other possible complications of SCD (Green & Ananya, 2016). Additionally, the chances of pre-term delivery or delivery by caesarean section either due to infection or maternal and foetal indications is increased (Cardwell, 2013). The potential physical effects of sickle cell disease (SCD) on pregnancy vary from woman to woman. However, it must be recognized that these snags can result in increased maternal and foetal morbidity and mortality (Saini, Nile, & Keum, 2016). Besides the physical effects of SCD on pregnancy, the woman must also deal with psychological and social stresses of living with a chronic illness.

2.3.3.4 Malaria infection

Malaria infection is the most prevalent parasitic infection worldwide, especially in SSA. Severe states of malaria can lead to changing degree of anaemia from a life-threating level of below 5g/dl to slightly lower than 11g/dl. This is due to weakened immunity to malaria infection during pregnancy. WHO estimates that malaria contributes about 10% of SSA's disease burden (Qureshi *et al.,* 2014). Primigravid women stand the highest risk of developing malaria in pregnancy, and its subsequent morbidity patterns. Routine administration of malaria prophylaxis to pregnant women led to a significant reduction in the incidence of severe anaemia that is related to *P. falciparum* infection (Port *et al.*, 2012).

2.3.4 Parity, birth interval and age of the woman

Multi-parity, short birth interval and adolescent pregnancy can also lead to anaemia. Women need high iron stores to replace the iron lost during menstruation, but most of them conceive with depleted iron stores. Subsequently, the iron deficiency condition worsens when faced with pregnancy (Tadesse *et al.,* 2017).

Female adolescents are more susceptible to anaemia due to poor nutrition and demand for growth. Menstruation and pregnancy, therefore, compound the already existing anaemia (Gedefaw, Ayele, Asres, & Mossie, 2015). Parity study done in Nigeria revealed that anaemia was more prevalent in multigravidae compared to primigravidae. It is on record that in Africa, prevalence of anaemia reduced with increased parity. In contrast with the developed countries, prevalence of anaemia increased with parity, being 4% and 11.9% respectively in primigravidae and multigravidae (Adam, Radi, & Babiker, 2015).

2.3.5 Socio-cultural beliefs

Socio-cultural beliefs also has a hand in causing anaemia during pregnancy. It is important to understand that the pregnant woman belongs to a community where numerous beliefs and cultural practices already exist. Consequently, these affect a woman's views on things including pregnancy, health and health care. Although generally folic acid and iron supplementation are recommended, there are several economic, cultural and social obstacles to these simple preventive measures (WHO *et al.*, 2012). According to Derso, Abera and Tariku, (2017), gender disparity has been seen in women receiving less attention than men in rural areas. Poor access to medical services is worsened by cultural, economic, and social factors including gender inequality in accessing food; and by the burden of work and special dietary requirements such as iron supplements. Therefore, many women and particularly rural women are often trapped in a cycle of ill-health worsened by childbearing and hard physical labour.

2.3.6 Symptoms of anaemia

Anaemic pregnant women may present with any combination of the classical symptoms of anaemia. These symptoms include but not limited to fatigue, lethargy, cheilosis, glossitis,

pallor, pale sclera, muscle aches, difficulty concentrating, sleepiness, irritability, general malaise, palpitation, tachycardia, dyspnoea, angina, and or paraesthesia (tingling, numbness of the extremities) as seen in pernicious anaemia (Nelms *et al.*, 2010).

CHAPTER THREE

3.0 METHODS

3.1 Study design

This was a hospital based cross-sectional study that was carried out at the Kintampo North Municipal Hospital from May to June 2019. All pregnant women aged 15 years and above who visited the antenatal clinic of the hospital were eligible to participate in the study.

3.2 Study site

The study was conducted in the Kintampo North Municipality (KNM) in the Bono East Region of Ghana. The Municipality is one of the 11 municipals/districts in the Bono East Region with a total population of 111,448 and an estimated pregnancy of 4,534 for the year 2017. It has an average annual ANC registrants of 4,968, a monthly gestation of 36 weeks and an ANC attendants of more than 278. The Kintampo North Municipality has 17 facilities offering antenatal care, 3 of which are in the urban settings and the rest are in a rural settings. Facilities in the urban settings comprise of a government hospital (KNMH), 2 private hospital and 1 private maternity home. Facilities in the rural settings include 4 health centres (H/C) and 10 community-based health planning and services (CHPS) compounds (KNMHD, 2017). The facility provides these services: ANC, inpatient, OPD, pharmacy, X ray, laboratory, mortuary, maternity and theatre. The hospital has 87 beds, with an average outpatient case of 400 per day. The number of nurses is 134 and 3 doctors with 8 physician assistants. There are 12 Midwives, 4 community health nurses, a dietician and 2 nutrition officers.

3.3 Study population

All pregnant women aged 15 to 49 years who visited the antenatal clinic at the Kintampo Municipal Hospital were eligible to enrol.

3.4 Calculation of sample size

The sample size for the study was calculated using the formula $n = (z^2\,pq)/d^2$ where

n = sample size

z = z-score that corresponds with 95% confidence interval = 1.96

p = estimated proportion of anaemia in pregnancy = 29% = 0.29, (Ghana Health Service, 2017).

q = 1-p = 1 – 0.29 = 0.71

d = Margin of error = 5% = 0.05

$n = (1.96^2 \times 0.29 \times 0.71)/0.05^2$

n = 317 + (10% of 317)

n = 349

3.5 Sampling procedure

Data were collected from 496 participants during the period of May to June 2019. Twenty-five participants were selected daily from an average of 90 antenatal attendants. The total number of women were counted and pieces of papers were cut and numbered to match the exact number of women present at the commencement of ANC services. Twenty-five of these papers were labelled “yes” while the rest were labelled “no”. Each participant was

asked to pick a piece of paper. Those who picked the pieces of papers with "yes" as the label were enrolled in the study after they have duly consented and signed to partake in the study. Pregnant women that reported to the ANC as first-time registrants were not enrolled in the study and those that did not consent to be part of the study after they picked "yes" were excused. The process was repeated until the maximum number of twenty-five participants was reached for each day. Nurses were then requested to direct every eligible participant that came from the laboratory with haemoglobin (Hb) test results in a secluded place that ensured privacy for the respondent. This secluded place was not too far from the point of care. This procedure was repeated for six weeks until a sample of four hundred and ninety-six (496) for the study was obtained.

3.6 Inclusion criteria

All pregnant women of all trimesters, with at least two records of Hb and who consent to participate, were recruited into the study.

3.7 Exclusion criteria

1- Pregnant women who attended ANC for the first time because we needed at least two Hb results to compare the impact of ANC services on their Hb levels.

2- Women who were transfused in less than two weeks because the result will not be a true reflection of their normal Hb.

3- Pregnant women that were sick and unable to respond to the questionnaire

4- Pregnant women without a checked Hb

5- Women who did not consent to participate in the study.

3.8 Data collection procedure

The questionnaire was pretested at Yizura hospital in the Kintampo North Municipality. Data were extracted from the ANC booklets on basic socio-demographic characteristics and two haemoglobin levels of pregnant women in any available trimester. A suitably structured questionnaire for the quantitative cross-sectional study was used to obtain information on demographics, socioeconomic background, medical and dietary practices of study participants. Pretesting of the questionnaire was carried out to check for its validity in the local context before the actual data collection commenced.

3.8.1 Height

The height of participants was measured by means of a Seca Stadiometre to the nearest 0.1cm. Participants were politely asked to remove their shoes: and made to stand with heels together and touching the back of the stadiometre. It was ensured that arms of participants hanged freely with palms facing thighs. The measurement was then taken with the participants standing as erect as possible, looking straight ahead with the head upright and not tilted backwards (Frankfurt plane). It was also ensured that participants' heels stay flat on the floor and the measure on the stadiometre was then lowered until it touched the top of the head. Standing height was subsequently recorded to the nearest 0.1 cm (Gibson, 2005).

3.8.2 Weight

Weight of participants was measured with a digital electronic scale to the nearest 0.5kg. All participants were weighed without shoes and in light clothing. It was ensured that participants did not have on them any material such as wallet, phone and/or watch that could affect the outcome of the reading. The scale was then placed on a hard level surface; the

participants were asked to stand in the middle and kept still until the measurement was taken (Gibson, 2005).

3.8.3 Body mass index (BMI)

BMI was determined for study participants and was calculated as body weight in kilograms divided by square of height in meters. BMI = Weight (kg) / Height^2 (m^2). The participants were then classified into normal nutritional status, at risk of malnutrition and malnourished based on their individual BMI.

3.9 Data processing and statistical analysis

Data were entered and cleaned in Microsoft Excel 2016. It was then exported to Stata version 15 for analysis. Descriptive statistics (means and standard deviations) was calculated for continuous variables while proportions were used to calculate categorical variables. Numerical variables like age of participants, gravidity, parity, number of ANC visits, Hb levels at both first and current visits, gestational age at first and current ANC visits were all recorded and categorized. Age of participants was categorized (15–19, 20–24, 25–29, 30–34, 35–39 and ≥ 40). Gestational ages at first and current ANC visits were both categorized into first (1 to 12 weeks), second (13 to 27 weeks) and third trimesters (28 weeks to birth). Also, Hb at first and current ANC visits were categorized into no anaemia (Hb > 11g/dl), mild anaemia (Hb 10 – 10.9g/dl), moderate anaemia (7 – 9.9g/dl) and severe anaemia (Hb < 7g/dl). These were further re-categorized into anaemia and no anaemia, (WHO, 2001). Chi-square analysis was then used to test for association between categorical variables with the re-categorized Hb at current ANC visit as the main dependent variable. Binary logistic regression analysis was used to assess for socio-demographic, socio-economic, clinical and dietary factors that are associated with anaemia. Factors that were

statistically significant (P – value <0.05) were included in the multivariable logistic regression models.

3.10 Ethical consideration

Ethical approval for the study was received from the Ghana Health Service Ethics Review Committee. Clearance was also sought from the management of the Kintampo Municipal Hospital before the start of the study. Study procedure, confidentiality, and issues of privacy were all clearly explained to study participants in a language they understood. Recruited participants were made to understand that their identity would neither be disclosed nor traceable since questionnaire will require the use of codes and not names. It was also explained to participants that findings from the study would be used solely for academic purposes for which it is intended and would not be disclosed to a third party.

Completed questionnaires and study documents are kept under lock and key whilst computer files from the study are protected with a password to avoid unauthorized access. Participants were assured of their right to withdraw from the study at any stage or time without any effect on the care they receive in the facility. It was explained to participants they will not receive direct benefits in responding to the questionnaire, but their responses will help improve future care delivery in the facility. Participation was not a risk to a woman, but a substantial amount of her time was needed to respond to the questionnaire.

CHAPTER FOUR

4.0 RESULTS

4.1 Sociodemographic characteristics of the women

Table 1 shows the 496 pregnant women who attended ANC at the Kintampo North Municipal Hospital were successfully recruited after they consented and agreed to be part of the study. The age of the pregnant women ranged from 15 to 43 years with a mean(sd) of 28.3 (5.6) years. 190 (38.3%) were within 25 – 29 years age category, 402 (81.1%) were married, and 295(59.5%) subscribed to Christianity. Most, 301(60.5%) of them were self-employed and 183(36.9%) completed Junior High School (JHS). 28.4(35.1%) of the pregnant women were primiparous and (70.8%) had at most 5 family members in their household.

Table 1: Sociodemographic characteristics of women.

Sociodemographic characteristics	Frequency (*N* = 496)	Percent (%)
Age (years)		
15 – 19	25	5.0
20 – 24	95	19.2
25 – 29	190	38.3
30 – 34	112	22.6
35 – 39	55	11.1
>= 40	19	3.8
Highest level of education		
No formal education	43	8.7
Basic education	92	18.5
Junior High School	183	36.9
Senior High School	111	22.4
Tertiary	67	13.5
Household size		
<=5 family members	351	70.8
>=6 family members	145	29.2
Marital status		
Single	65	13.1
Married	402	81.1
Divorced	1	0.2
Cohabiting	28	5.7
Occupation		
Government employee	48	9.7
Self-employed	301	60.7
Unemployed	125	25.2
Other	22	4.4

4.2 Clinical characteristics of the women

Out of the 496 pregnant women that were recruited into the study, 347(70%) of them had a birth spacing interval of two or more years, while 20(4.0%), reported with less than two years of birth interval. During their first ANC visit, 277(55.9%) of the women were found to be in their first trimester. The current ANC visit, however, had the majority, 438(88.3%), of the women in their third trimester. At the time of the interview, 442(89.1%) of them made at least four different ANC visits. The majority, 155(31.3%) of them were pregnant for the second time while 206(41.5%) had given birth to two or more children.

Table 2: Clinical characteristics of the women

Clinical characteristics	Frequency (*N* = 496)	Percent (%)
Birth spacing		
<2 years	20	4
>=2	347	70
Gestational age (trimester) at first ANC visit		
First trimester	277	55.9
Second trimester	213	42.9
Third trimester	6	1.2
Gestational age at current ANC visit		
First trimester	4	0.8
Second trimester	54	10.9
Third trimester	438	88.3
Gravidity		
First pregnancy	125	25.2
Second pregnancy	155	31.3
Third pregnancy	97	19.6
Fourth pregnancy	62	12.5
Fifth or more pregnancy	57	11.5
Parity		
Nulliparous	149	30.0
Primiparous	141	28.4
Multiparous	206	41.5
Number of ANC visits		
Two visits	20	4.0
Three visits	34	6.9
Four or more visits	442	89.1

4.3 Consumption of iron supplements and iron-rich foods

Table 3 below displays iron supplementation and consumption of iron-rich foods. Almost all, 491(99.0%) the pregnant women received iron supplements, 370(75.1%) of them received it on more than two occasions and 489(98.6%) took it always. The number of participants who consumed eggs/meat for more than two times per week was 364(73.4%) while 326(65.7%) of them consumed vegetables/fruits for more than two times in week. Most, 413(83.3%), of the pregnant women did not consume non-food items (pica).

Table 3: Consumption of iron supplements and iron-rich foods

Variables	Categories	Frequency (*N=496*)	Percent (%)
Received iron tablet	No	5	1.0
	Yes	491	99.0
Consumed the iron tablets	No	7	1.4
	Yes	489	98.6
Number of times iron tablets received	Once	35	7.1
	Twice	88	17.9
	More than two times	370	75.1
Frequency of consuming egg/meat	Once a week	8	1.6
	Twice a week	124	25.0
	More than twice a week	364	73.4
Frequency of consuming vegetables/fruits	Never	1	0.2
	Once a week	24	4.8
	Twice a week	145	29.2
	More than twice a week	326	65.7
Pica	No	413	83.3
	Yes	83	16.7

4.4 Medical interventions and malaria infection in pregnant women

Of the 496 women that were recruited into the study, only 314(63.3%) of them received ITN, 302(60.9%) slept under the ITN the previous night and 140(28.2%) of them were infected with malaria parasites. Most, 438(88.3%) of the participants received malaria prophylaxis (SP) and 274(55.2%) were given anti-helminth during the pregnancy.

Table 4: Medical interventions and malaria infection in pregnant women

Variables	Categories	Frequency (*N=496*)	Percentage (%)
Received ITN?	No	182	36.7
	Yes	314	63.3
Used it last night?	No	194	39.1
	Yes	302	60.9
Received anti-helminth?	No	222	44.8
	Yes	274	55.2
Infected with malaria?	No	356	71.8
	Yes	140	28.2
Received malaria prophylaxis?	No	58	11.7
	Yes	438	88.3

4.5 Bivariate association between sociodemographic characteristics of the women and anaemia

There was a significant difference between the level of education and anaemia at current visit (Chi 22.42, P=0.001).

Of all the women that were enrolled in the study, the majority 183(36.9%) attended Junior High School and 63(34.4%) of them were anaemic. 43(8.7%) of them did not have formal education and 8(18.6%) of them were anaemic. Those with tertiary education, 67(13.5%), were the least affected by anaemia 8(11.9%).

The association between occupation of pregnant women and anaemia was significant (Chi 27.37, p=0.001). Majority 301(60.7%) of the women were self-employed with 94(31.2%) been anaemic. Those who chose the "other" as their occupation were 22(4.4%) and the majority, 4(63.6%), of them presented with anaemia.

There was no association netween marital status and anaemia (Chi 2.91, p=0.2300). The majority, 402(81.1%), of the women were married and about one-third, 109(27.1%), were anaemic. Of those who were cohabiting, 12(41.4%), of them were anaemic.

Table 5: Bivariate association between sociodemographic characteristics of women and anaemia

Sociodemographic characteristics	Not anaemic *n*(%)	Anaemic *n*(%)	χ^2	P-value
Age categories			6.25	0.28
15 - 19	15(60.0)	10(40.0)		
20 - 24	62(65.3)	33(34.7)		
25 - 29	135(71.0)	55(29.0)		
30 - 34	86(76.8)	26(23.2)		
35 - 39	43(78.2)	12(21.8)		
>= 40	14(73.7)	5(26.3)		
Educational level			22.42	**<0.001**
No formal education	35(81.4)	8(18.6)		
Basic education	55(59.8)	37(40.2)		
Junior high school	120(65.6)	63(34.4)		
Senior high school	86(77.5)	25(22.5)		
Tertiary	59(88.1)	8(11.9)		
Occupation			27.37	**<0.001**
Government employee	45(93.8)	3(6.3)		
Self-employed	207(68.8)	94(31.2)		
Unemployed	95(76.0)	30(24.0)		
Other	8(36.4)	14(63.4)		
Marital status			2.91	0.23
Single	45(69.2)	20(30.8)		
Married	293(72.9)	109(27.1)		
Cohabiting	16(58.6)	12(41.4)		

Note: Fischer's exact chi-square test was used to determine the significant difference between the various categories, P-value <0.05.

4.6 Bivariate association between clinical characteristics of women and anaemia

Birth spacing between previous and current pregnancy had no significant impact on whether pregnant women were anaemic or not (Chi 2.45, p= 0.29). The birth interval between previous and current pregnancy of most, 347(70.0%), of the women was at least 2 years and 34(30.0%), of them were anaemic.

There was no significant association between both gestational age at first, (Chi 0.93, p=0.63), and current visit, (Chi 0.73, p=0.69) and anaemia. Over half, 277(55.9%), of the pregnant women reported in the first trimester during their first ANC visit and 74(26.7%), of them were anaemic. The third trimester of the current visit saw the majority, 438(88.3%), of women attending ANC with 122(27.9%) of them been anaemic.

There was no significant association between gravidity and anaemia among pregnant women (Chi 1.72, p=0.79). About a quarter of the pregnant women who presented with their first, third, fourth and fifth or more pregnancies had anaemia. Approximately one-third, 33(26.4%), of those who were pregnant for the second time was also anaemic.

Parity was also not significantly associated with anaemia among pregnant women 1.27(0.53%). The majority, 206(41.5%), of the women were multiparous at current ANC visit and 57(27.7%) of them presented with anaemia. Among those who were primiparous, 141(28.4%), about a third, 45(31.9%).

There was a significant association between the number of ANC visits and anaemia among pregnant women (Chi 6.32, p=0.04). The majority, 442(89.1%), of the women made four or more ANC visits and 16(47.1%) of them were anaemic.

Table 6: Bivariate association between clinical characteristics of women and anaemia at Kintampo North Municipal Hospital, Bono East, Ghana, June to July 2019.

Clinical characteristics	Not anaemic *n*(%)	Anaemic *n*(%)	χ^2	P-value
Birth spacing			2.45*	0.29
First Pregnancy	95(73.6)	34(26.4)		
<2 years	17(85.0)	3(15.0)		
>=2	243(70.0)	104(30.0)		
Gestational age at first ANC visit			0.93*	0.63
First	203(73.3)	74(26.7)		
Second	148(69.5)	65(30.5)		
Third	4(66.7)	2(33.3)		
Gestational age at current ANC visit			0.73	0.69
First	3(75.0)	1(25.0)		
Second	36(66.7)	18(33.3)		
Third	316(72.1)	122(27.9)		
Gravidity			1.72*	0.79
First pregnancy	92(73.6)	33(26.4)		
Second pregnancy	105(67.7)	50(32.3)		
Third pregnancy	70(72.2)	27(27.8)		
Fourth pregnancy	46(74.2)	16(25.8)		
Fifth or more pregnancy	42(73.7)	15(26.3)		

Fisher's exact test was used

Clinical characteristics	Not anaemic *n*(%)	Anaemic *n*(%)	χ^2	P-value
Parity			1.27*	0.53
Nulliparous	110(73.8)	39(26.2)		
Primiparous	96(68.1)	45(31.9)		
Multiparous	149(72.3)	57(27.7)		
Number of ANC visits			6.32*	**0.04**
Two visits	14(70.0)	14(30.0)		
Three visits	18(52.9)	16(47.1)		
Four or more visits	323(73.1)	119(26.9)		

Note: Fischer's exact chi-square test was used to determine the significant difference between the various categories, P-value <0.05.

4.7 Bivariate association between consumption of iron supplements and iron rich foods with anaemia.

Whether or not pregnant women received iron supplement or consuming iron-rich foods had no significant association with the Hb status of the women (Chi 2.47, p= 0.14). Of the 355 pregnant women that were not anaemic, 353(99.4%) received iron supplement and 138(97.1%) of those that had anaemia also received the iron supplement.

There was no significant association between the number of times pregnant women received iron supplements and their anaemia status (Chi-square 0.78, p=0.68). Among those who received the iron supplements on more than two occasions, 102(72.9%) of them were anaemic while 268(75.9%) of them were not.

There was no significant association between the frequency of consuming egg/meat and anaemia status of the pregnant women (Chi-square 3.89, p=0.13). The majority, 268(75.5%), of those who were not anaemic consumed animal proteins more than two times in a week whilst 96(68.1%), of those who were anaemic also consumed it for more than two times in a week.

A significant association was established between the frequency of vegetables/fruits consumption and anaemia status of the pregnant women (Chi-square 23.68 p<0.001). About three-fourth, 256(72.1%), of those who consumed vegetables/fruits two times or more in a week were normal and almost half 96(49.7%), of those who presented with anaemia also consumed it more than two times a week.

Pica consumption was significantly associated with anaemia in the pregnant women (Chi-square 14.76, p<0001). A little over one-third, 38(27.0%), of those who had anaemia craved for pica while the majority of those with normal Hb, 310(87.2), did not.

Table 7: Bivariate association between consumption of iron supplements and iron-rich foods with anaemia among pregnant women at the Kintampo North Municipal Hospital (N=496)

Iron tablet and iron-rich foods consumption	Not anaemic *n*(%)	Anaemic *n*(%)	χ^2	P-value
Received iron tablet			2.47	0.14
No	2(0.6)	3(2.1)		
Yes	353(99.4)	138(97.1)		
Consumed the iron tablets?			0.73	0.41
No	4(1.1)	3(2.1)		
Yes	351(98.9)	138(97.9)		
Number of times iron tablets received			0.78	0.68
Once	23(6.5)	12(8.6)		
Twice	62(17.6)	26(18.6)		
More than two times	268(75.9)	102(72.9)		
Frequency of consuming egg/meat			3.89	0.13
Once a week	4(1.1)	4(2.8)		
Twice a week	83(23.4)	41(29.1)		
More than twice a week	268(75.5)	96(68.1)		
Frequency of consuming vegetables/fruits			23.68	**<0.001**
Never	1(0.3)	0(0.0)		
Once a week	13(3.7)	11(7.8)		
Twice a week	85(23.4)	60(42.6)		
More than twice a week	256(72.1)	70(49.7)		
Pica consumption			14.76	**<0.001**
No	310(87.2)	103(73.0)		
Yes	45(12.7)	38(27.0)		

Note: Fischer's exact chi-square test was used to determine the significant difference between the various categories, P-value <0.05.

4.8 Bivariate association between medical intervention and anaemia in pregnant women.

None of the medical interventions was significantly associated with anaemia among pregnant women though it is expected to reduce the burden of maternal anaemia.

Table 8: Bivariate association between medical intervention and anaemia among pregnant women at the Kintampo North Municipal Hospital (N=496)

Medical interventions	Nonanaemic *n*(%)	Anaemic *n*(%)	χ^2	P-value
Received ITN?			0.45	0.54
No	127(35.8)	55(39.0)		
Yes	228(64.2)	86(61.0)		
Used it last night?			0.06	0.82
No	140(39.4)	54(38.3)		
Yes	215(60.6)	87(61.7)		
Received anti-helminth?			0.05	0.82
No	160(45.1)	62(44.0)		
Yes	195(54.9)	79(56.0)		
Infected with malaria?			0.50	0.48
No	258(72.7)	98(69.5)		
Yes	97(27.3)	43(30.5)		
Received malaria prophylaxis?			1.93	0.21
No	46(13.0)	12(8.5)		
Yes	309(83.0)	141(91.5)		

Note: Fischer's exact chi-square test was used to determine significant difference between the various categories, P-value <0.05.

4.9 Logistic analysis of sociodemographic factors associated with anaemia pregnant women

Level of education was significantly associated with anaemia. The odds of pregnant women with basic education being anaemic is 2.96 times compared to pregnant women with no formal education. COR 2.96 (1.23 - 7.05) p=0.015.

There was a significant association between occupation with anaemia. The odds of a self-employed pregnant woman becoming anaemic is 85% less as compared to a pregnant government employee.{COR 0.15 (0.04 - 0.48) p=0.002}. Again, the odds of an unemployed pregnant woman becoming anamic is 79% less compared to a pregnant government employee. COR 0.21 (0.06 - 0.73), p= 0.014. Finally, the odds of pregnant women who were neither self-employed nor unemployed (predominantly students) becoming anaemic is 96% less compared to pregnant government employee COR 0.04 (0.10 – 0.16), p<0.001.

Age of study participants and their marital status were not significantly associated with anaemia.

Table 9: Logistic analysis of sociodemographic factors and its association with anaemia among pregnant women

Demographic factors	COR	95% CI	P-Value	AOR	95% CI	P-Value
Age categories						
15 - 19	1					
20 - 24	0.8	0.32 - 1.97	0.626			
25 - 29	0.61	0.26 - 1.44	0.261			
30 - 34	0.45	0.18 - 1.13	0.089			
35 - 39	0.42	0.15 - 1.17	0.096			
>= 40	0.54	0.15 - 1.96	0.346			
Educational level						
No formal education	1			1		
Basic education	2.94	1.23 - 7.05	**0.015**	2.73		**0.03**
Junior high	2.3	1.01 - 5.25	**0.049**	1.96		0.12
Senior high	1.27	0.52 - 3.09	0.596	1.01		0.98
Tertiary	0.59	0.20 - 1.72	0.337	0.51		0.22
Occupation						
Government employee	1			1		
Self-employed	0.15	0.04 - 0.48	**0.002**	0.31	0.08 - 1.26	**0.101**
Unemployed	0.21	0.06 - 0.73	**0.014**	0.47	0.11 – 1.10	**0.309**
Other	0.04	0.10 - 0.16	**<0.001**	0.07	0.02 – 0.35	**0.001**
Marital status						
Single	1					
Married	1.19	0.68 – 2.11	0.54			
Cohabiting	0.63	0. 25 - 1.56	0.32			

4.10 Logistic analysis of clinical characteristics associated with anaemia in pregnant women

Birth spacing, gestational age at first and second ANC visit, gravidity, parity and number of ANC visits were all not associated with anaemia during univariate logistic analysis. However, after adjusting for age of pregnant women, birth spacing and parity become significantly associated with anaemia after adjusting for age. The odds of pregnant women with a birth spacing of more than 2 years being anaemic is 1.2 as compared to women who were pregnant for the first time. COR 1.2 (0.76 – 1.89) p=0.44 and AOR 1.89 (1.12-3.20) p=0.018. Similarly, the odds of primiparous women having anaemia is 1.32 times compared to nulliparous women. COR 1.32 (0.79 - 2.20) p=0.28 and AOR 1.78(1.03 - 3.06) p=0.04. The odds of multiparous women becoming anaemic is 1.08 times compared to nulliparous women. OR 1.08 (0.67 - 1.74) p=0.75 and AOR 2.16 (1.16 – 4.01) p=0.02.

Table 10: Logistic analysis of clinical characteristics associated with anaemia among pregnant women

Clinical characteristics	COR	95% CI	P-Value	AOR	95% CI	P-Value
Birth spacing						
First Pregnancy	1			1		
<2 years	0.49	0.14 – 1.79	0.28	0.7	0.19– 2.61	0.596
>=2	1.2	0.76 – 1.89	0.44	1.89	1.12 – 3.20	**0.018**
Gestational age at first ANC visit						
First	1			1		
Second	1.21	0.81 – 1.79	0.36	1.16	0.78 – 1.73	0.47
Third	1.37	0.25 – 7.65	0.72	1.27	0.22 – 7.25	0.79
Gestational age at current ANC visit						
First	1			1		
Second	1.5	0.15 - 15.46	0.73	1.25	0.12 - 13.12	0.85
Third	1.16	0.12 - 11.24	0.9	0.99	0.10 - 9.73	0.99

Clinical characteristics	COR	95% CI	P-Value	AOR	95% CI	P-Value
Gravidity						
First pregnancy	1			1		
Second pregnancy	1.33	0.79 - 2.24	0.29	1.73	0.99 - 3.00	0.05
Third pregnancy	1.08	0.59 - 1.95	0.81	1.81	0.92 - 3.58	0.09
Fourth pregnancy	0.97	0.48 - 1.94	0.93	2.05	0.89 - 4.72	0.09
Fifth or more pregnancy	1	0.49 - 2.03	0.99	2.46	1.00 - 6.08	0.05
Parity						
Nulliparous	1			1		
Primiparous	1.32	0.79 - 2.20	0.28	1.78	1.03 - 3.06	**0.04**
Multiparous	1.08	0.67 - 1.74	0.75	2.16	1.16 - 4.01	**0.02**
Number of ANC visits						
Two visits	1			1		
Three visits	2.07	0.64 - 6.68	0.22	2.14	0.66 - 6.97	0.21
Four or more visits	0.86	0.32 - 2.29	0.76	0.9	0.33 - 2.40	0.82

4.11 Logistic analysis of consumption of iron supplements associated with anaemia in pregnant women

Binary logistic regression analysis of women who received iron supplements, those who consumed the iron supplements, the number of times they received the iron supplement, and the frequency of consuming egg/meat was not significantly associated with anaemia in pregnant women. The odds of women receiving iron supplement becoming anaemic was reduced by 74% compared to those who did not receive the iron supplement. COR 0.26 (0.04 - 1.58) p=0.14. The odds of those who consumed the iron supplements becoming anaemic was reduced by 42% compared to those who did not consume the iron supplement. COR 0.52 (0.12 - 2.37) p=0.40. The odds of those who received the iron supplement on more than two occasions was reduced by 27% compared to those who received it only once. COR 0.73 (0.35 – 1.52) p=0.4. The odds of pregnant women who consumed first-class proteins (egg/meat) becoming anaemic was reduced by 64% compared to those that consumed it once a week. COR 0.36 (0.09 – 1.46) p=0.15.

There was a significant association between the consumption of vegetables/fruits with pregnant women being anaemic or not. The odds of pregnant women who consumed vegetables/fruits twice a week becoming anaemic was 2.58 times as compared to those who do not consume it. COR 0.39 (1.69 – 3.94) p=0.001 and AOR 0.45 (0.29 – 0.72) p=0.001. Pica consumption was significantly associated with anaemia in pregnant women. Pregnant women who consumed pica were 2.54 times more likely to become anaemic, compared to those that did not consume it.

Table 11: Logistic analysis of consumption of iron supplements associated with anaemia among pregnant women at the Kintampo North Municipal Hospital (N=496)

Iron tablet and iron-rich foods consumption	COR	95% CI	P-Value	AOR	95% CI	P-Value
Received iron tablet?						
No	1					
Yes	0.26	0.04 - 1.58	0.14			
Consumed the iron tablet?						
No	1					
Yes	0.52	0.12 - 2.37	0.40			
Iron tablets received						
Once	1					
Twice	0.8	0.35 - 1.85	0.61			
More than two times	0.73	0.35 - 1.52	0.40			
Egg/meat						
Once a week	1					
Twice a week	0.49	0.12 - 2.08	0.34			
More than twice a week	0.36	0.09 - 1.46	0.15			
Vegetables/fruits						
Never	1			1		
Once a week	0.32	0.14 –0.75	**0.009**	2.86	0.13 - 0.87	**0.016**
Twice a week	0.39	0.25 - 0.59	**<0.001**	2.58	0.29 – 0.72	**<0.001**
More than twice a week	1	-	-	1		-
Pica consumption						
No	1			1		
Yes	2.54	1.56 - 4.13	**<0.001**	2.37	1.45 - 3.87	**<0.001**

4.12 Prevalence of anaemia among antenatal attendants

Of the 496 pregnant women, 171(34.5%) presented with Hb<11.0g/dl at first ANC visit (registration). Their mean Hb was 11.4g/dl and SD ±1.3g/dl. One (0.2%) of the pregnant women presented with severe anaemia (Hb<7g/dl). Sixty-two (12.5%) had moderate anaemia (Hb 7 – 9.9 g/dl) and 108 (21.8%) had mild anaemia (Hb 10 – 10.9 g/dl).

The prevalence of anaemia at current ANC among the 496 pregnant women was 141(28.4%), Hb< 11.0g/dl, with a mean Hb of 11.4g/dl and SD ±1.1g/dl. Out of these 141 women, 36(7.3%) had moderate anaemia and 105(21.2%) had mild anaemia.

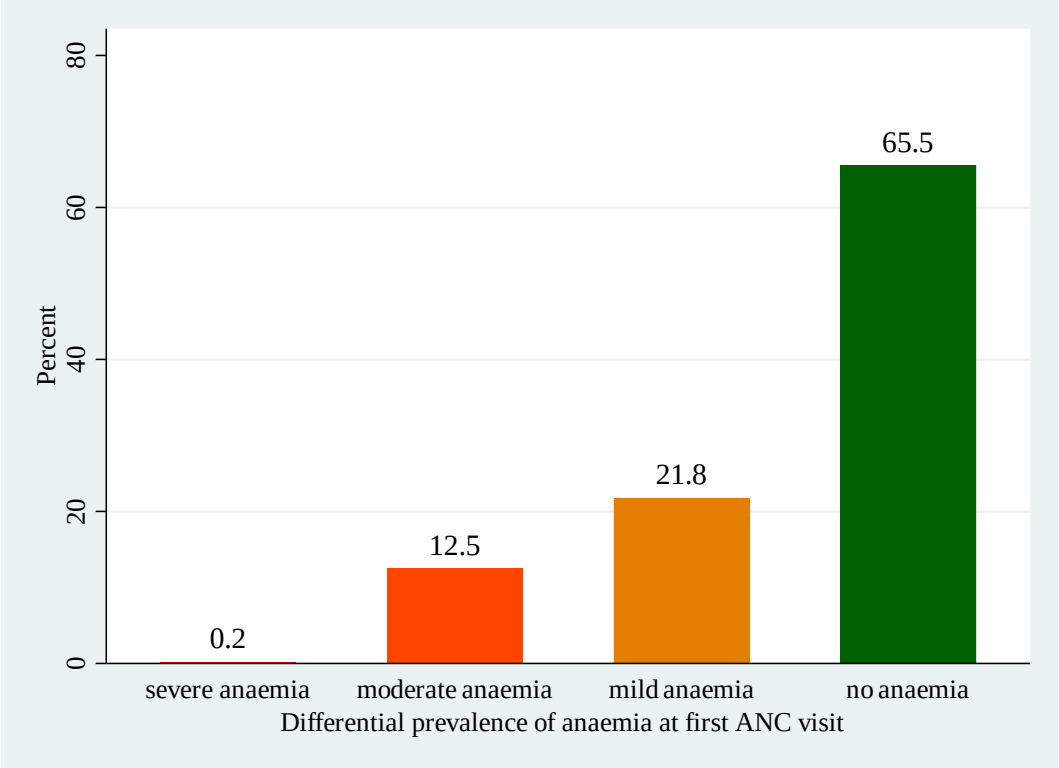

Figure 2: Severity of anaemia among pregnant women at Kintampo North Municipal Hospital at first ANC visit.

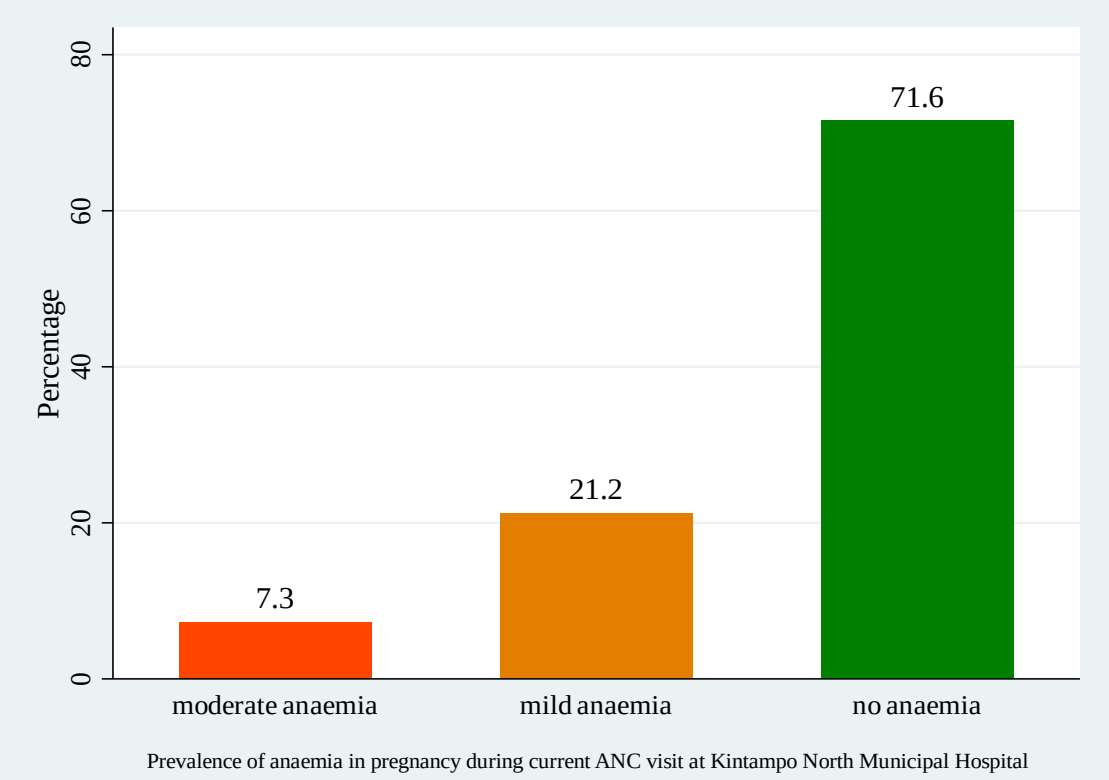

Figure 3: Severity of anaemia among pregnant women at current ANC visit Kintampo North Municipal Hospital

Among the 496 pregnant women that were recruited into the study from the ANC, the prevalence of anaemia (Hb <11g/dl) in the Kintampo North Municipal Hospital at their first (registration) and current visits were found to 34.5% and 28.4% respectively.

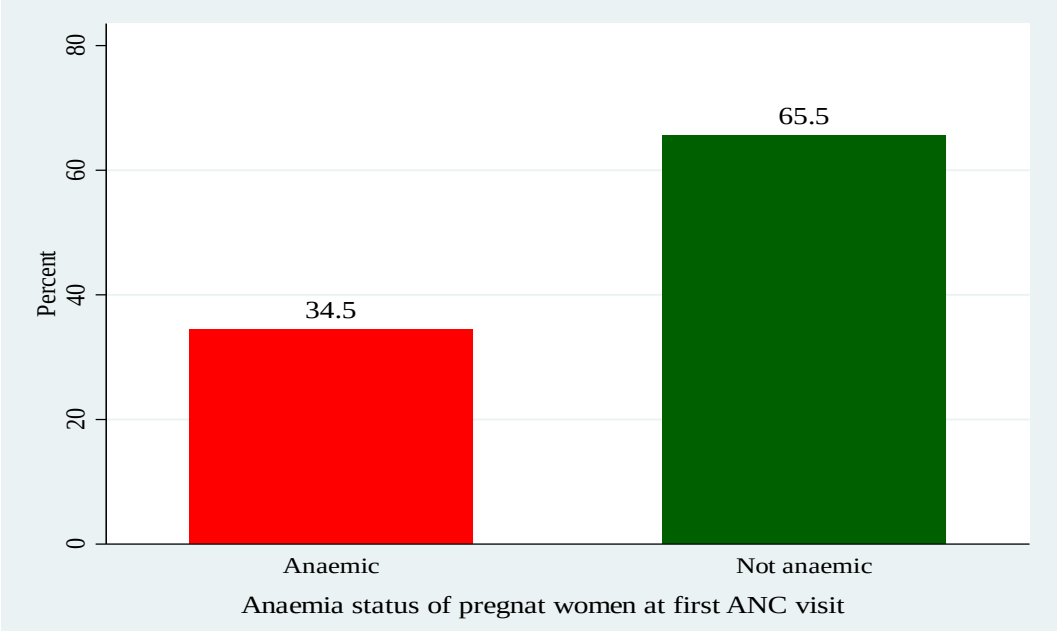

Figure 4: Prevalence of anaemia among pregnant women making their first ANC visit at the Kintampo North Municipal Hospital

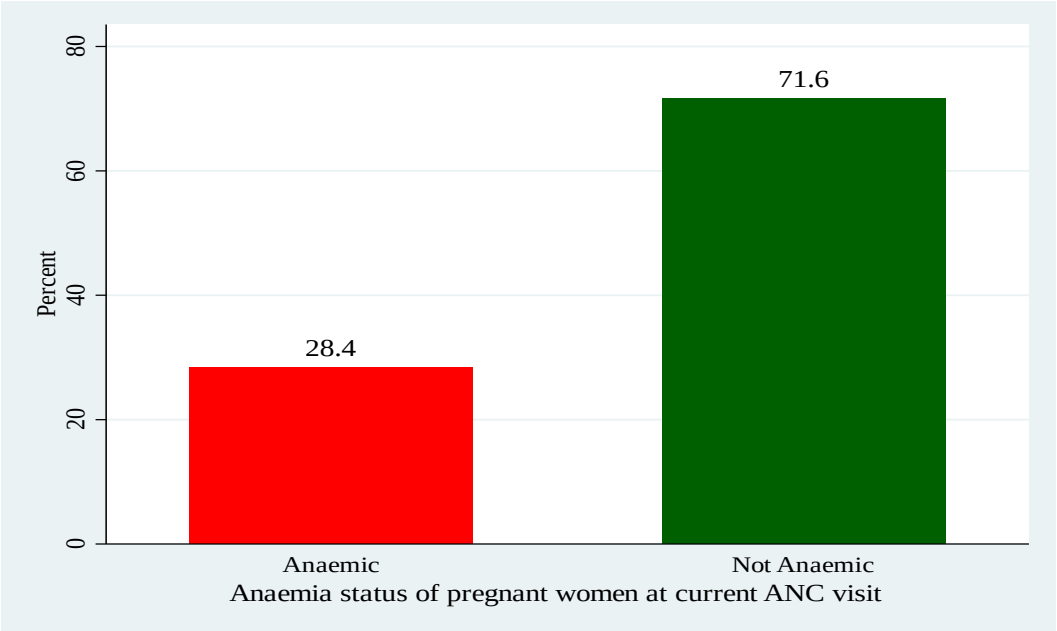

Figure 5: Prevalence of anaemia among pregnant women making their second or more ANC visit at the Kintampo North Municipal Hospital

CHAPTER FIVE

5.0 DISCUSSION

This study was a hospital-based cross-sectional study, that was conducted to estimate the prevalence of anaemia and its associated factors among pregnant women who visited the Kintampo North Municipal Hospital. Figures 4 and 5 show the prevalence of anaemia during registration and current ANC visits respectively. There was a drop in the prevalence of anaemia from the first ANC visit to current visit, 34.5% to 28.4% ($p < 0.001$) respectively. The 6.1% drop in the level of anaemia may be attributed to ANC services like provision of insecticide-treated nets (ITN), iron supplements, malaria prophylaxis and counselling among others that were rendered to pregnant women. Of the 34.5% prevalence of anaemia that was recorded among the pregnant women at first ANC visit, 0.2% was severe, 12.5% was moderate and 21.8% was mild.

Again, of the 28.4% of the total prevalence of anaemia that was estimated at the current ANC visit among the pregnant women, 7.3% was moderate and 21.2% was mild. Severe anaemia was not recorded in the current (Figure 2) visit as opposed to one in the first ANC visit (Figure 3). Also, the severity (severe, moderate and mild) of anaemia reduced at current visit compared to the first and this can be attributed to the ANC services that were offered to the pregnant women. The prevalence of anaemia, 28.4%, during current ANC visit was not too different from a systematic review conducted by Kassa, Muche, Berhe, & Fekadu, (2017), in which they established the prevalence of anaemia among pregnant women to be 29%.

Studies show that anaemia during pregnancy is associated with several problems including but not limited to: increased perinatal and maternal morbidity and mortality, increased obstetric problems, maternal physical and psychological comorbidity (Kassa et al., 2017).

Factors such as the educational status, frequency of vegetables/fruits consumption, number of ANC visits made by the pregnant women, occupational status and pica consumption were significantly associated with anaemia in pregnancy. However, the number of ANC visit lost its significance when it was run in both binary logistic and multivariate models.

The study showed that age was not associated with anaemia in pregnancy at the KMH. The prevalence of anaemia was highest in the 20 – 24 year age category compared to the 15 – 19 years age group. This difference was not significant at both the crude level and after adjusting. A study by Getachew et al., (2012) showed a similar result with women within the age bracket of 21 - 25 reporting with the highest anaemia. Again, in a study that was conducted in Wolayita Sodo Town, Southern Ethiopia, pregnant women in the 15 - 24 age category and in Tanzania 14 - 24 age group were the most affected by anaemia (Kefiyalew et al., 2015; Stephen et al., 2018).

There was a strong association between education and becoming anaemic. Women with tertiary education were the least likely to be anaemic when compared to the other educational groups. Various studies have reported a similar trend. Pregnant educated women are more likely to be employed, earn higher incomes, consume nutritious food and as such are less likely to become anaemic. Another study in Ghana by Anlaakuu & Anto, (2017), also reported a lower prevalence of anaemia among pregnant women with tertiary education. Other studies with similar findings were conducted in Northern Tanzania and Zurich, Switzerland (Bencaiova, Burkhardt, & Breymann, 2012a; Stephen et al., 2018)

Frequency of vegetables/fruits consumption was strong associated with anaemia in pregnant women. Those who consumed vegetables/fruits at least twice every week were less likely to have anaemia as compared to those who consumed it only ones. This could be explained by the fact that dark green leafy vegetables contain some amounts of non-haem iron that helps to reduce the severity anaemia. Fruits such as oranges, limes, lemons and tomatoes contain high amounts of vitamin C that increases the bioavailability of the non-haem iron from the vegetables and make their absorption much easier. The bioavailability of this non-haem is less compared to haem iron (iron from animal sources). Also, fruits contain vitamins like folate and cobalamin that help to prevent other forms of anaemia. Other studies that were conducted in different countries showed similar trends (Lebso, Anato, & Loha, 2017; Saini et al., 2016; Tadesse et al., 2017). A study conducted by Karaoglu et al., (2010), however, gave a contrasting result. These differences can be attributed to variation in study sites, individual differences and sampling techniques.

The number of ANC visits by pregnant women was also significantly associated with anaemia. However, it lost its significance after it was modelled in logistic regression. Various studies across the globe have also established a significant relationship between the number of ANC visits and becoming anaemic (Alemu & Umeta, 2015; Bencaiova, Burkhardt, & Breymann, 2012b; Bodeau-livinec et al., 2011; Stephen et al., 2018). Those with 4 or more ANC visits were less likely to be anaemic because of the numerous interventions that were put in place to reduce their severity of anaemia. Malaria prophylaxis, iron and folate supplement, ITNs and nutritional counselling are some of the preventive measures that were put in place to reduce the prevalence of anaemia among them. Women with the recommended number of 4 or more ANC visits were more likely to receive all the above services compared to those with fewer visits.

Occupation of study participants was among the factors that were associated with anaemia. Those who were self-employed, unemployed (including house wives and concubines) much less likely to be anaemic compared to those working in Government establishment. This can be attributed to the fact that those with formal employment may not have the time to eat regularly as compared to those who are unemployed. Also, the house wives are those who prepare the meals and as such, they are better positioned to consumed juiciest parts. Again, those who were not working and not married may be concubines to other men. Studies have showed that men take care of their concubines better than their wives. Some studies that were conducted in Ghana and other countries like Ethiopia agree with this finding (Kassa et al., 2017; Kefiyalew et al., 2015). Other studies, however, did not find a significant association between occupation and becoming anaemic (Glover-Amengor et al., 2005; Stephen et al., 2018).

Pica was significantly associated with anaemia among pregnant women. Those who craved for pica were 2.54 times more likely to be anaemic as compared to those who did not. This was significant ($p<0.001$) in linear logistic model and after adjusting. AOR 2.37(1.45 – 3.87), $p<0.001$. A study by Karaoglu et al., (2010), established an association between pica and anaemia. Stephen et al., (2018), however, did not find a significant association between pica and anaemia in their study. This differences could be explained by the type of clay or soil the pregnant women crave for. This is because different soils/clays have different species of blood sucking worms and their eggs. The prenatal Hb concentration of the women may also play a key role in this regard.

5.1 Limitations of this study

The study was conducted at KMH and it constitutes selection bias. This is because the people who vist the ANC are different from those who do not.

The nature (close-ended questions) of the questionnaire made it impossible for respondents to freely express themselves.

Also, women who might be coming to ANC for the first time because of delayed onset of anaemia who might have substantially higher anaemia may be excluded due to the design of the study.

It is also cross-sectional and as such it can not describe causality.

There could also be confounders between one visit and the other, because the pregnant women could have different exposures that may affect anaemia levels and hence not only be the subject of the antenatal interventions. The associations, however, are very important.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The prevalence of anaemia at KMH was 28.4%. The main factors that were significantly associated with anaemia during pregnancy in this study were level of education, frequency of vegetables/fruits consumption, number of ANC visits made by the pregnant women, occupational status and pica. None of the anaemia preventing interventions such as, ITN usage, anti-helminths, and malaria prophylaxis, that were put in place to help reduce the prevalence of anaemia was statistically significant.

Prevalence of anaemia (Hb < 11.0g/dl) in the pregnant women dropped from 34.5% at registration to 28.4% at the current visit. No severe anaemia (Hb < 7.0g/dl) was recorded at current visit.

6.2 Recommendation

A deeper understanding of how anaemia is being reduced in the country is needed, as such further qualitative studies could be done by KMH to get a deeper insight into what really causes anaemia in pregnant women. This could be achieved in less than 2 years.

How to avoid pica in pregnancy should be emphasized during antenatal clinic services. Health promotion should be targeted at practices that help to lower the prevalence of anaemia in pregnant women and those that help to promote the hemoglobin concentration among them. These can be achieved within the short (less than 2 years) if it is made a priority by KMH.

Health promotion should be targeted at educating women on the importance of consuming varieties of vegetables and fruits to help reduce the severity of anaemia in pregnant women. Additional nation-wide studies are needed to further the understanding of the determining factors for anaemia in pregnant women. This could be championed by GHS as a long term solution to curbing maternal anaemia.

REFERENCES

Abbaspour, N., Hurrell, R., & Kelishadi, R. (2015). *Review on iron and its importance for human health Review on iron and its importance for human health*. *19*(FEBRUARY 2014), 1–9.

Abu Hashim, H., Foda, O., & Ghayaty, E. (2017). Lactoferrin or ferrous salts for iron deficiency anemia in pregnancy: A meta-analysis of randomized trials. *European Journal of Obstetrics Gynecology and Reproductive Biology*, *219*, 45–52. https://doi.org/10.1016/j.ejogrb.2017.10.003

Adam, I., Radi, E. A., & Babiker, S. (2015). *Comments on the article : Anaemia and pregnancy outcomes in a South African rural population by L . -J . Van Bogaert . Journal of Obstetrics and*. *3615*(November). https://doi.org/10.1080/01443610701666355

Adamu, A. L., Crampin, A., Kayuni, N., Amberbir, A., Koole, O., Phiri, A., … Fine, P. (2017). Prevalence and risk factors for anemia severity and type in Malawian men and women: Urban and rural differences. *Population Health Metrics*, *15*(1), 1–15. https://doi.org/10.1186/s12963-017-0128-2

Alemu, T., & Umeta, M. (2015). *Reproductive and Obstetric Factors Are Key Predictors of Maternal Anemia during Pregnancy in Ethiopia : Evidence from Demographic and Health Survey (2011)*. *2015*.

Anlaakuu, P., & Anto, F. (2017). Anaemia in pregnancy and associated factors: a cross sectional study of antenatal attendants at the Sunyani Municipal Hospital, Ghana. https://doi.org/10.1186/s13104-017-2742-2

Bencaiova, G., Burkhardt, T., & Breymann, C. (2012a). Anemia—prevalence and risk factors in pregnancy. *European Journal of Internal Medicine*, *23*(6), 529–533. https://doi.org/10.1016/j.ejim.2012.04.008

Bencaiova, G., Burkhardt, T., & Breymann, C. (2012b). European Journal of Internal Medicine Anemia — prevalence and risk factors in pregnancy. *European Journal of Internal Medicine*, *23*(6), 529–533. https://doi.org/10.1016/j.ejim.2012.04.008

Bodeau-livinec, F., Briand, V., Berger, J., Xiong, X., Massougbodji, A., Day, K. P., & Cot, M. (2011). *Maternal Anemia in Benin : Prevalence , Risk Factors , and Association with Low Birth Weight*. *85*(3), 414–420. https://doi.org/10.4269/ajtmh.2011.10-0599

Burke, R. M., Leon, J. S., & Suchdev, P. S. (2014). Identification, prevention and treatment of iron deficiency during the first 1000 days. *Nutrients*, *6*(10), 4093–4114. https://doi.org/10.3390/nu6104093

Cardwell, M. S. (2013). Eating disorders during pregnancy. *Obstetrical & Gynecological Survey*, *68*(4), 312–323. https://doi.org/10.1097/ogx.0b013e31828736b9

Childress, K. M. S., & Myles, T. (2013). *Baking Soda Pica Associated With Rhabdomyolysis and Cardiomyopathy in Pregnancy*. *122*(2), 495–497.

https://doi.org/10.1097/AOG.0b013e31829634b7

Chowdhury, S., Rahman, M., & Abm, M. (2014). *Review Article Anemia in Pregnancy*. *26*(01), 49–52.

Dainty, J. R., Berry, R., Lynch, S. R., Harvey, L. J., & Fairweather-Tait, S. J. (2014). Estimation of dietary iron bioavailability from food iron intake and iron status. *PLoS ONE*, *9*(10), 1–7. https://doi.org/10.1371/journal.pone.0111824

Derso, T., Abera, Z., & Tariku, A. (2017). Magnitude and associated factors of anemia among pregnant women in Dera District: A cross-sectional study in northwest Ethiopia. *BMC Research Notes*, *10*(1). https://doi.org/10.1186/s13104-017-2690-x

Emmanuel, O. A., Olusegun, A. A., Rachel, A. A., & Sunday, S. T. (2014). Iron deficiency anaemia associated with helminths and asymptomatic malaria infections among rural school children in S outhwestern Nigeria. *Asian Pacific Journal of Tropical Disease*, *4*(1), 590–594. https://doi.org/10.1016/S2222-1808(14)60684-8

Gaillard, R., Eilers, P. H. C., Yassine, S., Hofman, A., Steegers, E. A. P., & Jaddoe, W. V. (2014). *Risk Factors and Consequences of Maternal Anaemia and Elevated Haemoglobin Levels during Pregnancy : a Population-Based Prospective Cohort Study*. 213–226. https://doi.org/10.1111/ppe.12112

Gautam, C. S., Saha, L., Sekhri, K., & Saha, P. K. (2008). Iron deficiency in pregnancy and the rationality of iron supplements prescribed during pregnancy. *Medscape Journal of Medicine*, *10*(12), 283. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19242589

Gebreweld, A., Bekele, D., & Tsegaye, A. (2018). Hematological profile of pregnant women at St . Paul ' s Hospital Millennium Medical. *BMC Hematology*, 1–7. https://doi.org/10.1186/s12878-018-0111-6

Gedefaw, L., Ayele, A., Asres, Y., & Mossie, A. (2015). Anemia and Associated Factors Among Pregnant Women Attending Antenatal Care Clinic in Wolayita Sodo Town, Southern Ethiopia. *Ethiopian Journal of Health Sciences*, *25*(2), 155–162. https://doi.org/10.4314/ejhs.v25i2.8

Ghana Health Service, F. H. D. (2017). *Family Health Division Annual Report 2016*.

Ghana Statistical Service(GSS), Ghana Health Service(GHS), and I. I. (2015). Ghana Demographic and Health Survey. *Cochrane Database of Systematic Reviews (Online)*, *17*(1), 30–43. https://doi.org/10.1007/s13398-014-0173-7.2

Ghana Statistical Service. (2015). Ghana demographic health survey. *Demographic and Health Survey 2014*, 530. https://doi.org/10.15171/ijhpm.2016.42

Glover-Amengor, M., Owusu, W. B., & Akanmori, B. (2005). Determinants of anaemia in pregnancy in sekyere west district, ghana. *Ghana Medical Journal*, *39*(3), 102–107. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17299553%5Cnhttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC1790823

Goonewardene, M. (2012). Best Practice & Research Clinical Obstetrics and Gynaecology Anaemia in pregnancy. *Best Practice & Research Clinical Obstetrics & Gynaecology*, *26*(1), 3–24. https://doi.org/10.1016/j.bpobgyn.2011.10.010

Goonewardene, M., Shehata, M., & Hamad, A. (2012). Anaemia in pregnancy. *Best Practice & Research Clinical Obstetrics & Gynaecology*, *26*(1), 3–24. https://doi.org/10.1016/j.bpobgyn.2011.10.010

Green, R., & Ananya, D. M. (2016). Megaloblastic Anemias Nutritional and Other Causes. *Medical Clinics of NA*. https://doi.org/10.1016/j.mcna.2016.09.013

GSS. (2009). Ghana Demographic and Health Survey Annual Report. In *Ghana Statistical Service (GSS) Ghana Demographic and Health Survey*. https://doi.org/10.15171/ijhpm.2016.42

Karaoglu, L., Pehlivan, E., Egri, M., Deprem, C., Gunes, G., Genc, M. F., & Temel, I. (2010). The prevalence of nutritional anemia in pregnancy in an east Anatolian province , Turkey. *BMC Public Health*, 1–12. https://doi.org/10.1186/1471-2458-10-329

Kassa, G. M., Muche, A. A., Berhe, A. K., & Fekadu, G. A. (2017). Prevalence and determinants of anemia among pregnant women in Ethiopia; a systematic review and meta-analysis. *BMC Hematology*, *17*(1), 17. https://doi.org/10.1186/s12878-017-0090-z

Kassebaum, N. J., Jasrasaria, R., Naghavi, M., Wulf, S. K., Johns, N., Lozano, R., … Murray, C. J. L. (2014). A systematic analysis of global anemia burden from 1990 to 2010. *Blood*, *123*(5), 615–624. https://doi.org/10.1182/blood-2013-06-508325

Kefiyalew, F., Zemene, E., Asres, Y., & Gedefaw, L. (2015). *Anemia among pregnant women in Southeast Ethiopia : prevalence , severity and associated risk factors Methods Results*. 3–7. https://doi.org/10.1186/1756

Kenneth, R. B., & Howard, A. P. (2008). *Anemias and other red cell disorders*. https://doi.org/10.1007/s11269-011-9817-y

Kimbi, J. K. A., Nkweti, V. N., Ntonifor, H. N., Apinjoh, T. O., Chi, H. F., Tata, R. B., & Achidi, E. A. (2017). Profile of red blood cell morphologies and causes of anaemia among pregnant women at first clinic visit in the mount Cameroon area : a prospective cross sectional study. *BMC Research Notes*, 1–7. https://doi.org/10.1186/s13104-017-2961-6

Klemm, R. D., Sommerfelt, A. E., Boyo, A., Barba, C., Kotecha, P., Mona, S., & Franklin, N. (2011). Cross-country Comparison of Anemia Prevalence, Reach, and Use of Antenatal Care and Anemia Reduction Interventions. *Usaid*, (July), 1–88.

Lebso, M., Anato, A., & Loha, E. (2017). Prevalence of anemia and associated factors among pregnant women in Southern Ethiopia: A community based cross-sectional study. *PLoS ONE*, *12*(12), 1–11. https://doi.org/10.1371/journal.pone.0188783

Lee, J.-O., Lee, J. H., Ahn, S., Kim, J. W., Chang, H., Kim, Y. J., … Lee, J. S. (2014). Prevalence and risk factors for iron deficiency anemia in the korean population: results of the fifth KoreaNational Health and Nutrition Examination Survey. *Journal of Korean Medical Science*, *29*(2), 224–229. https://doi.org/10.3346/jkms.2014.29.2.224

Lee, K. A., Zaffke, M. E., & Baratte-Beebe, K. (2001). Restless Legs Syndrome and Sleep Disturbance during Pregnancy: The Role of Folate and Iron. *Journal of Women's Health & Gender-Based Medicine*, *10*(4), 335–341. https://doi.org/10.1089/152460901750269652

Mahan, L. K., & Raymond, J. L. (2017). *Krause's Food & The Nutrition Care Process* (14TH EDITI). St. Louis, Missouri 63043: Elsevier.

McLean, E., Cogswell, M., Egli, I., Wojdyla, D., & De Benoist, B. (2009). Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993-2005. *Public Health Nutrition*, *12*(4), 444–454. https://doi.org/10.1017/S1368980008002401

Nadarajan, V. S. (2014). *Autoimmune haemolytic anaemia – diagnosis and treatment*. 80–85.

Nelms, M., Sucher, K. P., Lacey, K., & Roth, S. L. (2010). *Nutrition Therapy & Pathophysiology* (Second Edi; E. Feldman, A. Glubka, & M. M. Marketing, Eds.). Belmont, CA 94002-3098: Yolanda Cossio.

Olatunbosun, O. A., Abasiattai, A. M., Bassey, E. A., James, R. S., Ibanga, G., & Morgan, A. (2014). *Prevalence of Anaemia among Pregnant Women at Booking in the University of Uyo Teaching Hospital , Uyo , Nigeria*. *2014*(1–7).

Port, L., Watier, L., Cottrell, G., Choudat, I., Rachas, A., Bouscaillou, J., & Massougbodji, A. (2012). *Anaemia during pregnancy : impact on birth outcome and infant haemoglobin level during the first 18 months of life*. *17*(3), 283–291. https://doi.org/10.1111/j.1365-3156.2011.02932.x

Qureshi, I. A., Arlappa, N., & Qureshi, M. A. (2014). Prevalence of malaria and anemia among pregnant women residing in malaria-endemic forest villages in India. *International Journal of Gynecology and Obstetrics*, *127*(1), 93. https://doi.org/10.1016/j.ijgo.2014.06.009

Rajagopal, S. S., Kandasamy, K., Prasad, A., Surendran, A., Sebastian, A. C., & Ramanathan, S. (2017). EPIDEMIOLOGICAL STUDY OF PREVALENCE OF ANEMIA AND ASSOCIATED RISK FACTORS IN A RURAL COMMUNITY; A HOME-BASED SCREENING. *Asian Journal of Pharmaceutical and Clinical Research*, *10*(2), 307. https://doi.org/10.22159/ajpcr.2017.v10i2.15661

Saini, R. K., Nile, S. H., & Keum, Y. S. (2016). Food science and technology for management of iron deficiency in humans: A review. *Trends in Food Science and Technology*, *53*, 13–22. https://doi.org/10.1016/j.tifs.2016.05.003

Salhab, M., Hsu, A., Ryer, E., Appiah, J., & Switzer, B. (2017). Microangiopathic hemolytic anemia in pregnancy. *Transfusion and Apheresis Science*, *56*(3), 354–356.

https://doi.org/10.1016/j.transci.2017.02.001

Satyam, P., & Khushbu, Y. (2015). Maternal Anemia in Pregnancy : An Overview. *Journals, Human Article, Review*, (3).

Shill, K. B., Karmakar, P., Kibria, M. G., Das, A., Rahman, M. A., Hossain, M. S., & Sattar, M. M. (2014). Prevalence of iron-deficiency anaemia among university students in Noakhali Region, Bangladesh. *Journal of Health, Population and Nutrition*, *32*(1), 103–110.

Shubair, M. E. (2014). Comments on: Iron deficiency anemia among kindergarten children living in the marginalized areas of Gaza Strip Palestine**See paper by Sirdah MM et al. on pages 132–8. *Revista Brasileira de Hematologia e Hemoterapia*, *36*(2), 104–105. https://doi.org/10.5581/1516-8484.20140024

Stephen, G., Mgongo, M., Hussein Hashim, T., Katanga, J., Stray-Pedersen, B., & Msuya, S. E. (2018). Anaemia in Pregnancy: Prevalence, Risk Factors, and Adverse Perinatal Outcomes in Northern Tanzania. *Anemia*, *2018*, 1–9. https://doi.org/10.1155/2018/1846280

Stevens, G. A., Finucane, M. M., De-regil, L. M., Paciorek, C. J., Flaxman, S. R., Branca, F., & Peña-rosas, J. P. (2013). *Global , regional , and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995 – 2011 : a systematic analysis of population-representative data*. 16–25. https://doi.org/10.1016/S2214-109X(13)70001-9

Tadesse, S. E., Seid, O., Mariam, Y. G., Fekadu, A., Wasihun, Y., Endris, K., & Bitew, A. (2017). Determinants of anemia among pregnant mothers attending antenatal care in Dessie town health facilities, northern central Ethiopia, unmatched case -control study. *PLoS ONE*, *12*(3). https://doi.org/10.1371/journal.pone.0173173

Tomar, S. G., Singhal, S., & Shukla, A. (2017). Anemia in pregnancy : Epidemiology and it's determinants. *International Journal of Medical and Health Research*, *3*(1), 5–9.

WHO. (2013). *World Health Health Statistics 2013* (Vol. 84). Retrieved from http://ir.obihiro.ac.jp/dspace/handle/10322/3933

WHO. (2014). Global Nutrition Targets 2025 : Anaemia Policy Brief (WHO/NMH/NHD/14.4). *Global Nutrition Targets 2025*, *2*(WHO/NMH/NHD/14.4), 8. https://doi.org/WHO/NMH/NHD/14.4

WHO. (2015). The Global Prevalence of Anaemia in 2011. *Geneva: World Health Organization.*, 48. https://doi.org/10.1017/S1368980008002401

World Health Organization, Williams, a L., van Drongelen, W., Lasky, R. E., Sanderson, M., Lai, D., … Wang, D. H. (2012). Guideline : Daily iron and folic acid supplementation in pregnant women. *World Health Organization*, *46*, 323–329. https://doi.org/10.1055/s-0028-1104741

Young, S. (2011). *Craving Earth : Understanding Pica : The Urge to Eat Clay , Starch , Ice , and Chalk by Sera Young Review by : By Peter W . Abrahams The Quarterly Review*

of. *86*(4), 349.

APPENDICES

APPENDIX I

Informed consent form

Name of Researcher:	SUMAILA ISSAH
Name of Institution:	School Public Health
	College of Health Sciences
	University of Ghana.
Name of Supervisor:	Dr. Alexander Manu

Project Title:

PREVALENCE AND RISK FACTORS OF ANAEMIA AMONG ANTENATAL CARE (ANC) ATTENDANTS AT THE KINTAMPO NORTH MUNICIPAL HOSPITAL.

Introduction:

You are invited to participate in a research being conducted on anaemia in pregnancy by Mr. Issah Sumaila, a Student at the Department of Epidemiology and Disease Control of the School of Public Health, University of Ghana. For this project, the study will employ two main approaches for data collection. These will be data extraction from participant ANC Booklet using a checklist and administration of a structured questionnaire. The purpose of this research is to determine the prevalence of anaemia (HB <11.0g/dl) among ANC attendants at the Kintampo Municipal Hospital and risks factors associated

with anaemia in pregnant women. The information generated will be used for academic research or publication and to help advance knowledge about the current trends for policy makers. All information obtained will be encrypted, secured and confidential. For this research, you will answer questions in a survey. You are free to withdraw your participation at any time should you become uncomfortable with the study. If you have any questions or concerns, feel free to contact me on 0249252116, or by email at issah85@gmail.com. I hope you will use this opportunity to share your experiences and viewpoints. Thank you very much for your help.

I certify that the participant will be given ample time to read and learn about the study. All questions and clarifications raised by the participant will be adequately addressed.

_____ _____

Signature of Researcher Date

Consent

I have been invited to take part in the research titled above. I have been told that the purpose of this study is to evaluate the prevalence of anaemia among pregnant women attending ANC at the Kintampo North Municipal Hospital. My role in this study is to complete an attached questionnaire of which I understand my participation is totally voluntary and free, and that I am not going to be subjected to any risk, danger or discomfort.

I have been informed that the confidentiality of the information will be safeguarded and that my privacy and anonymity will be ensured in the collection, storage, and publication of the research material. I have the right to refuse to participate at any time I wish to.

I have read the forgone information. All questions I asked have been answered to my satisfaction. I therefore voluntarily consent to participate in this study.

I have read this letter and consent to participate.

Signature of participant: _____ Date: _____

Signature of researcher: _____ Date: _____

APPENDIX II

Questionaire

PREVALENCE AND RISK FACTORS OF ANAEMIA AMONG ANTENATAL CARE (ANC) ATTENDANTS AT THE KINTAMPO NORTH MUNICIPAL HOSPITAL.

S/No:…….. **Date:…….**

	SECTION A: DEMOGRAPHIC DATA	Response
1	Age of participant (in completed years)	[ ]
2	Height of participant (cm)	[ ]
3	Current weight of participant (kg)	[ ]
4	What is your marital status? 1- Single 2- Married 3- Divorced 4- Separated 5- Cohabiting 6- Widowed	[ ]
5	What is your occupation 1- Government employee 2- Self-employed 3- Unemployed 4- Others, specify	[ ]
6	What is your religious affiliation? 1. Christianity 2. Islam 3. Traditional 4. Atheist	[ ]
7	What is the size of your household?	[ ]
8	What is your highest level of education? 1- No formal education 2- Basic education	[ ]

	3- Junior High School 4- Senior High School 5- Tertiary	

SECTION B

	ANC REGISTER RECORDS REVIEW	Response
9	Number of ANC visits	[ ]
10	Gestational age at first visit (in weeks)	[ ]
11	Hb at first visit	[ ]
12	Gestational age at current visit (in weeks)	[ ]
13	Hb at current visit	[ ]
14	Gravidity (Number of Pregnancy) [**NB: Skip** questions **15** and **16** if this is the first pregnancy].	[ ]
15	Parity (Number of Children)	[ ]
16	Birth interval between current and previous pregnancy	[ ]
17	Were you given anti-malaria prophylaxis during this pregnancy? 1. Yes 2. No	[ ]

SECTION C

	MEDICAL AND NUTRITIONAL HISTORY	Response
18	Have you ever been given an iron/folic acid tablet supplement during this pregnancy? 1- Yes 2- No [**NB: Skip** question **19** and **20** if answer is "**No**"]	[ ]

19	Have you been taking the iron/folic acid tablet supplement during this pregnancy 1- Yes 2- No	[ ]
20	If yes, how many times have you received the supplement? 1. Once 2. Twice 3. More than two times	[ ]
21	Pica consumption during this current pregnancy 1- Yes 2- No	[ ]
22	How often do you consume the following food items during this pregnancy? Egg/Meat/Fish/Snails/any other source of animal protein 1- Never 2- Once a week 3- Twice a week 4- More than twice a week	[ ]
23	Green leafy vegetables/fruits 1- Never 2- Once a week 3- Twice a week 4- More than two times a week	[ ]
24	Were you infected with malaria during this pregnancy? 1- Yes 2- No	[ ]
25	Were you given mosquito net during this pregnancy? 1. Yes 2. No **Skip** question **26** If the respondent answered **No** to question **25**	[ ]
26	Did you sleep in it last night? 1. Yes 2. No	[ ]
26	Have you been given an anti-helminths during this pregnancy? 1. Yes 2. No	[ ]

APPENDIX III

GHS-ERC

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

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

MyRef. GHS/RDD/ERC/Admin/App/19/2019
Your Ref. No.

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
GPS Address: GA-050-3303
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com
20th June, 2019

Issah Sumaila
University of Ghana
School of Public Health
Legon

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

GHS-ERC Number	**GHS-ERC 042/04/19**
Project Title	Prevalence and Risk Factors of Anaemia among Antenatal Care (ANC) Attendants at the Kintampo North Municipal Hospital
Approval Date	20th June, 2019
Expiry Date	19th June, 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