SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

THE PREVALENCE AND DETERMINANTS OF ANAEMIA AMONG PREGNANT WOMEN IN HOHOE

BY

EMMANUEL ENYONAM ZEYE

(10637370)

THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PUBLIC HEALTH DEGREE

JULY, 2019

Declaration

I, Emmanuel Enyonam Zeye, declare that works belonging to other people which I used during my study have been duly acknowledged through referencing. This proposal has also not been submitted in part or full for the award of any other degree in any institution in Ghana or abroad.

…… ……

Emmanuel Enyonam Zeye (Date)

(Student)

…… ……

Dr Sackey O. Samuel (Date)

(Supervisor)

Dedication

I dedicate this work to the Zeye family and to all the people whose lives have been adversely affected by anaemia.

Acknowledgements

I thank God for His graces in taking me through a successful program. To the Zeye family, your prayers, encouragement and continuous support was very essential in my schooling. Dr Sackey O. Samuel, you've been a father away from home and I'm grateful for all the help with my dissertation. My gratitude goes to my research assistants who helped me with my data collection; Ignatius Great Sakada, Prince Francis Obum and Edwin Etornam Zeye. I wish to thank the staff of the Hohoe ANC for their help during my data collection. I could not have finished this work without you. To Edem Kpewuo, thank you for helping proof-read my work and making great inputs. My gratitude goes out to all who in diverse ways have contributed to the success of this work.

Table of Contents

List of tables

List of figures

List of acronyms

AOR	Adjusted Odds Ratio
ANC	Ante-Natal Clinic
CHNs	Community Health Nurses
CI	Confidence Interval
COR	Crude Odds Ratio
DHIMS2	District Health Information Management System 2
GDHS	Ghana Demographic Health Survey
GHS	Ghana Health Service
GSS	Ghana Statistical Service
Hb	Haemoglobin
IDA	Iron Deficiency Anaemia
IQ	Intelligence Quotient
IPT	Intermittent Preventive Treatment
IPTp	Intermittent Preventive Treatment in Pregnancy
ITN	Insecticide Treated Net
LLIN	Long-Lasting Insecticide Treated Nets
MOH	Ministry of Health
PNC	Post-Natal Clinic
RBC	Red Blood Cell
REDCap	Research Electronic Data Capture
SD	Standard Deviation
SP	Sulfadoxine-Pyrimethamine

UNICEF	United Nations Children's Fund
WHO	World Health Organisation

Abstract

Introduction

Anaemia is one of the most common health conditions which can affect anyone especially women of reproductive age and children. Pregnant women are at an even higher risk due to the physiological demands of the foetus.

Anaemia affects over 800 million women and children and 38.2% of pregnant women worldwide. In Ghana 42% of women of reproductive age have anaemia. The situation is worse in the Volta Region where 46.5% are anaemic.

Methods

This research was done at Hohoe among pregnant women and lactating mothers to determine the prevalence of anaemia in the target group. The research was a cross-sectional study based in the Hohoe Municipal Hospital. The study participants were selected using systematic random sampling with the ANC/PNC attendance register as the sampling frame. Interviews were done and questionnaires administered to study participants. Also, health records, including the Hb level history, attendance at ANC, recent history of malaria or worm infestation and demographic characteristics, were taken from the maternal records book of respondents. In all, 407 pregnant women were part of the study. STATA version 15 was used for the data analysis. Microsoft Excel 2016 was also used to draw charts and tables. Pearson's chi-square tests and Fischer's exact tests were used to find associations. Logistic regressions were also used to find if these associations exist when adjusting for other variables.

Results:

The prevalence of anaemia among the participants was found to be 32.7% (anaemia on first ANC visit) of which there were 48.1% moderate cases and 51.9% mild cases of anaemia. 51.4% of the respondents had high knowledge on anaemia, 38.6% had fair knowledge and 11.0% had low knowledge.

The level of a pregnant woman's formal education, the number of times a pregnant woman deworms, the trimester in which a pregnant woman visits the ANC and the parity were the factors that were found to be significant determinants of the anaemia status of the study participants.

Conclusion and recommendations:

Anaemia is still an issue of public health concern among the study population. CHNs doing more community sensitization and education during home visits on topics like early attendance to ANC when pregnant can go a long way to help reduce the burden of anaemia.

Also, midwives should ensure that pregnant women are given the adequate dosage of anthelmintic during the period of their pregnancy.

Since education was found to be a strong determinant, it will be prudent for the CHNs to include the need for educating the girl-child as part of their educational activities. Also, the ministry of education should ensure all girls have at least basic level of education.

Chapter 1

1.0 Introduction

1.1 Background

Anaemia is a condition characterised by low levels of haemoglobin in the blood or a reduced volume of red blood cells. Anaemia is one of the most common health conditions, affecting about 800 million women and children globally with the highest prevalence (62.3%) found in the Africa region (WHO, 2015b). It is a condition caused by many factors including micronutrient deficiency (especially iron, folate and vitamin A), bone marrow diseases, the body's inability to produce red blood cells and other diseases or infections. Iron deficiency has been found to be the main cause of anaemia (McLean, Cogswell, Egli, Wojdyla, & de Benoist, 2009), resulting in about 50% of all cases of anaemia. The main causes of anaemia in Ghana include malaria, intestinal worm infestation and inadequate dietary iron intake. (GSS, 2015).

In Ghana, 42% of women of reproductive age have mild to severe anaemia. The Upper East region had the lowest prevalence of anaemia (35.6%) while the Volta region recorded the highest (48.7%)(WHO, 2015b). Breastfeeding women and pregnant women have the highest prevalence of anaemia (45% and 44.6% respectively) (WHO et al., 2012). A pregnant woman is anaemic if the haemoglobin concentration of her blood is below 11.0g/L in her first or third trimester. In her second trimester, a haemoglobin concentration of below 10.5g/L signifies anaemia. The WHO recommends an intervention of daily iron and folic acid supplementation for all pregnant women (up to 60 mg of elemental iron in countries like Ghana where anaemia among pregnant women is above 40%). Pregnant women who were diagnosed with anaemia early in pregnancy should, however, receive twice this dose until their haemoglobin levels fall within the normal range(WHO et al., 2012).

Anaemia comes with a plethora of symptoms including dizziness, fatigue, general body weakness, shortness of breath and irregular heartbeats. More pronounced symptoms include

impairment in mental and physical development and increased risk of morbidity and mortality. Anaemia can also lead to a reduction in productivity of the individual and the larger community as a whole. It is estimated that a total of 1.9 billion Ghana Cedis will be lost due to reduced worker productivity caused by anaemia in Ghana from 2011 to 2020 (GHS & MOH, 2013).

In pregnant women, anaemia can result in premature delivery. It can also lead to the delivery of low birth weight children, congenital anomalies and perinatal deaths.

1.2 Problem Statement

Anaemia is a global problem which affects about 800 million women and children in both rich and poor countries (WHO, 2015b). Out of these, about 500 million non-pregnant women are anaemic (WHO, 2016a). Globally, anaemia affects 38.2% of pregnant women (WHO, 2016b). Anaemia has serious health consequences including fatigue, increased risk of infections, pre-term birth, low birth weight and mortality. (GSS, 2015; L. H. Allen, 2000). Pregnant women, women in reproductive age and children are the most at risk.

Prevalence of anaemia in children (6 – 59 months) was found to be very high in South-East Asia, Eastern Mediterranean and Africa with the anaemic forming 53.8%, 48.6% and 62.3% respectively (WHO, 2015b). In pregnant women, the burden was 48.7%, 38.9% and 46.6% respectively.

In Ghana, 56% of women have anaemia with about 4% with severe anaemia resulting in a severe level of public health significance (WHO, 2015b).

In a more recent study, it was found that only 42% of Ghanaian women were anaemic (GSS, 2015). The case in the Volta region, however, is worse than the national average with 48.7% of women being anaemic. This is the highest recorded prevalence in the country (GSS, 2015). The prevalence is far beyond the recommended level for intervention according to the WHO

by 28.7%. This value is about twice the threshold of 20% specified by the WHO. In Ghana, 44.6% of pregnant women have been found to have anaemia.

Anaemia has so many adverse effects that, it's incidence and prevalence need to be checked. Researching into the determinants in a population in which the prevalence of the condition is still high could provide pointers in determining the reasons behind its continuous persistence.

1.3 A conceptual framework for the determinants and effects of anaemia

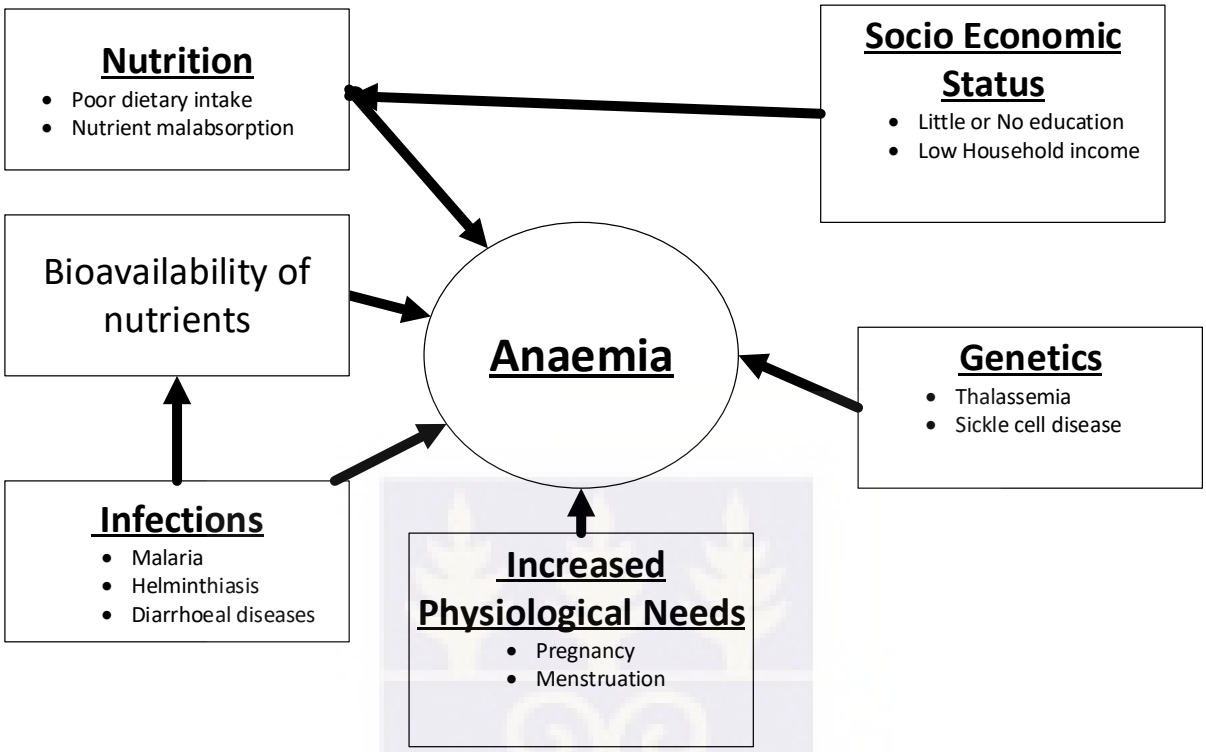

Figure 1.1 Conceptual framework for the determinants of anaemia among pregnant women

1.3.1 Narrative: Determinants and effects of anaemia

Parasitic infections like malaria and helminthiasis are the main causes of malaria. These parasites mostly compete for nutrients with the host organism, thereby depriving the host of the necessary nutrients in the right quantity, directly leading to anaemia as shown in the conceptual framework above. These parasites sometimes ingest blood and destroy blood cells hence leading to anaemia. Infections at times make it difficult for the body to effectively use the nutrients consumed in food, thereby indirectly leading to anaemia as shown above.

Also, poor nutrition (GSS, 2015) due to inadequate consumption of food rich in iron, folic acid and vitamin C could lead to anaemia as these play very important roles in the synthesis of red blood cells. This poor nutrition could be caused by food insecurity due to unemployment or poor knowledge on proper nutrition. So even though food insecurity and poor nutritional

knowledge could not directly lead to anaemia, they could clearly affect dietary intake which can lead to anaemia as shown in the conceptual framework above. Consumption of iron and folic acid inhibitors like phytate and calcium could also reduce the quantity of these nutrients available to the body hence resulting in anaemia (R. Hurrell & Egli, 2010).

In pregnant women, a major factor that could lead to anaemia is their current physiological state of pregnancy. In pregnancy, the foetus uses the red blood cells produced by the pregnant woman for its growth and development. This is especially profound in the third trimester of pregnancy. This could lead to inadequate red blood cells for the pregnant woman, therefore leading to anaemia

The nutrients demand of the foetus reduces the nutrients available for the pregnant woman and this should be quickly replenished through proper nourishment and food supplements. Poor nutrition which does not meet the demands of the pregnancy could lead to anaemia.

Less common factors also exist that could lead to anaemia in pregnancy which include some genetic conditions like sickle cell anaemia.

1.4 Research Questions

1. What is the prevalence of anaemia among pregnant women in Hohoe?
2. What do the pregnant women in Hohoe know about anaemia?
3. What factors influence the anaemia status of pregnant women in Hohoe?

1.5 General Objective

To determine the prevalence, knowledge and determinants of anaemia among pregnant women in Hohoe.

1.6 Specific Objectives

1. To determine the prevalence of anaemia among pregnant women in Hohoe
2. To assess the knowledge of anaemia among pregnant women living in Hohoe on anaemia
3. To determine the determinants of anaemia in pregnancy among pregnant women in Hohoe.

Chapter 2

2.0 Literature Review

2.1 Introduction

Anaemia is a condition in which the red blood cells are not enough in the body. Anaemia is one of the most widely spread conditions, affecting about 800 million women and children globally with the highest prevalence (62.3%) found in the Africa region (WHO, 2015b). Anaemia is caused by a decreased production of red blood cells (RBC), or faster destruction of RBCs than they are produced or a severe loss of blood (Wu, Lesperance, & Bernstein, 2016). Discrepancies in the creation or destruction of RBCs could be due to many factors. This is mainly due to infections, nutrition and physiological needs. All living things need nourishment for various physiological functions. Pregnant women even need more nutrients than the people who are not pregnant due to the demands of the foetus. The nutrients consumed by the pregnant woman are shared between her and her growing foetus. The foetus also uses the red blood cells of the woman for its development and growth, therefore depleting what is available for the mother. (University of Rochester Medical Center, Burd, & Dozier, 2017).

2.1.1 How anaemia is diagnosed

Diagnosing anaemia is usually done with a blood test for haemoglobin (mostly using complete blood counts). The WHO recommends full blood count testing as the best method for diagnosing anaemia in pregnancy. In cases where such infrastructure cannot be accessed, the use of a haemoglobinometer is preferred to the use of haemoglobin colour scales when it comes to diagnosing anaemia in pregnancy (WHO, 2016b). Haemoglobin is a protein in red blood cells that transport oxygen to cells. The haemoglobin levels are usually compared with standard ranges set by the WHO (WHO & Chan 2011). These ranges differ based on characteristics like age, sex, physiological requirements like pregnancy and lactation, altitude and smoking status. Anaemia is categorised by severity. The categories include severe, moderate and mild. For

pregnant women, the ranges are Hb < 7.0g/dl (severe anaemia), Hb < 9.9 g/dl (moderate anaemia), Hb < 10.9g/dl (mild anaemia) and Hb < 11.0g/dl (any anaemia).

Anaemia could result from a number of causes which are not accounted for in the simple blood test for haemoglobin. About 50% of anaemia is thought to be caused by iron deficiency (McLean et al., 2009; WHO, 2015b). To determine the cause of anaemia, the medical examiner may perform other tests like ferritin tests and physical examinations (NHS Choices, 2016).

2.1.2 The effects of anaemia

Anaemia can lead to dizziness, fatigue, headache, coldness, shortness of breath, heart palpitations and pale complexion. Aside from these effects, anaemia can have very dramatic effects like the low birth weight of children, maternal and child mortality, reduction in productivity in adults and impairment in the physical and cognitive development of children (McLean et al., 2009).

In Ghana, it is estimated that about 1.9 billion Ghana Cedis will be lost due to anaemia between 2011 to 2020 (GHS & MOH, 2013).

2.1.3 Prevention and correction of anaemia

Interventions to prevent or control anaemia usually depend on the cause of anaemia in the affected population or individual. Usually, taking food containing enough bioavailable iron may be enough. Iron deficiency, which accounts for the majority of the cases of anaemia, is mostly targeted when it comes to the control of anaemia. The WHO has put together some guidelines that suggest ways of controlling anaemia in different populations based on the level of anaemia among their age groups. Most of the interventions involve iron supplementation (with or without folic acid) intermittently or continuously (WHO et al., 2012). These supplementations are compulsory for pregnant women, including the use of anti-helminths after the first trimester

2.2 Anaemia in pregnancy

Pregnant women are at higher risk of becoming anaemic, as the nutrients the consume will be used by the pregnant woman herself and her developing foetus. Also, her red blood cells serve both the foetus and herself. The foetus needs it for its growth and development. Due to these, the pregnant woman is more predisposed to becoming anaemic in her condition.

Apart from nutrition and physiological state of the pregnant woman, other factors, like infections (especially malaria and helminthiasis) could determine whether a woman becomes anaemic during her pregnancy or not. Less pronounced factors like genetic conditions and socio-economic status can also influence the anaemia status of pregnant women

2.3 Anaemia in Pregnancy and Nutrition

Nutrition is an important life process for every living thing. Every human being needs an optimal diet made up of the required nutrients in order to live healthy. These nutrients can either be macronutrients - needed in large quantities or micronutrients – needed in smaller quantities (Anderson, Root, & Garner, 2015). Generally, micronutrients help the body to produce enzymes and hormones for the performance of many body functions. They help in the metabolic activities that take place in the human body. Various micronutrients, however, perform various specific functions. Some are necessary for activating the enzymes that are responsible for these chemical activities. During the physiological state of pregnancy, these nutrients are needed in higher quantities by the pregnant woman. Vitamin A, Iron, Folic Acid and Vitamin C are important in combating anaemia in pregnancy. The lack or insufficient intake of any of this will result in adverse health effects, which may cause permanent damage to health. Pregnant women who are vegans or vegetarians may have a harder time meeting their nutritional needs to combat anaemia from just plant-based foods without supplements (NHS Choices, 2017). Even though micronutrient deficiencies are common in the developed

countries, the burden is far greater in the developing world. (L. Allen, Benoist, Dary, & Hurrell, 2006)

2.3.1 Iron

Even though iron is abundant in nature, it is usually not abundant in organisms, having varying degrees of deficiency (Abbaspour, Hurrell, & Kelishadi, 2014; Quintero-Gutiérrez, González-Rosendo, Sánchez-Muñoz, Polo-Pozo, & Rodríguez-Jerez, 2008). This is because iron exists mostly in forms that cannot be readily absorbed by living organisms. Humans and other living things have adapted to this in several ways (Abbaspour et al., 2014) including mechanisms to capture iron in different forms or to break down iron to a form that can readily be absorbed by the organism.

Because of the importance of iron, its presence in the diet of humans is very important. In the first few months of life, iron present in breast milk is usually sufficient to meet a baby's needs. The baby's demands for iron increases by four to six months of age. Again, the body's demands for an iron increase after the first year of age and also during the period of growth spurts in adolescence (Abbaspour et al., 2014).

Iron is the most important nutrient when it comes to anaemia, especially anaemia in pregnancy. This is because Iron deficiency anaemia is the most common form of anaemia worldwide, being about 50% of all cases of anaemia (Clark, 2008; Killip, Bennett, & Chambers, 2007; Wong, 2017). Another research also showed that iron deficiency accounts for 75% of all anaemia in pregnancy (Abbaspour et al., 2014; Horowitz, Ingardia, & Borgida, 2013). Iron is a key component of red blood cells which is important for the formation of haemoglobin without which the red blood cells cannot transport oxygen through the body. Iron deficiency anaemia results from prolonged iron imbalance (World Health Organization, 2001). It usually starts with a negative iron balance which results in the depletion of iron stores and the production of red blood cells which are deficient in iron (Clark, 2008). It usually starts with a negative iron

balance which results in the depletion of iron stores and the production of red blood cells which are deficient in iron (Clark, 2008). Determining if anaemia is actually due to iron deficiency or other chronic disease can be done by checking iron stores (serum ferritin and haemosiderin) are lower than their normal values (Cook, 2005). For adults who have anaemia, a serum ferritin level of below 15g/l signifies iron deficiency, especially in people above 5 years (Abbaspour et al., 2014). When the serum ferritin levels are between 15g/l and 30g/l, iron deficiency is not conclusive but very likely (Pasricha et al., 2010). The use of serum ferritin levels to diagnose iron deficiency can however be erroneous in cases of infections and inflammations. This is because the levels of ferritin rise above the threshold for diagnosis in such cases (Pasricha et al., 2010). In cases of anaemia, markers like the C-reactive protein may help identify inflammation if the levels of serum ferritin have been found to be higher than expected. A high soluble transferrin receptor concentration could also signify iron depletion in tissues.

Oral supplementation of iron is usually a good means of correcting iron deficiency as long as it is administered in the right dose for an adequate duration (Pasricha et al., 2010). Intravenous and intramuscular treatments are possible but are not very popular due to concerns about negative effects (like venous thrombosis and allergic reactions) that may arise from the use of these methods.

Deficiency of iron (iron-deficiency anaemia) is very dangerous during pregnancy. Iron deficiency in pregnancy can lead to the delivery of low birth weight babies, delivery of pre-term babies, slow recovery after delivery and possibly, still births and the death of the pregnant woman in the worst of cases (University of Rochester Medical Center et al., 2017; Wong, 2017). Iron deficiency, especially in pregnancy is very common to the extent that, the WHO has suggested compulsory supplementation of iron for pregnant women who come from regions with over 20% prevalence of anaemia (WHO & Chan, 2011). In worse cases, higher doses of iron supplements in combination with other supplements are recommended for

pregnant women. To determine anaemia in pregnant women, the WHO has established that a blood haemoglobin level of 9.9g/dl or lower indicates some form of anaemia. A systematic review done with randomized control trials and observational cohort studies found that, iron is essential in increasing the haemoglobin levels of pregnant women by 4.59g/dl on average, thereby reducing the risk of anaemia by 50% (NHS Choices, 2016).

2.3.2 Vitamin A

Vitamin A is a precursor for rhodopsin which plays an important role in the rods in the eye. Vitamin A is also very important when it comes to anaemia, especially in pregnancy. It helps in the synthesis of the of red blood cells and iron metabolism (da Cunha, Siqueira, Trindade, & Arruda, 2014; Michelazzo, Oliveira, Stefanello, Luzia, & Rondó, 2013). It is also very important due to the fact that it is crucial in cell differentiation and development, especially at the time when the growth and development of the foetus is necessary. Too much of it can't have negative effects though. Too little of it can also result in deficiency diseases including night blindness. A study also suggests that, the deficiency of Vitamin A can lead to anaemia due to its importance in erythropoiesis (Gebremedhin, 2014). Vitamin A on its own cannot combat anaemia. A research done by collating other literature on PubMed showed that, Vitamin A combined with iron supplementation has a higher ability to combat anaemia in pregnancy than the use of iron supplements alone (Michelazzo et al., 2013). A study done among school children showed a decrease in serum ferritin and an increase in haemoglobin levels when vitamin A supplements were combined with Iron supplementation (Al-Mekhlafi et al., 2013).

2.3.3 Folic Acid (folate) and Cobalamin (B12)

Apart from the prevention of spinal tube defects like the *spina bifida*, folic acid (and Vitamin B12) are essential to the maturation of red blood cells. It is advised folic acid is taken even before a woman gets pregnant, or as soon she gets pregnant. Vitamin B12, apart from its role in the manufacturing of red blood cells helps in the absorption of folic acid. These help in

providing the body with enough red blood cells in the blood to prevent anaemia. Deficiency of Vitamin B12 can result in anaemia, including pernicious anaemia. Pregnant women who are vegans are most likely at risk of this form of anaemia as Vitamin B12 comes naturally mainly from animal source. It is advised that pregnant women who are vegans use fortified foods like cereals to meet their vitamin B12 needs.

2.3.4 Vitamin C

Vitamin C does not quickly come to mind when anaemia is mentioned. Vitamin C however helps in the production of red blood cells in the body which is the main step in combating anaemia. Apart from this, vitamin C helps in the absorption of iron into the body. Iron absorption is more effective in the presence of vitamin C. Pregnant women are encouraged to take vitamin C-rich foods or take vitamin c supplements during pregnancy in order to prevent anaemia. Abuse of this nutrient can however result in the delivery of preterm babies. Also, for pregnant women who are vegans, vitamin c is very important when consuming non-heme iron and it is encouraged to be taken together with food (NHS Choices, 2017).

2.3.5 Calcium, Phosphorus and Phytates

Calcium is essential for the development of strong bones and teeth. This is especially true for a developing foetus and its mother. Some researches however associate an increase in serum calcium to a reduction in the absorption rate of iron. A study done by Lynch SR to review the epidemiological evidence that calcium is able to inhibit the absorption of iron showed that, calcium salts in single human meals have that effect when calcium and iron are both found in the lumen of the small intestines at the same time, even though the mechanism by which this happens is not established (Lynch, 2000). Another study however disagrees partially with this stance that, the reduction in iron absorption rate that seems to occur on calcium consumption is only transient and that continuous consumption of calcium did not show any changes in the markers used in measuring anaemia status (Lönnerdal, 2010). Phytates have also been found

to inhibit iron absorption in the body (R. F. Hurrell, 2004). A research found out that, as little as 3mg of phytate from bran can reduce the effectiveness of iron absorption by 50% (Hallberg, 1987). Also, studies have shown that the amount of phosphorus in the blood or consumed with food is inversely proportional to the amount of iron that is being absorbed by the body (Yossef, 2010). A study also found this relation only in a phosphorus-iron-calcium complex (Yossef, 2010).

2.4 Anaemia in pregnancy and infections

Parasites that infect the body, especially during pregnancy, can make the pregnant woman weak or destroy her red blood cells. Some infections during pregnancy can also be easily transferred to the developing foetus. The most common infections that could lead to anaemia in pregnancy are malaria and worm infestation. It has been found that, malaria, helminthiasis and iron deficiency are the main causes of anaemia in Ghana (UNICEF & Ministry of Health, 2014).

2.4.1 Malaria

Malaria in pregnancy is an important public health issue, especially in the African region. Infection by *plasmodium falciparum* or *Plasmodium vivax* could lead to various other conditions, including anaemia. When the malaria parasites enter the body, they infect the red blood cells which are then ruptured at the end of the infection cycle. This reduces the amount of red blood cells available in the blood, leading to anaemia (WHO, 2018). This could also lead to low birth weight, increasing the possibility of infant mortality (WHO, 2015a). The state of pregnancy makes women more susceptible to infections. In the African region, most women have some immunity towards malaria and may not manifest the symptoms of malaria during pregnancy. This makes is easy to ignore the effects of malaria resulting in anaemia (Shulman, Dorman, & Bulmer, 2002).

2.4.2 Helminthiasis

Parasitic worm infestation is one of the main causes of anaemia. Parasitic worms, especially hookworms, trigger chronic blood loss mostly by the release of anticlotting factors that ensure they have continuous flow of blood from the host (Osazuwa, Ayo, & Imade, 2011). Helminthiasis has been found to be associated with anaemia in pregnancy (Shrinivas, Radhika, Sreelatha, & Kavitha, 2014). During pregnancy, a lot of women do not pay much attention to personal hygiene and their diet. Some eating disorders like pica due to hormonal and nutritional changes in pregnancy also make it easier for pregnant women to get helminth infections, especially soil-transmitted helminths (Shrinivas et al., 2014). Apart from causing continuous internal bleeding which may lead to anaemia, these helminths can deprive a person of nutrients consumed, lead to improper digestion and absorption of these nutrients, thereby leading to anaemia and other deficiency diseases (WHO, 2017). The WHO recommends preventive chemotherapy for pregnant women in regions where prevalence of helminthiasis is above 20% or regions with 40% or more prevalence of anaemia in pregnancy (WHO, 2017).

2.5 Other contributing factors to anaemia

Apart from the main factors that can lead to anaemia in pregnancy, other factors like socio – economic status and less common factors like genetics can also lead to anaemia. Research has found a correlation between anaemia and socio economic status where an increase in the socio economic status of girls led to a decrease in the prevalence of anaemia (Kim et al., 2014). Another study done in Puskesmas Kecamatan Duren Sawit found a significant association between the level of education of pregnant women, their socio – economic status and anaemia prevalence (Chandra et al., 2018). A study done in North Shoa zone, Ethiopia had similar results where the educational level of a pregnant woman and her occupation were found to be statistically significantly associated with her anaemia status (Mekonnen, Ambaw, & Neri, 2018). A research done in Nigeria did not find any association between socio economic status

and anaemia. It rather found food security and level of food insecurity to be factors that significantly influence anaemia status of pregnant women (Sholeye, Animasahun, & Shorunmu, 2017). The difference in results could be due to the differences in the study areas.

In pregnancy, other factors that could contribute to anaemia include the number of times a woman has given birth (parity), child spacing and adolescent pregnancy. Parity, multiple spontaneous abortions and gravidity were found to be directly related to the presence of anaemia in a study done in Trinidad and Tobago. The study also found out that the gestational age of a pregnant woman on her first visit to ANC had a direct relation to her anaemia status (Uche-Nwachi et al., 2010). Another study found that, the severity of anaemia in pregnancy increased with increase in parity, increased with decreasing child spacing (birth – intervals) and increased with late booking for ANC (Kalsoom, Tarar, & Tahmina, 2013).

2.6 Strategies in combating anaemia in pregnancy

2.6.1 Food and food supplement based approaches

Micronutrient deficiencies, especially those of iron, folate and vitamin B12, contribute most to the high prevalence of anaemia in pregnancy. For this reason, the main strategies in combating anaemia in pregnancy include the use of food and food supplements. At most ANCs, nutrition counselling is given to pregnant women, with most focus on diversifying the nutrient consumption and the consumption of foods rich in specific micronutrients. In addition, the WHO recommendation of giving daily iron and folic acid supplements (30 – 60mg of elemental iron and 400µg of folic acid) to pregnant women, especially those in regions with severe anaemia prevalence (WHO, 2016b) is strictly followed in most countries and their districts, including Hohoe, the district in which this study was done. The WHO also recommends that a pregnant woman who is diagnosed with anaemia in pregnancy should have her daily dose of elemental iron supplements increased to 120mg until her haemoglobin levels get back to

normal (WHO, 2016b). Outside the hospital, foods fortified with diverse combinations of micronutrients to combat nutritional deficiencies are available.

2.6.2 Combating infections

Since the major causes of anaemia in pregnancy in Ghana are parasitic infections (GSS, 2015), including malaria and helminthiasis, combating infections has been one of the strategies that have been adopted to reduce the burden of anaemia among pregnant women. Some preventive strategies like the distribution of insecticide treated bed nets to pregnant women who attend ANC. Insecticide treated bed nets have been found to be effective in the control of malaria causing vectors (Lengeler C, 2009). The WHO recommends the promotion of the use of ITNs by pregnant women as part of the package for ensuring a positive pregnancy experience (WHO, 2016b). WHO also recommends giving IPTp-SP to pregnant women after the first trimester of pregnancy on each ANC visit (from the second trimester onwards). By the end of her term, a pregnant woman should receive at least three doses of IPTp-SP (Okpere, Enabudoso, & Osemwenkha, 2010; WHO, 2016b). This also helps combat the malaria-causing parasites. Unfortunately, the distribution of ITNs does not guarantee it's use. Studies have shown that, not all households which have ITN make use of it. According to the GDHS, 68% of households own an ITN but only 43% of pregnant women in these households slept under the nets the night before the survey (GSS, 2015). Also uptake of IPTp in some African countries had been found to be low and declining. This mostly was attributable to the uncertainty of health professionals about SP administration. After simplified and targeted messages were adopted, and countries implementing policies towards the administration of at least three doses of SP during pregnancy, some improvements were seen (WHO, 2016b).

The WHO recommends preventive anthelmintic treatment for pregnant women who live in endemic areas (areas where the prevalence of soil-transmitted helminths is above 20%) and where anaemia is a severe public health problem (anaemia prevalence of greater or equal to

40%). This treatment is done with a single-dose (400mg) albendazole or (500mg) mebendazole in the second trimester of pregnancy. This is a highly cost-effective means of allowing better nutrient absorption and preventing anaemia. However, out of 10 women in Ghana, only 4 of them took deworming medications during their last pregnancies (GSS, 2015).

2.7 Other researches

This study is not the first one that attempts to find out about the prevalence and determinants of anaemia in pregnant women. Other studies have sought to find out what the factors that result in anaemia in various populations with varying features could be. Most of these studies concentrated on high-risk groups including children, pregnant women and non-pregnant women within the reproductive age.

2.7.1 Prevalence of anaemia and anaemia in pregnancy

It has been estimated by the WHO (2015) that 800 million women and children are affected with anaemia. The highest prevalence of anaemia was found in children, followed by pregnant women. Non-pregnant women in their reproductive age had the lowest prevalence of anaemia in the groups considered. Pregnant women had a mean Hb of 12.6 g/dl which was beyond the threshold for mild anaemia, accounting for pregnancy. This mean Hb level, however, differed between and within regions. The African region had some of the highest prevalence of severe anaemia in children. The African region recorded the lowest Hb levels and highest anaemia prevalence, reflecting the factors that contribute to anaemia, malaria and inheritable conditions that are more prevalent in the region. Other researches done in other African countries have found varying prevalence of anaemia. A research done in South Africa recorded a prevalence of 42.7% of anaemia in pregnancy (Tunkyi & Moodley, 2015). A 23.53% of anaemia prevalence in pregnancy was also found in another research done in Ethiopia (Zekarias, Meleko, Hayder, Nigatu, & Yetagessu, 2017).

A 32.2% prevalence was also found in Nigeria in a study done among pregnant women (Ikeanyi & Ibrahim, 2015). Most of these researches recorded very few cases of severe anaemia. Most of the cases were mild while others were moderate. Some of the studies did not record any case of severe anaemia.

The mean Hb level for pregnant women in Ghana, who were within the reproductive age of 15 to 49 years, was 10.5g/dl. 62% of pregnant women were found to have one form of anaemia or the other. This shows a clear situation of severe public health significance.

The prevalence of anaemia in pregnancy according to the Ghana Demographic and Health Survey, 2015 was 44.6%. This level is of great public health significance based on the cut-off limits set by the WHO.

The prevalence of anaemia recorded in the District for the year 2015 was 45%, 45% in 2016 and 37% in 2017.

A study done among pregnant women in Ablekuma South District in the Greater Accra Region of Ghana showed that 78% of the pregnant women had some level of anaemia (Dickson, 2016). This figure was largely different from the national average and the prevalence recorded within the district for the current research. This could be due to the difference in study areas.

Another study (Anlaakuu, 2015) which set out to find the prevalence of anaemia in pregnant women in the Sunyani Municipal Hospital, Ghana found a 41.5% prevalence of anaemia with a mean Hb level of 11.4 g/dl. None of the women was found to be severely anaemic. The prevalence found in this study was however closer to what was found nationally that same year.

2.7.2 Determinants of anaemia in pregnancy

A community-based study done in Ablekuma south reported a very high level of adherence (90%) to the iron supplementation regime that is given to pregnant women. Significant associations were found between the age of the pregnant women and their knowledge of anaemia. The association between their level of formal education and their knowledge of

anaemia was also significant ($p < 0.001$)(Dickson, 2016). The study was not able to show a significant association between knowledge of the effects of anaemia during pregnancy and adherence to iron supplementation. Since the study did not set out to find out the anaemia status of the pregnant women, it could not show if this high conformity reflects in the anaemia status of the women.

In the study done in Sunyani, it was established that gestational age on first ANC visit, the age of the pregnant woman, malaria infection, consumption of fish and snails, occupation and the number of ANC visits to be significant determinants of anaemia within the population (Anlaakuu, 2015). These were mostly in-line with findings from the GDHS where parasitic infections including worm infestation and malaria were significant determinants of anaemia in pregnancy.

Chapter 3

3.0 Methods

3.1 Study Design

This study was a facility based analytical cross-sectional study. Since cross-sectional studies are good for determining disease burden, it will help in determining the current prevalence of anaemia as well as its determinants.

3.2 Study Area

This study took place in Hohoe - the capital town of the Hohoe Municipality, one of the 25 administrative districts in the Volta region of Ghana. Hohoe municipality lies almost in the centre of the region, with Afadzato south district, Kpando municipal, Biakoye District, Jasikan district and Togo lying on its southeast, southwest, northwest, north and east respectively. Hohoe has a population of 167,016 people (GSS, 2014) which is about 7.3% of the total population of the Volta region. More than half (52.6%) of the population is Urban. Hohoe has a male to female ratio of 1:1.088. Most (88.3%) of the population is literate. Almost half (48.6%) of the females in Hohoe are within the reproductive age.

The Akwapim-Togo ranges pass through the municipality which includes the highest peak in Ghana, the Afadjato (Mountain Afadja) which is 880.3m above sea level and serves as a tourist attraction site. The terrain of the municipality is gradually undulating with the lower-lying areas mostly being used for cultivation of rice since they are swampy.

The municipality lies between the forest-savannah transitional ecological zone and falls in the wet semi-equatorial climatic zone. The two main seasons are experienced there; the dry season spans four to five months (between November and April) while the rainy season, which used to have two well-defined peaks, seems to have merged to form one (late April to October) (GSS, 2014). The temperature in the municipality mostly ranges between a low of 26^{o}C to a high of 32^{o}C.

The people of Hohoe are predominantly Christians. About 89.1% of the populace are Christians. The Moslems form about 7.8% of the population while the traditionalists are 1.2% of the population. The remaining belong to other religions.

The main occupations of the people of Hohoe include petty trading, crop farming and the rearing of livestock. The people have one paramount chief and celebrate the Gbidukor festival in November (or early December) each year.

There are 21 health facilities within the municipality. The Hohoe township has one referral hospital, the Hohoe Municipal Hospital (Hohoe Municipal Assembly, 2014).

3.3 Variables

Haemoglobin level was the main variable of interest in finding out the prevalence of anaemia within the pregnant women. In order to find out the knowledge of anaemia and iron deficiency, some other variables, including educational status, number of births and attendance at ANC were also considered. In identifying the determinants of anaemia among the population, occupation, birth spacing, household income, food security, hygiene, dietary practices, supplementation practices and access to health care are the variables that were taken into consideration. Below is a summary and operational definition of the variables involved in this study

Table 3.1 Study variables and their operational definition

Variable	**Operational definition**		**Scale of measurement**
Anaemia	Initial Hb level of the pregnant woman below 11.0 g/dl		Dependent
	Severe anaemia	Hb < 7.0g/dl	
	Moderate anaemia	Hb < 9.9 g/dl	
	Mild Anaemia	Hb < 10.9g/dl	
	Any anaemia	Hb < 11.0g/dl	

Initial Hb	First Hb measurement of a pregnant woman at ANC for current pregnancy	Independent
Hb history	All Hb taken during each trimester of pregnancy	Independent
Occupation	The major work respondent does to earn money or food	Independent
Educational Level	The highest level of formal education attained by the pregnant woman	Independent
Age	The age (in years) of the pregnant woman at her last birthday	Independent
Household income	The total amount of money earned by all employed members of the household made for the household	Independent
Marital status	Whether the woman is married (legally), divorced (legally), separated, cohabiting or not married (single)	Independent
LLIN use	Whether the pregnant woman used LLIN the night before she was interviewed	Independent
Number of ANC visits	Number of times a pregnant woman had attended ANC since current pregnancy	Independent
Number of children	The total number of live births this woman has had	Independent
Birth spacing	The number of years between this pregnancy and the previous one (if any)	Independent
Number of meals taken a day	Average number of times the pregnant woman takes a meal (Portions of food taken at a sitting)	Independent
Number of times dewormed	The total number of times that the woman got dewormed during the period of pregnancy	Independent
Incidence of malaria	Whether the woman was ever diagnosed with malaria during her pregnancy	Independent

3.4 Study population

Ante-natal Clinic attendants, as well as Post Natal Clinic attendants who have given birth within the two months prior to the study or are attending PNC for the first time, were the population under consideration for this study. All participants attend PNC at the selected health facility. Post-partum mothers who have attended no ANC prior to delivering their current children were not included in the study.

3.5 Sampling

3.5.1 Sample size

The sample size was calculated using the national prevalence of anaemia in pregnant women.

The sample size was calculated using the Cochran formula of $n = \frac{z^2pq}{d^2}$, where

n = minimum sample size

z = 1.96 which is the corresponding z-score to 95% confidence interval

p = estimate of proportion for anaemia among pregnant women = 44.6% = 0.446

q = proportion of pregnant women who are not anaemic $(1 - p)$ = 55.4% = 0.554

d = margin of error = 5%

$$n = \frac{1.96^2 \times 0.446 \times 0.554}{0.05^2}$$

$$n = \frac{3.8416 \times 0.446 \times 0.554}{0.0025}$$

$$n = \frac{0.9492}{0.0025}$$

$$n = 379.6792$$

$$n \approx 380$$

To cater for non-responses, incomplete data and other unforeseen circumstances, a value of 10% of the minimum sample size was included in the sample size to result in an additional sample size of 38

Therefore, the final calculated sample size for the study was 418

3.5.2 Sampling method

Data collection took place from May to June 2018. Lactating mothers who had delivered within the last two months or are attending PNC for the first time during the period of the study were eligible for inclusion. Also, pregnant women attending ANC were included. Thirty (30) of these women were sampled daily in the following fashion:

1. A list of the ANC and PNC attendants for each day was taken from the attendance book
2. The list was numbered from 1 to n (where n is the number of pregnant women/lactating mothers who attended ANC for the day)
3. The number of attendants for the day was then divided by 30 to get the sampling interval, k
4. A random starting point was generated using the formula **=randbetween (1, k)** in Microsoft Excel 2016, where k is the sampling interval
5. The kth pregnant woman was selected from the numbered list, starting from the random starting position found in four (4) above.
6. In cases where the selected respondent does not qualify for inclusion in the study (either for not consenting or falling outside the inclusion criteria), the next person in the list was recruited into the study recursively

3.6 Data collection method and tools

Secondary data were collected from the maternal health records book of the eligible women. Data taken included their Hb history for each of the visits to the laboratory, as well as ANC attendance history, demographic characteristics and other health status indicators like diagnosis of malaria and treatment of worm infestation.

Structured questionnaires made up of both open ended and closed ended questions in English language were used in collecting first-hand information from sampled women. Some of the data collected was socioeconomic status, eating practices, marital status and knowledge about anaemia.

The questionnaire was designed using Research Electronic Data Capture (REDCap) and administered using smartphones. Few paper-based versions were available for participants who were more comfortable with the use of the paper-based version or for the literate who will like

to self-administer the questionnaires. In the latter situation, the women were guided on each question they answered.

Research assistants, one nutritionist and one nurse, were recruited and trained for three days (3 hours a day) in data collection and the use of the REDCap software (Harris et al., 2009) for Android. These research assistants then helped in the data collection after they played an active part in the pretesting of the tools in order to familiarize themselves with the tools and techniques being used for the study.

3.7 Quality control

Research assistants were thoroughly trained on how to go about the data collection and how to use the tools. They were supervised by the principal investigator periodically as the data collection went on, to ensure they were doing the right thing. Data collected was synchronized online with Redcap at the end of each day's work. The use of the REDCap software helped to reduce discrepancies in data collection. Nevertheless, data collected with REDCap as well as with the paper-based questionnaires were cross-checked at the end of every day and missing data retaken where necessary.

Some data, especially socio-demographic data, collected using the maternal record books were confirmed by the respondent with the questionnaires administered.

3.8 Data processing and analysis

Data collected was exported from REDCap in .csv format and .do format for Stata. The analysis was done using Microsoft Excel 2016 and Stata (StataIC) version 15. The data was imported into Stata and some variables were computed, categorized and labelled.

3.8.1 Summary/sample tables

Categorical variables were summarised as frequencies and proportions and presented as tables and charts. Mean and standard deviations were found for the continuous variables such as Hb level and age. Some continuous variables like Hb level were categorized according to the WHO

cut-offs for mild, moderate and severe anaemia and proportions displayed. Various cross-tabulations were drawn up between many independent variables and the dependent variable.

3.8.2 Statistical methods

Pearson's chi-square tests were used to determine whether an association existed between an exposure and the occurrence or otherwise of an outcome. Odds ratios were calculated for the associations found. Fischer exact tests were used in cases where the cell values of contingency tables had small values, with expected values smaller than 5. Logistic regression analysis was used to find the existence of the associations between some predictor variables and the outcome while controlling for other variables.

3.9 Ethical considerations

Ethical approval for the study was obtained from the Ghana Health Service Ethical Review Committee. A letter of introduction was also obtained from the University before going to the field. Permission was sought from the management of the Hohoe Municipal Hospital before the study proceeds in the facility.

During the study, the purpose of the study was explained to each potential respondent, they were informed of the right to exit the interview at any point and assured of the confidentiality of the information they will give. The interview only proceeded after the respondent accepts the terms and gives her consent for the interview. Potential respondents were allowed to ask questions about anything that was unclear to them about the conduct of the research and use of the data gathered, and satisfying answers were provided. Interviewing of respondents was done at a location and at a volume where she will not be overheard by others so that everything said was confidential between the researcher and the particular respondent.

Respondents' identifying information was kept to the minimum and was only visible to the principal investigator after the data collection was completed. Data obtained during the study was safely kept online in principal investigator's REDCap account. Backup copies were also

kept in the email of the principal investigator. The downloaded dataset was stripped of all identifying information, stored on a CD, and submitted to the School of Public Health's Department of Epidemiology and Disease Control. The dataset on the computer used for analysis was shredded from the computer at the end of the analysis.

3.10 Pre-test or pilot study

The questionnaire designed for the study was tested in a pilot study at the Hohoe municipal hospital. This helped in identifying questions that were incomprehensible or ambiguous. It also helped to estimate the amount of time needed per respondent and identify questions that respondents might find offensive. Corrections were made to the questionnaire after the pretesting exercise before using the corrected instruments in the collection of actual data. Permission was sought from the management of the Hohoe municipal hospital before the study was done. Respondents for the pre-testing were not recruited unless they agreed to the consenting form terms. Their names were noted and were not included in the main study.

Data collected during pre-testing was analysed to make sure the tool used could adequately answer the research questions for which they were designed.

Chapter 4

4.0 Results

4.1 Socio-demographic characteristics

The respondents in the study were four hundred and seven (407) pregnant women and lactating mothers taken from the Hohoe Municipal Hospital between May and June 2017. Their ages ranged from 15 to 44 years with a mean of 28.0 years (SD = 5.9 years).

Majority (85.7%) of the respondents were either gainfully employed or learning a trade. In all, 45 (11%) of the women were government workers, 289 (71%) were self-employed or learning a trade, some of the respondents in the study were students.

Most of the women 380 (93.4%) had ever had some form of formal education, the majority of which went to at least the JSS/JHS level.

The respondents included people from at least 30 different ethnic groups with the most common ethnic group being the Ewes (67.3%). Other common ethnic groups were the Kotokolis, the Guans and the Akans

Most of the women pegged their monthly household income below GHC 1000.00 with a few other earning as much as GHC 3000.00 and above. Below is a summary of the socio-demographic distribution of the respondents.

Table 4.1 Socio-Demographic Characteristics of the Respondents

Variable	Frequency (N = 407)	Percentage
Age categories (years)		
15 – 19	32	7.9
20 – 24	86	21.1
25 – 29	127	31.2
30 – 34	94	23.1
35 – 39	62	15.2
40 and above	6	1.5
Level of Education		
None	27	6.6
Primary	44	10.8
JHS/O-level	218	53.6
SHS/Vocational/A-level	77	18.9
Tertiary	41	10.1
Occupation		
Unemployed	58	14.3
Farming	20	4.9
Teaching	37	9.1
Trading	168	41.3
Seamstress	48	11.8
Hairdressing	30	7.4
Baking	14	3.3
Student	15	3.7
Other	17	4.2
Marital Status		
Single	38	9.3
Married	265	65.1
Divorced	2	0.5
Co-habiting	102	25.1
Religion		
Christian	341	83.8
Islamic	64	15.7
ATR	2	0.5
Ethnicity		
Ewe	274	67.3
Akan	15	3.7
Other	118	29.0
Household income		
Less than GHC 1000	231	56.8
Between GHC 1000 and GHC 2000	136	33.4
Between GHC 2000 and GHC 3000	30	7.4
Between GHC 3000 and GHC 4000	9	2.2
More than GHC 4000	1	0.2

4.2 Obstetric characteristics of respondents

Out of the 407 respondents, most first attended ANC in their first trimester of pregnancy. Some however still did not attend ANC until their third trimester of pregnancy. The haemoglobin level of the women on their first visit to the Ante-natal clinic ranged from 7.4g/dl to 17g/dl. On average the respondents came to the hospital with an initial HB of 11.56 g/dl (SD = 1.44g/dl). The current pregnancy was not the first for 289 (71%) of the women since they already had one or more pregnancies before this one. For 22 (7.6%) of them however, these pregnancies did not result in live births or children that survived longer than a year. Some miscarried, while some had still births or infant deaths. The current pregnancy was the first pregnancy for 96 (23.6%) of the women and the second pregnancy for 120 (29.5%) women. The rest of the women had more than two pregnancies. The maximum number of pregnancies had by any of the women was eight pregnancies.

Most (93.8%) of the women who have ever had a child waited between two or more years before having their current pregnancy. A few (12.4%) even had their youngest children being older than 8 years.

Table 4.2 Obstetric characteristics of respondents

Variable	Frequency (N = 407)	Percentage
HB on first visit		
> 11	274	67.3
9.9 – 11	69	17.0
7 - 9.9	64	15.7
Trimester of first visit		
First Trimester	215	52.8
Second Trimester	173	42.5
Third Trimester	19	4.7
Number of children (Parity)		
0	118	29.0
1 – 2	213	52.3
3 – 4	69	17.0
5 – 6	5	1.2
7 – 8	2	0.5
Number of previous pregnancies (Gravidity)		
1 – 2	216	53.1
3 – 4	149	36.6
5 – 6	39	9.6
7 – 8	3	0.7
Birth Spacing (years)		
0 – 1	18	6.2
2 – 4	147	50.9
5 – 8	88	30.5
9 – 12	27	9.3
Above 12	9	3.1

4.3 Prevalence of anaemia among respondents

Out of the respondents, 274 (67.3%) had no form of anaemia on their first visit to the ANC while the remaining 133 (32.7%) had from mild to moderate anaemia.

For women who were anaemic, 52% of them had mild anaemia and the remaining 48% had moderate anaemia. None of the respondents had severe anaemia

4.4 Infections, their prevention and treatment

Majority 301 out of all the 407 (74%) respondents, never dewormed during their current pregnancy going against the recommendations of the WHO. Exactly 76 (18.7%) of them dewormed only once during their pregnancy while 30 (7.5%) of them dewormed two or more times during their pregnancy.

All the respondents were given Long-lasting insecticide treated nets (LLIN) when they got pregnant. Unfortunately, 30 (7.4%) of them, confirmed they did not use it at all. The remaining 377 (92.6%) of them said they used the LLINs one or more times. When the women who said they used the bed nets were questioned further to find out whether they used it the night before the interview, 114 (30.2%) said they did not sleep under their LLINs the night before the interview for various reasons including the high temperature in the net and difficulty hanging the net.

Most of the women however did not get malaria during their current/most recent pregnancy. Up to 112 (21.5%) of women had at least one episode of malaria during the course of their pregnancy. Almost half (49.1%) of the women who had at least one episode of malaria had not been using LLIN and this could have contributed to the infection of malaria during pregnancy. The respondents all took one form of IPT treatment or another. All of them had the LLINs. Many of them, however, did not get or had not yet taken any routine antimalarial. The WHO recommends that pregnant women take at least 3 doses of IPTp-SP during their pregnancy (after the first trimester). On average, the women took between 2 and 3 doses of SP which falls short of the WHO recommendation. The maximum number of doses taken by a nursing mother during her pregnancy was 5 doses.

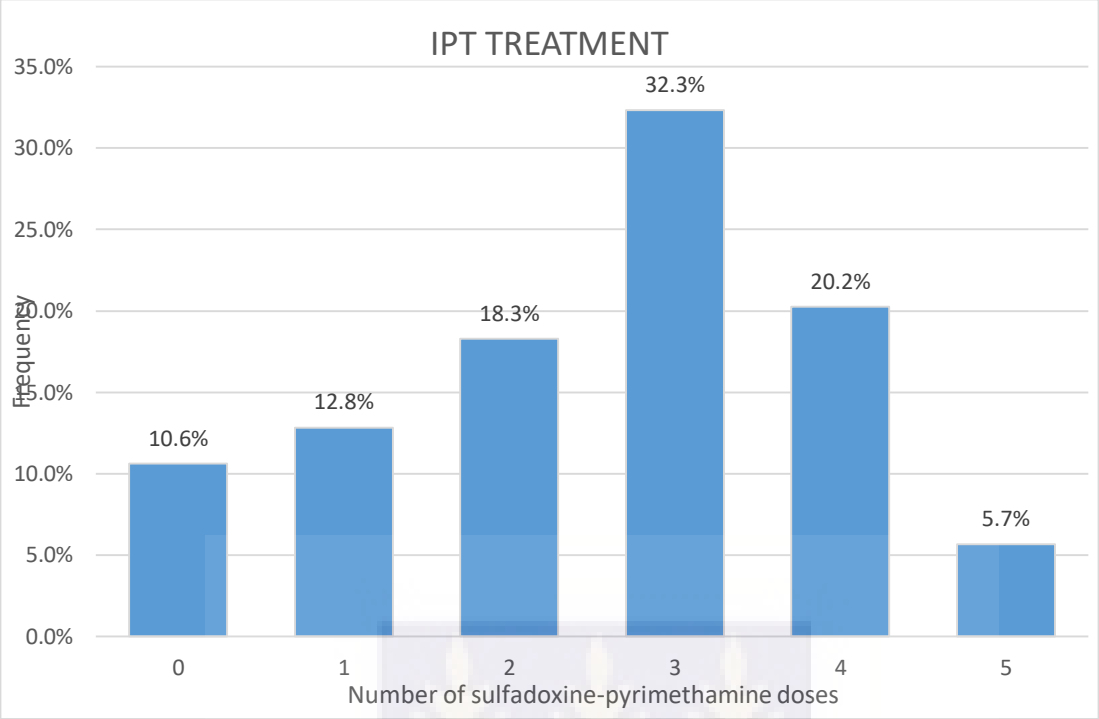

Figure 4.1 IPT (sulfadoxine-pyrimethamine)

Majority of the respondents took iron supplements during their pregnancy. Up to 11 (2.7%) of the women, however, did not take any iron supplements. The reasons for this ranged from shortage at the hospital or late reporting to ANC close to term.

Not all the women who took iron supplements, however, followed the prescription especially the frequency. Up to 31.8% of the women did not follow the prescribed regime in relation to dosage all the time. They did say they followed it once a while when they remembered they were given drugs. Up to 6.3% of them did not follow the dosage at all by either discarding of the drugs or not taking them at all. Some of these women claimed they forgot totally or they had negative reactions when they took drugs in their previous pregnancies. Most of the women who took supplements (66.3% women) however said they went strictly to the prescription

4.5 Knowledge on anaemia

Out of the 407 respondents, 236 (58%) of them had ever heard of the condition known as anaemia and could give a brief explanation of what it is. The remaining 171 (42%) of the women did not remember hearing of a condition by name "anaemia" before. After explaining the condition to them, 30 (17.5%) out of the 171 women did not know what anaemia was. The rest could remember hearing of it and name instances when they, or someone they knew, suffered the condition. In all, 377 (92.7%) of the women had heard of anaemia (either by name or description) and could explain it or give instances where they or someone they knew was diagnosed with it.

When the respondents who had heard of anaemia were asked about its causes, 12 (3.2%) of the women could not mention a single thing that could cause anaemia. Up to 141 (37.4%) of the women could mention one thing that causes anaemia. The remaining 224 (66.4%) of the women could mention at least two (2) things that could cause anaemia.

The causes of anaemia that were identified can be categorized into four (4) which include inadequate dietary intake, infections and other diseases, severe blood loss and other causes. Most of the women mentioned dietary intake or iron-rich foods as a cause of anaemia. Other less popular causes of anaemia mentioned include stress, cold, refusal to take supplements, not drinking enough water, pica and spiritual forces. Some of these causes however were based on beliefs and had no scientific backing.

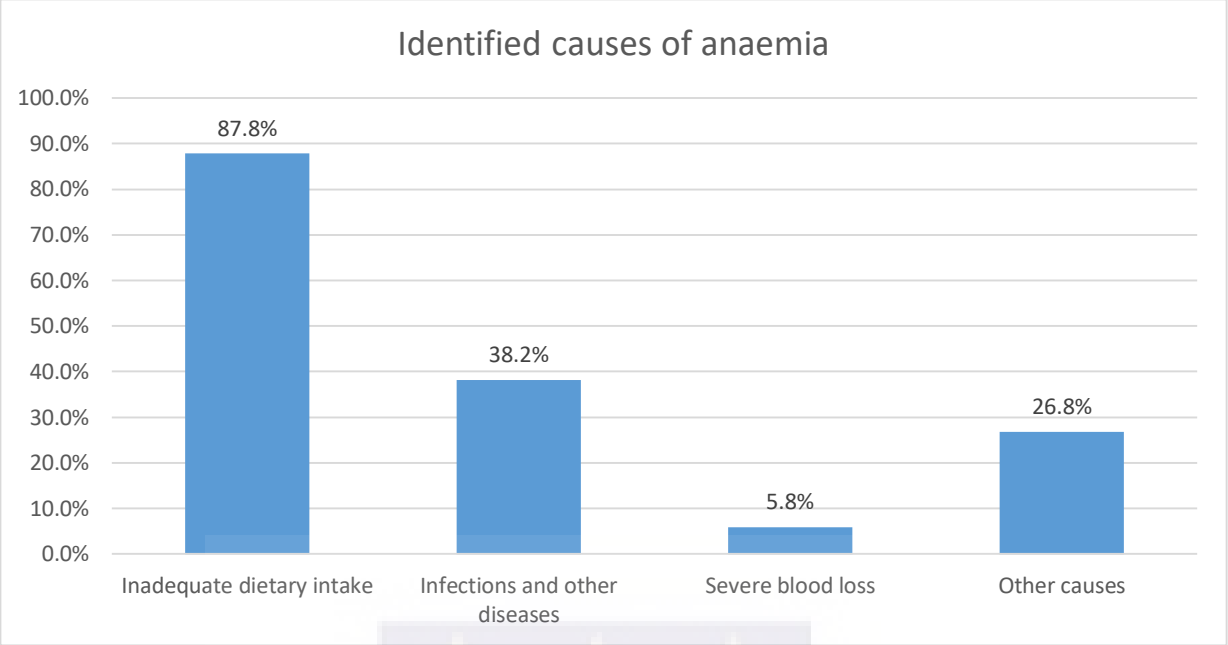

Figure 4.2 Causes of anaemia (multiple responses)

The women who mentioned that inadequate dietary intake can cause anaemia mentioned some foods which could prevent or resolve anaemia. Most of them identified that Vegetables, especially green leafy vegetables, play an important role in the prevention and resolution of anaemia. Some of the vegetables mentioned include kontonmire, spinach and garden eggs which were all common vegetables in the township.

Out of the 144 (38.2%) respondents who said infections and other health conditions could cause anaemia, 134 (93.1%) could mention at least one infection that can cause anaemia. Dominant among the infections mentioned was malaria and worm infestation. Other health conditions like hypertension, diarrhoea, HIV, cholera, diabetes and sickle cell were also mentioned.

Blood loss during delivery of a baby, miscarriage, severe cuts, accidents and heavy menstruation were the common situations identified which could cause enough bleeding to result in anaemia.

When asked about the effects of anaemia, 13 (3.4%) of the women who said they know what anaemia is could not mention any of its effects. Most (76.4%) of the women could mention more than one effect

The effects of anaemia that could be identified include dizziness, fatigue, general body weakness and others. Other effects mentioned include weight loss, paleness and complications during delivery.

Table 4.3 Effects of anaemia (multiple responses)

Effect	Frequency	Percentage
Dizziness	206	56.6
Increased risk of morbidity and mortality	170	46.7
General body weakness	167	45.9
Fatigue	62	17.0
Shortness of breath	15	4.1
Impaired mental and physical development	15	4.1
Irregular heartbeats	5	1.4
Reduction in productivity	3	0.8
Other	62	17.0

More than half (72%) of the women could mention at least two ways that a person could prevent or cure anaemia. The chart below shows the prevention methods mentioned and the number of people who mentioned them

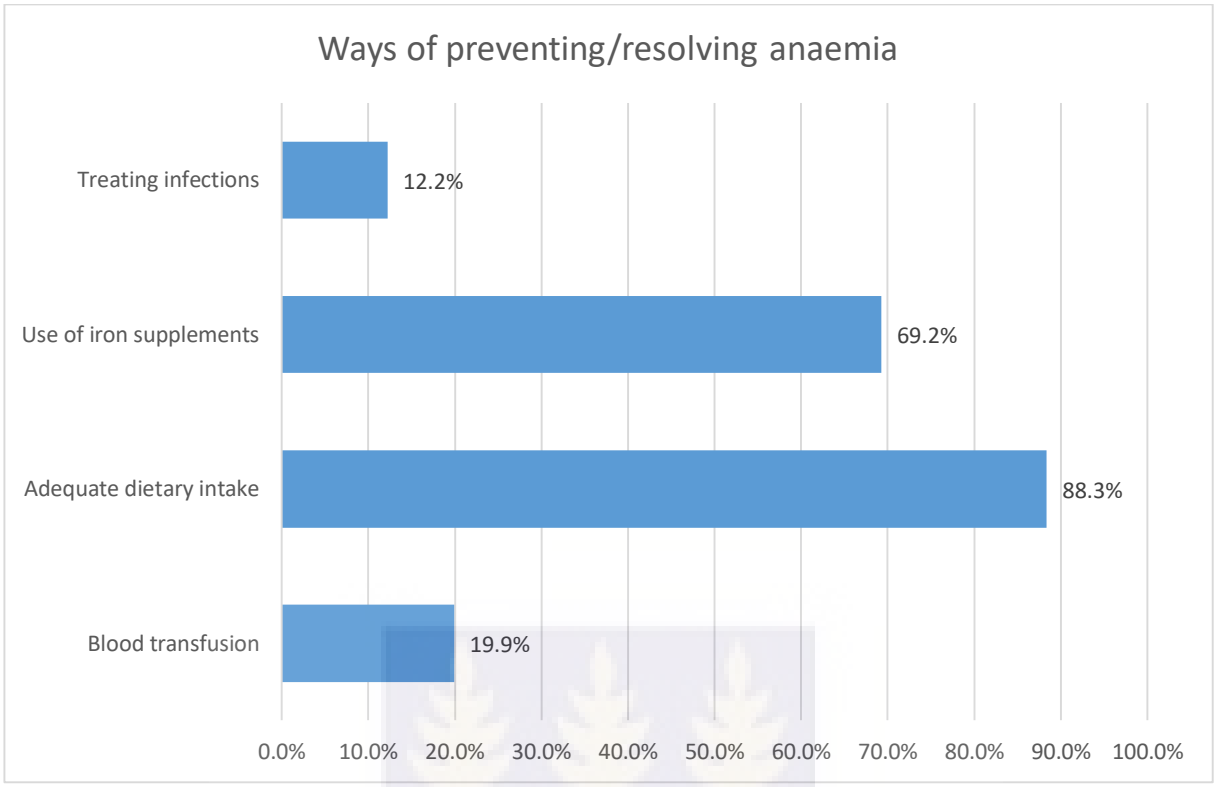

Figure 4.3 Ways of preventing/curing anaemia (multiple responses)

The overall knowledge that the respondents had on anaemia was computed on a composite scale (refer to appendix 1) using their responses to the questions on the effects, causes and prevention of anaemia. It was found that majority of the women 209 (51.4%) had high knowledge on anaemia, 153 (37.6%) had fair knowledge on anaemia and 45 (11.0%) had low knowledge on anaemia.

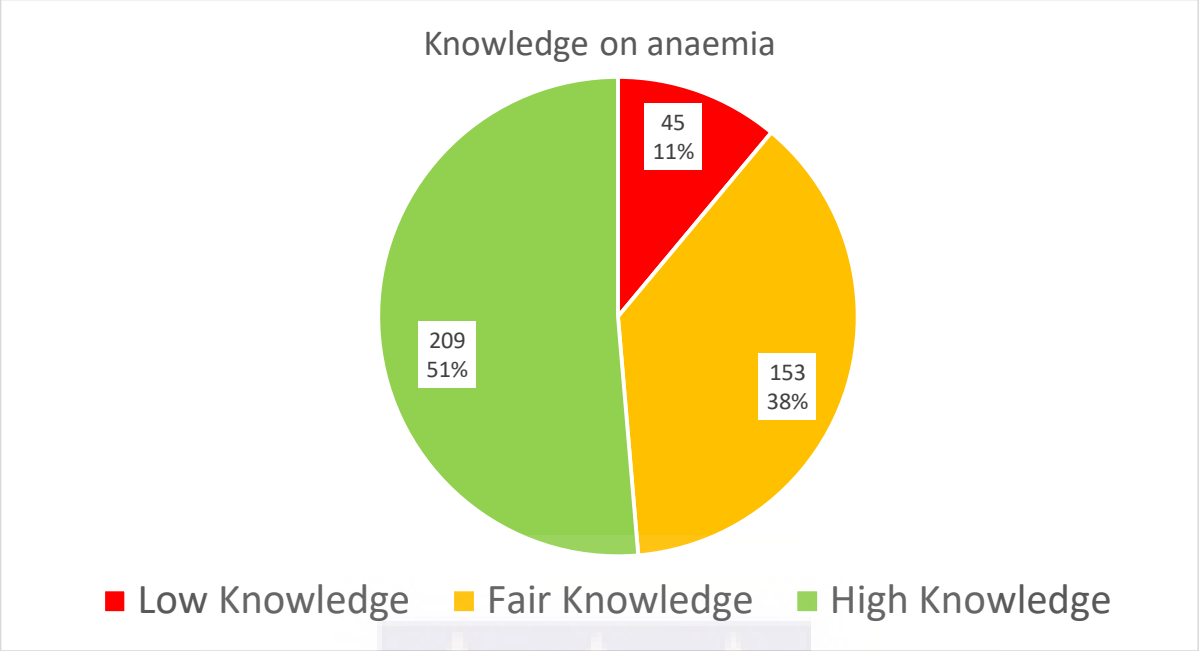

Figure 4.4 Knowledge on anaemia

4.6 Nutrition

In a day, some of the women took only one meal while few other women ate as many as eight times while they were pregnant. On average, they ate three times a day (Mean: 3.20, 1.46 SD). Few (8.6%) ate 5 or more times a day. Some of these meals are usually light and of small portions.

For fruit consumption, few (2.0%) women did not take fruits during their pregnancy. Reasons given for this include feeling nausea on smelling fruits and not feeling to eat any fruit during pregnancy.

Table 4.4 Frequency of fruit consumption

Frequency of fruit consumption	Number of respondents	Percentage
I didn't take any fruits	8	2.0
Once or less a week (rarely)	88	21.8
Twice to thrice a week (usually)	93	23.1
More than thrice a week (frequently)	214	53.1

Most of them consumed a lot of the iron-rich foods that are available in the town during their pregnancy. These foods were from both plant and animal origin. Most (97.5%) of them always took vegetables, especially green leafy vegetables. Iron from animal sources included fish, meat, eggs (from various birds, especially chicken) and snails. Fish was taken by more of the women (96.3%) compared to egg and meat (92.6% and 79.9% respectively). Snails were the least consumed (41.8%). Some explanations given for not consuming snails was that, there was the belief that the consumption of snails by a pregnant woman will cause her child to continuously drool when born.

4.7 Bivariate analysis of the anaemia status of respondents

To answer the question of factors that may determine anaemia status of a pregnant woman in Hohoe, some factors were compared to the anaemia status of the women to check their association with anaemia using a chi-square test. Fischer exact tests were used when expected value in more than 20% of the cells were less than 5. Age was not found to be significantly associated with anaemia status ($\chi^2 = 3.24$, $p = 0.518$). However, a significant association was found between the level of formal education of a pregnant woman and her anaemia status ($\chi^2 = 9.80$, $p = 0.044$). The gestational age of the pregnancy at the time a woman first visits the ANC has also been found to be significantly associated with her anaemia status ($\chi^2 = 10.61$, $p = 0.005$). The knowledge a woman has about anaemia, considering the causes, effects and prevention/cure altogether was not found to be significantly associated with her anaemia status ($\chi^2 = 0.6229$, $p = 0.732$).

The number of children older than 6 weeks that a woman has also been found to have a link with anaemia ($\chi^2 = 6.8083$, $p = 0.001$).

Lastly, no significant difference was found between the number of times a woman ate during a day while she was pregnant and her anaemia status ($\chi^2 = 2.73$, $p = 0.435$). The frequency of

her fruit consumption per week was however found to be significantly associated with her anaemia status (χ^2 = 9.07, p = 0.028). Table 4.5 below provides more details about the association between some factors and anaemia status of the respondents.

In short, the factors found to be associated with anaemia in pregnancy were the level of formal education of a woman, her gestational age on first ANC booking, the number of children that the woman previously had, and her frequency of fruit consumption.

Table 4.5 Bivariate analysis of anaemia and possible demographic factors

Factors	No Anaemia N (%)	Anaemia N (%)	χ^2	P -value
Age categories of respondents				
15 - 19	19 (59.4)	13 (40.6)	3.2411	0.518
20 - 24	54 (62.8)	32 (37.2)		
25 - 29	92 (72.4)	35 (27.6)		
30 - 34	63 (67.0)	31 (33.0)		
35 and above	46 (67.6)	22 (32.4)		
Level of education				
None	12 (44.4)	15 (55.6)	9.8005	**0.044**
Primary	33 (75.0)	11 (25.0)		
JHS/O-level	146 (67.0)	72 (33.0)		
SHS/Vocational/A-level	51 (66.2)	26 (33.8)		
Tertiary	32 (78.0)	9 (22.0)		
Occupation				
Self - employed	194 (66.9)	96 (33.1)	1.6444	0.649
Government worker	31 (70.5)	13 (29.5)		
Student	12 (80.0)	3 (20.0)		
Unemployed	37 (63.8)	21 (36.2)		
Marital status				
Single/Divorced/Widowed	26 (65.0)	14 (35.0)	1.5463	0.672
Married	177 (66.8)	88 (33.2)		
Co-habiting	71 (69.6)	31 (30.4)		
Religion				
Christian	235 (68.9)	106 (31.1)	-	.221*
Islamic	38 (59.4)	26 (40.6)		
ATR	1 (50.0)	1 (50.0)		
Ethnic group				
Ewe	188 (68.6)	86 (31.4)	4.3568	0.113
Akan	13 (86.7)	2 (13.3)		
Other	73 (61.9)	45 (38.1)		
Monthly household income (GHC)				
< 1000	154 (66.7)	77 (33.3)	-	.416*
1000 - 2000	89 (65.4)	47 (34.6)		
2000 - 3000	22 (73.3)	8 (26.7)		
3000 and above	9 (90.0)	1 (10.0)		

* Fisher's exact test p - values

Table 4.6 Bivariate analysis of anaemia and possible obstetric/clinical factors

Factors	No Anaemia N (%)	Anaemia N (%)	χ^2	P -value
ANC or PNC				
ANC	215 (67.0)	106 (33.0)	0.0816	0.775
PNC	59 (68.6)	27 (31.4)		
Age of last child (years)				
0 - 1	12 (66.7)	6 (33.3)	3.6464	0.302
2 - 4	99 (67.3)	48 (32.7)		
5 - 8	61 (69.3)	27 (30.7)		
9 and above	30 (83.3)	6 (16.7)		
Number of times dewormed				
0	209 (69.4)	92 (30.6)	5.0909	.078
1	43 (56.6)	33 (43.4)		
2 or more	22 (73.3)	8 (26.7)		
Use LLIN				
No	18 (60.0)	12 (40.0)	.7892	.374
Yes	256 (67.9)	121 (32.1)		
Used LLIN last night				
No	73 (64.0)	41 (36.0)	1.1226	.289
Yes	183 (69.6)	80 (30.4)		
Malaria infection during pregnancy				
No	203 (68.8)	92 (31.2)	1.0843	.298
Yes	71 (63.4)	41 (36.6)		
Doses of IPTp-SP				
0	31 (72.1)	12 (27.9)	2.5941	.457
1 – 2	75 (59.5)	51 (40.4)		
3 – 4	135 (63.4)	78 (36.6)		
5 or more	16 (69.6)	7 (30.4)		
Use of iron supplements				
No	8 (72.7)	3 (27.3)	-	.490*
Yes	266 (67.2)	130 (32.8)		
Following iron supplementation prescription				
No	3 (37.5)	5 (62.5)	-	.258*
Once a while	21 (72.4)	8 (27.6)		
Most of the time	57 (64.0)	32 (36.0)		
Always	185 (68.5)	85 (31.5)		
Trimester of first ANC visit				
First Trimester	159 (74.0)	56 (26.0)	10.6151	**.005**
Second Trimester	106 (61.3)	67 (38.7)		
Third Trimester	9 (47.4)	10 (52.6)		
Number of pregnancies (including this pregnancy)				
1 - 2	149 (69.0)	67 (31.0)	0.6091	.737
3 - 4	98 (65.8)	51 (34.2)		
5 and above	27 (64.3)	15 (35.7)		
Number of children older than 6 weeks				

0	72 (61.0)	46 (39.0)	6.8083	**.001**
1 - 2	160 (75.1)	53 (24.9)		
3 and above	42 (55.3)	34 (44.7)		

* Fisher's exact test p - values

Table 4.7 Bivariate analysis of knowledge and nutrition on anaemia

Factors	No Anaemia N (%)	Anaemia N (%)	χ^2	P -value
Knowledge on the causes of anaemia				
Low	44 (64.7)	24 (35.3)	0.4368	.804
Fair	126 (68.9)	57 (31.1)		
High	104 (66.7)	52 (33.3)		
Knowledge on the effects of anaemia				
Low	32 (74.4)	11 (25.6)	2.7508	.253
Fair	209 (65.3)	111 (34.7)		
High	33 (75.0)	11 (25.0)		
Knowledge of how to prevent/cure anaemia				
Low	32 (74.4)	11 (25.6)	1.9803	.372
Fair	40 (61.5)	25 (38.5)		
High	202 (67.6)	97 (32.4)		
Knowledge on anaemia				
Low Knowledge	31 (68.9)	14 (31.1)	.6229	.732
Fair Knowledge	97 (63.4)	56 (36.6)		
High Knowledge	131 (62.7)	78 (37.3)		
Number of meals taken in a day				
1 – 2	60 (65.9)	31 (34.1)	0.6702	0.715
3 – 4	189 (68.5)	87 (31.5)		
5 or more	25 (62.5)	15 (37.5)		
Frequency of eating fruits per week				
Once or less	65 (65.0)	35 (35.0)	1.6290	0.443
Twice or thrice	59 (63.4)	34 (36.6)		
More than thrice	150 (70.1)	64 (29.9)		

* Fisher's exact test p - values

4.8 Logistic regression analysis of determinants of anaemia

The factors found to be significant from this research, as well as other factors found to be significant in other researches, were also analysed using logistic regression models in order to find out if those associations still exist when controlling for some of the factors. Crude odds ratios were found using a simple binary logistic regression model of anaemia and some independent variables. All variables found to have an association with the anaemia status of

pregnant women in Hohoe were also put in a multiple logistic model and adjusted odds ratios were calcualted. The entire model for the multiple logistic regression was found to be significant with Prob > chi2 = 0.0016.

The results showed that, for a pregnant woman in Hohoe in this study, the level of education, the number of times a woman dewormed, the trimester in which she first booked ANC and her parity are factors that are associated with anaemia status.

It was found that, controlling for the number of times a woman dewormed, her parity and the trimester of first ANC booking, compared to a pregnant woman with no formal education, a pregnant woman with primary education had a 68% reduced odds of becoming anaemic whiles one with tertiary education had 75% reduced odds of becoming anaemic. These were found to be statistically significant (p-value 0.031 and 0.016 respectively).

Also, when controlling for the level of education, parity and the number of times a woman dewormed during pregnancy, booking ANC for the first time during the second trimester increases the odds of becoming anaemic by 65% compared to booking in the first trimester. This was also statistically significant (p-value 0.028).

The number of children a woman had prior to her pregnancy was also found to be associated with her anaemia status in the multiple logistic regression when controlling for her level of education, the number of times she dewormed and the trimester in which she first booked ANC.

It was found that, the odds of becoming anaemic was 52% lower in a woman who had previously given birth to one or two children compared to a woman who had no previous child. This was statistically significant (p-value 0.016).

Adjusting for parity, trimester of first ANC booking and education, it was found that a woman who dewormed once or twice had a 72% increased odds of becoming anaemic compared to a woman who had not dewormed at all. This was significant (p-value 0.049). This could be due

to the fact that, the women's anaemia status was done on their first visit and the intervention of deworming was done later during her ANC attendance.

The results are listed in table 4.8 below.

Table 4.8 Association between anaemia and some predictors

Factor	COR	P value	[95% CI]	AOR	P value	[95% CI]
Age Categories						
15 – 19	1					
20 - 24	0.866	0.734	0.378 - 1.986			
25 - 29	0.556	0.153	0.248 - 1.245			
30 - 34	0.719	0.434	0.315 - 1.643			
35 and above	0.699	0.419	0.293 - 1.667			
Level of education						
No formal educ	1			1		
Primary	0.267	**0.011**	0.096 - 0.740	0.318	**0.031**	0.112 - 0.903
JHS/O-level	0.395	**0.024**	0.176 - 0.887	0.437	0.053	0.189 - 1.009
SHS/Vocational	0.408	**0.049**	0.167 - 0.997	0.477	0.129	0.184 - 1.240
Tertiary	0.225	**0.006**	0.078 - 0.649	0.251	**0.016**	0.082 - 0.774
Deworming						
0	1			1		
1 – 2	1.743	**0.035**	1.041 - 2.920	1.715	**0.049**	1.003 - 2.932
3 and above	0.826	0.658	0.355 - 1.924	0.920	0.851	0.387 - 2.187
Trimester of first visit						
First Trimester	1			1		
Second Trimester	1.795	**0.008**	1.165 - 2.763	1.651	**0.028**	1.056 - 2.583
Third Trimester	3.155	**0.018**	1.219 - 8.163	2.472	0.076	0.911 - 6.708
Parity						
0	1			1		
1 – 2	0.518	**0.008**	0.320 - 0.840	0.480	**0.016**	0.265 - 0.873
3 and above	1.267	0.427	0.706 - 2.273	0.790	0.398	0.458 - 1.364
Monthly household Income						
<1000	1					
1000 - 2000	1.056	0.811	0.676 - 1.651			
2000 - 3000	0.727	0.465	0.310 - 1.709			
3000+	0.222	0.157	0.028 - 1.786			

Chapter 5

5.0 Discussion

Anaemia is a very common condition affecting over 800 million women and children worldwide. It is estimated that 38.2% of pregnant women are anaemic. Iron deficiency anaemia is the single most common micronutrient deficiency worldwide. Anaemia in pregnancy can lead to complications like low birth weight, pre-term delivery and other complications during delivery. This study set out to find the prevalence of anaemia, the knowledge of anaemia and the determinants of anaemia. It found out that, the prevalence of anaemia in Hohoe among pregnant women was 32.7% with an average haemoglobin level of 11.46g/dl using anaemia status on first ANC booking. The knowledge of anaemia among the women was generally high as 51.4% of them had high knowledge of anaemia, 38.6% had fair knowledge and 11.0% of them had low level of knowledge on anaemia. Four determinants of anaemia in pregnancy were identified by the research which include the level of formal education of the pregnant woman, the number of children which she had before the current pregnancy, the number of times she dewormed during her pregnancy and the trimester in which she first booked for ANC. These will be discussed below as well as findings from similar studies.

5.1 Prevalence of anaemia

The average haemoglobin level of the women found in the study was 11.46g/dl (SD = 1.44). This average value falls above the cut-off for anaemia in pregnancy according to the WHO. The findings on haemoglobin levels was similar in a research done in southern Ethiopia where the average Hb was 11.55 ± 2.97 g/dl SD (Gedefaw, Ayele, Asres, & Mossie, 2015). Similarly, a research done in the Sunyani Municipality of the Brong Ahafo Region, Ghana, found the average Hb of pregnant women to be 11.21g/dl (Anlaakuu, 2015) and different from what was found in this study. This difference could be accounted for by the difference in the study area, the study participants and the time interval between the two researches. For example, Sunyani

is a largely urban area compared to Hohoe. Also, very few of the respondents in Sunyani first booked at ANC in the second and third trimesters compared to those in Hohoe where almost half (47.2%) of the women first booked at ANC in their second and third trimesters. The age distribution however was similar in both studies.

Anaemia, though prevalent everywhere in the world is of severe public health importance in Ghana since the prevalence is above 40% (WHO & Chan, 2011). In Hohoe, the study area, the prevalence as stated in the DHIMS 2 for the years 2015 to 2017 was 45%, 45% and 37% respectively. This research found out that, the prevalence of anaemia in pregnant women on their first visit to ANC was 32.7%. This was lower than the values recorded for the previous years in the DHIMS 2 and much lower than the national prevalence in pregnant women. This difference could be due to interventions that may have been put in place and the time interval between the studies. The national prevalence of anaemia in pregnancy put Ghanaian women in the WHO categorisation for severe public health significance. However, the prevalence of anaemia found in this study is of moderate public health significance. The difference could be due to an increased awareness of healthy behaviours and lifestyles and better nutrition. This could also be evident in the achievement of a three maternal death for the year 2017 as opposed to seven deaths in 2016. A similar research done in Sunyani determined that 41.5% of the women were anaemic (Anlaakuu, 2015). The prevalence was 42.7% in another research done in South Africa (Tunkyi & Moodley, 2015). Also, a prevalence of 23.53% (Zekarias et al., 2017) was found in another research done in Ethiopia. These values were different from that found in this research. Possible reasons for this include the geographical areas from which the study participants were recruited and also differences in respondent characteristics. For instance, in the Ethiopian study where prevalence was 23.53%, more than half of the respondents (52.3%) were giving birth for the first time while in this study, more than half of the respondents had either one or two children. Other studies, however, collaborate the findings

in this study. A different study done in Ethiopia determined the prevalence of anaemia to be 39.94% (Gedefaw et al., 2015). Another study done in Nigeria had an anaemia prevalence of 32.2% (Ikeanyi & Ibrahim, 2015). Factors that could contribute to this similarity could be the study design used and the characteristics similar between respondents. There was no severe case of anaemia found in this study. Mild and moderate cases of anaemia were however recorded with 23.3% mild cases of anaemia and 13% of the respondents had moderate anaemia. Other studies however recorded severe cases of anaemia.

5.2 Knowledge on Anaemia

Knowledge can play a key role in whether a person adopts a behaviour or shuns away from it. The knowledge of the pregnant women was accessed on anaemia and scored. These scores were then categorized into three groups; low, fair and high knowledge. It was found that more than half (51%) of the women had high knowledge on anaemia while 11% had low knowledge on anaemia and 38% had fair knowledge on anaemia. Results found in this research was identical to results found in another study that was carried out in Putrajaya, Malaysia, which found the knowledge of anaemia in pregnant women. In that study 55.7% of the women had high knowledge, 28.6% had moderate knowledge and 15.7% had low knowledge (Adznam, Sedek, & Kasim, 2018). The instrument used in both studies were different. The knowledge assessment tried to look at different dimensions which include knowledge on the causes of anaemia, it's effects and prevention/cure. Up to 30 women could not remember ever hearing of anaemia even after the condition was described to them and diagrams shown them from behind their ANC book. Majority of the women could, however, remember ever hearing of anaemia and could all relate and mention instances where they or close friends/relatives were ever diagnosed with anaemia. Some of these women could not mention anything which they thought could lead to anaemia. A few others mentioned potential causes that were not scientifically related to anaemia, including spiritual attacks and thinking and cold weather.

34.6% of the women were able to mention one thing that causes anaemia. 55% of them were able to mention more than one thing that can cause anaemia. Key among the things mentioned was inadequate intake of foods that give blood (iron-containing foods), infections and other diseases. Respondents were questioned further to see if they knew example of such foods. The most popular food items mentioned were vegetables (mostly green leafy vegetables). This could be due to the fact that the area is rich in such vegetables and therefore is easily prescribed both indigenously and at the health facility. Also, some of the women who mentioned inadequate intake of foods that "give blood" mentioned other iron-rich foods like fish, meat and eggs. Fruits were also mentioned. Women who mentioned infections as a possible cause of anaemia were able to mention some infections and diseases including sickle cell anaemia, malaria and worm infestation. Some other conditions were mentioned like diarrhoea, diabetes and typhoid fever. It was found that the high knowledge on anaemia had no implication on the anaemia status of the women in the study.

5.3 Determinants of anaemia in pregnancy

From the research, the determinants of anaemia include the level of formal education, the number of times a woman deworms during her pregnancy, the trimester in which a woman first attends ANC and the number of children the woman previously has. Other researches found some of these factors to be significantly associated with anaemia. A study done earlier in Ghana found an association between the educational level of a woman and anaemia in pregnancy (GSS, 2015).

Anlaaku (2015) also found in a study done in Sunyani in the Brong Ahafo region of Ghana that, the earlier a pregnant woman booked for ANC, the lower her odds of becoming anaemic. A research carried out in Ethiopia (Gedefaw et al., 2015) found being in the third trimester to be significantly associated with anaemia status of a pregnant woman as well as multigravida and intestinal parasitic infections. The research however found some factors to be associated

with anaemia which this research did not find to be associated. Factors like age and income level were found to be significant in the study. The difference could be due to differences in the time, study area, study population and the socio-economic status of research participants. Another research done in Dhaka city (Chowdhury et al., 2015), established level of education to be associated with the anaemia status of pregnant women. A research in Yemen (Alflah, Wahdan, Hasab, & Tayel, 2017) also found gravidity and gestational age to be significant with the anaemia status of pregnant women.

5.4 Limitations of this research

This research was conducted in one hospital and in one town, limiting the generalizability of the findings to the study area.

The selected facility was the main referral facility in the municipality and studies could have been extended to CHPS compounds and other clinics and health centres in more remote areas in the municipality

Chapter 6

6.0 Conclusion and recommendations

6.1 Conclusions

The prevalence of anaemia among pregnant women in Hohoe is still of high and great public health significance. This is true even though all pregnant women were given at least one form of IPT treatment. All women in the study were given ITNs. Most of the women in the second or third trimesters had already received at least one dose of IPTp-SP.

Knowledge on the causes, effects and prevention/cure of anaemia was generally good among the pregnant women with over half of them having high knowledge on anaemia. This however seemed to have no significant implication on their anaemia status. This could be because even though they know about the condition, they are not able to put adequate measures in place to prevent it.

The level of formal education of a woman, deworming, the trimester in which she first attended ANC and the number of children she previously had were factors that were found to be associated with the anaemia status of a pregnant woman in this study.

6.2 Recommendations

- CHNs should improve on community sensitization and education during home visits on topics like early attendance to ANC when pregnant, nutrient-rich foods that women should take especially when planning to get pregnant, and use of LLINs. These can go a long way to help reduce the burden of anaemia.
- Also, midwives should ensure that pregnant women are given the adequate dosage of anthelmintic during the period of their pregnancy as prescribed by the WHO.
- Since education was found to be one of the strong determinants of anaemia in pregnancy, it will be prudent for the CHNs to include the need for educating the girl-child as part of their educational activities.

- Also, the Municipal Director of Education should ensure all girls have at least basic level of education and include in the school curriculum lessons on anaemia, pregnancy care and family planning
- Nurses should offer counselling on family planning (especially family size) to women.

References

Abbaspour, N., Hurrell, R., & Kelishadi, R. (2014). Review on iron and its importance for human health. *Journal of Research in Medical Sciences : The Official Journal of Isfahan University of Medical Sciences*, *19*(2), 164–174. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3999603/

Adznam, S. N. H., Sedek, R., & Kasim, Z. M. (2018). Assessment of knowledge level on anaemia among pregnant women in Putrajaya. In *AIP Conference Proceedings* (Vol. 1940). https://doi.org/10.1063/1.5028019

Al-Mekhlafi, H. M., Al-Zabedi, E. M., Al-Maktari, M. T., Atroosh, W. M., Al-Delaimy, A. K., Moktar, N., … Surin, J. (2013). Effects of vitamin A supplementation on iron status indices and iron deficiency anaemia: a randomized controlled trial. *Nutrients*, *6*(1), 190–206. https://doi.org/10.3390/nu6010190

Alflah, Y. M., Wahdan, I. H., Hasab, A. A., & Tayel, D. I. (2017). Prevalence and Determinants of Anemia in Pregnancy, Sana'a, Yemen. *International Journal of Public Health Science (IJPHS)*, *6*(3), 213. https://doi.org/10.11591/ijphs.v6i3.7931

Allen, L., Benoist, B. De, Dary, O., & Hurrell, R. (2006). Guidelines on food fortification with micronutrients.

Allen, L. H. (2000). Anemia and iron deficiency : effects on pregnancy outcome 1 – 3. *The American of Clinical Nutrition*, *71*, 1280–1284.

Anderson, J. J. B., Root, M. M., & Garner, S. C. (2015). *Human Nutrition: Healthy Options for Life*. Burlington: Jones & Bartlett Learning. Retrieved from https://books.google.com.gh/books?id=9aYdAwAAQBAJ&printsec=frontcover&dq=macronutrients+and+micronutrients+in+humans+pdf+free&hl=en&sa=X&ved=0ahUKEwic6JiSlYvXAhXG8RQKHSeJCEEQ6AEIJDAA#v=onepage&q&f=true

Anlaakuu, P. (2015). *Anaemia in pregnancy among antenatal attendants at the Sunyani Municipal Hospital*. University of Ghana, Legon. https://doi.org/10.1038/253004b0

Benjamin, S. B., Max, D., E., Edward, J., F., Walker, H., H., & David, R. K. (1956). *Taxonomy of Educational Objectives, Handbook 1, Cognitive Domain*. (S. B. Benjamin, Ed.) (1st Editio). London: Longmans, Green and Co Ltd.

Chandra, A. F., Marsigit, J., Pratiwi, A. A., Akhmad, S. R., Andrianus, A., & Priyatini, T. (2018). Education and Socioeconomic Status as Risk Factors of Anemia in Pregnancy: A Cross-Sectional Study in Puskesmas Kecamatan Duren Sawit. *Advanced Science Letters*, *24*(9), 6526–6529. https://doi.org/10.1166/asl.2018.12765

Chowdhury, H. A., Ahmed, K. R., Jebunessa, F., Akter, J., Hossain, S., & Shahjahan, M. (2015). Factors associated with maternal anaemia among pregnant women in Dhaka city. *BMC Women's Health*, *15*, 77. https://doi.org/10.1186/s12905-015-0234-x

Clark, S. F. (2008). Iron Deficiency Anemia. *Nutrition in Clinical Practice*, *23*(2), 128–141. https://doi.org/10.1177/0884533608314536

Cook, J. D. (2005). Diagnosis and management of iron-deficiency anaemia. *Best Practice and Research: Clinical Haematology*, *18*(2 SPEC. ISS.), 319–332. https://doi.org/10.1016/j.beha.2004.08.022

da Cunha, M. S. B., Siqueira, E. M. A., Trindade, L. S., & Arruda, S. F. (2014). Vitamin A

deficiency modulates iron metabolism via ineffective erythropoiesis. *The Journal of Nutritional Biochemistry*, *25*(10), 1035–1044. https://doi.org/10.1016/j.jnutbio.2014.05.005

Dickson, P. (2016). *KNOWLEDGE AND PERCEPTION OF RISK OF ANAEMIA DURING PREGNANCY AMONG PREGNANT WOMEN IN ABLEKUMA SOUTH*. University of Ghana, Legon.

Gebremedhin, S. (2014). Effect of a single high dose vitamin A supplementation on the hemoglobin status of children aged 6-59 months: propensity score matched retrospective cohort study based on the data of Ethiopian Demographic and Health Survey 2011. *BMC Pediatrics*, *14*, 79. https://doi.org/10.1186/1471-2431-14-79

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.

GHS, & MOH. National Nutrition Policy For Ghana (2013).

GSS. (2014). District Analytical Report Hohoe Municipality, 84. https://doi.org/10.1371/journal.pone.0104053

GSS. (2015). Ghana Demographic and Health Survey. *Ghana Statistical Service*, 530.

Hallberg, L. (1987). Wheat fiber, phytates and iron absorption. *Scandinavian Journal of Gastroenterology. Supplement*, *129*, 73–79. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/2820048

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, *42*(2), 377–381. https://doi.org/10.1016/J.JBI.2008.08.010

Hohoe Municipal Assembly. (2014). Republic of Ghana the Composite Budget of the Hohoe Municipal Assembly for the 2014 Fiscal Year, 1–71.

Horowitz, K. M., Ingardia, C. J., & Borgida, A. F. (2013). Anemia in Pregnancy. *Clinics in Laboratory Medicine*, *33*(2), 281–291. https://doi.org/10.1016/j.cll.2013.03.016

Hurrell, R., & Egli, I. (2010). Iron bioavailability and dietary reference values. *American Journal of Clinical Nutrition*, *91*(5), 1461S–1467S. https://doi.org/10.3945/ajcn.2010.28674F

Hurrell, R. F. (2004). Phytic Acid Degradation as a Means of Improving Iron Absorption. *International Journal for Vitamin and Nutrition Research*, *74*(6), 445–452. https://doi.org/10.1024/0300-9831.74.6.445

Ikeanyi, E., & Ibrahim, A. (2015). Does antenatal care attendance prevent anemia in pregnancy at term? *Nigerian Journal of Clinical Practice*, *18*(3), 323. https://doi.org/10.4103/1119-3077.151730

Kalsoom, S., Tarar, S. H., & Tahmina, N. (2013). ANAEMIA IN PREGNANCY ;a study of prevalence and risk factors in antenatal care attendees at ABSH Gujarat. *The Professional Medical Journal*, *20*(5), 736–742.

Killip, S., Bennett, J. M., & Chambers, M. D. (2007). Iron deficiency anemia. *American*

Family Physician, *75*(5), 671–678. https://doi.org/10.1177/0884533608314536

Kim, J. Y., Shin, S., Han, K., Lee, K. C., Kim, J. H., Choi, Y. S., … Ko, B. J. (2014). Relationship between socioeconomic status and anemia prevalence in adolescent girls based on the fourth and fifth Korea National Health and Nutrition Examination Surveys. *European Journal of Clinical Nutrition*, *68*(2), 253–258. https://doi.org/10.1038/ejcn.2013.241

Lengeler C. (2009). Insecticide-treated bed nets and curtains for preventing malaria Cover sheet Title Reviewers Dates Internal sources of support External sources of support, (2).

Lönnerdal, B. (2010). Calcium and Iron Absorption - Mechanisms and Public Health Relevance. *International Journal for Vitamin and Nutrition Research*, *80*(45), 293–299. https://doi.org/10.1024/0300-9831/a000036

Lynch, S. R. (2000). The effect of calcium on iron absorption. *Nutrition Research Reviews*, *13*(02), 141. https://doi.org/10.1079/095442200108729043

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 Nutr.* (Vol. 12). https://doi.org/10.1017/S1368980008002401

Mekonnen, F. A., Ambaw, Y. A., & Neri, G. T. (2018). Socio-economic determinants of anemia in pregnancy in North Shoa Zone, Ethiopia. *PLOS ONE*, *13*(8), e0202734. https://doi.org/10.1371/journal.pone.0202734

Michelazzo, F. B., Oliveira, J. M., Stefanello, J., Luzia, L. A., & Rondó, P. H. C. (2013). The influence of vitamin A supplementation on iron status. *Nutrients*, *5*(11), 4399–4413. https://doi.org/10.3390/nu5114399

NHS Choices. (2016). Iron deficiency anaemia - Treatment - NHS Choices. Retrieved October 26, 2017, from https://www.nhs.uk/Conditions/Anaemia-iron-deficiency-/Pages/Diagnosis.aspx

NHS Choices. (2017). Vitamins, supplements and nutrition in pregnancy - NHS. Retrieved February 15, 2019, from https://www.nhs.uk/conditions/pregnancy-and-baby/vitamins-minerals-supplements-pregnant/

Okpere, E. E., Enabudoso, E. J., & Osemwenkha, A. P. (2010). Malaria in Pregnancy Training: Manual for Health Providers, *51*(3), 109–113. Retrieved from https://www.ghanahealthservice.org/downloads/MALARIA IN PREGNACY.pdf

Osazuwa, F., Ayo, O. M., & Imade, P. (2011). A significant association between intestinal helminth infection and anaemia burden in children in rural communities of Edo state, Nigeria. *North American Journal of Medical Sciences*, *3*(1), 30–34. https://doi.org/10.4297/najms.2011.330

Pasricha, S.-R. S., Flecknoe-Brown, S. C., Allen, K. J., Gibson, P. R., McMahon, L. P., Olynyk, J. K., … Robinson, K. L. (2010). Diagnosis and management of iron deficiency anaemia: a clinical update. *The Medical Journal of Australia*, *193*(9), 525–532. Retrieved from https://www.mja.com.au/system/files/issues/193_09_011110/pas10224_fm.pdf

Quintero-Gutiérrez, A. G., González-Rosendo, G., Sánchez-Muñoz, J., Polo-Pozo, J., & Rodríguez-Jerez, J. J. (2008). Bioavailability of Heme Iron in Biscuit Filling Using Piglets as an Animal Model for Humans. *International Journal of Biological Sciences*,

4(1), 58–62. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2253952/

Sholeye, O., Animasahun, V., & Shorunmu, T. (2017). Anemia in pregnancy and its associated factors among primary care clients in Sagamu, Southwest, Nigeria: A facility-based study. *Journal of Family Medicine and Primary Care*, *6*(2), 323. https://doi.org/10.4103/jfmpc.jfmpc_74_16

Shrinivas, K., Radhika, Sreelatha, R., & Kavitha, K. (2014). Study of helminthiasis in pregnancy and its correlation with haemoglobin level. *Journal of Clinical and Diagnostic Research : JCDR*, *8*(10), OC07-9. https://doi.org/10.7860/JCDR/2014/10148.4931

Shulman, C. E., Dorman, E. K., & Bulmer, J. N. (2002). Malaria as a cause of severe anaemia in pregnancy. *Lancet (London, England)*, *360*(9331), 494. https://doi.org/10.1016/S0140-6736(02)09662-9

Tunkyi, K., & Moodley, J. (2015). Prevalence of anaemia in pregnancy in a regional health facility in South Africa. *South African Medical Journal*, *106*(1), 101. https://doi.org/10.7196/SAMJ.2016.v106i1.9860

Uche-Nwachi, E. O., Odekunle, A., Jacinto, S., Burnett, M., Clapperton, M., David, Y., … Singh, R. (2010). Anaemia in pregnancy: associations with parity, abortions and child spacing in primary healthcare clinic attendees in Trinidad and Tobago. *African Health Sciences*, *10*(1), 66–70. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20811527

UNICEF, & Ministry of Health. (2014). *Evaluation of the Weekly Iron and Folic Acid Supplementation*. Bhutan.

University of Rochester Medical Center, Burd, I., & Dozier, T. (2017). Anemia in Pregnancy - Health Encyclopedia - University of Rochester Medical Center. Retrieved February 7, 2019, from https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentTypeID=90&ContentID=P02428

WHO. (2015a). *Guidelines for the treatment of Malaria*. (WHO, Ed.), *WHO Report* (3rd Editio). Italy: World Health Organization. https://doi.org/10.1016/0035-9203(91)90261-V

WHO. (2015b). the Global Prevalence of Anaemia in 2011. *WHO Report*, *12*(4), 48. https://doi.org/10.1017/S1368980008002401

WHO. (2016a). Guideline Daily Iron. *Daily Iron Supplimentation in Infants and Children*, 44. Retrieved from http://apps.who.int/iris/bitstream/10665/204712/1/9789241549523_eng.pdf?ua=1

WHO. (2016b). *WHO recommendations on antenatal care for a positive pregnancy experience*. Geneva.

WHO. (2017). *Guideline: Preventive Chemotherapy To Control Soil-Transmitted Helminth Infections in At-Risk Population Groups*. Retrieved from http://apps.who.int/bookorders.

WHO. (2018). Malaria. Retrieved February 15, 2019, from https://www.who.int/en/news-room/fact-sheets/detail/malaria

WHO, & Chan, M. (2011). Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. *Geneva, Switzerland: World Health Organization*, 1–6.

https://doi.org/2011

WHO, 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

Wong, C. (2017). Iron deficiency anaemia. *Paediatrics and Child Health*, *27*(11), 527–529. https://doi.org/10.1016/j.paed.2017.08.004

World Health Organization. (2001). Iron Deficiency Anemia Assessment, Prevention and Control: A guide for programme managers. https://doi.org/10.1136/pgmj.2009.089987

Wu, A. C., Lesperance, L., & Bernstein, H. (2016). Screening for iron deficiency. *Policy Statement*, 538. Retrieved from http://www.contrasthealth.ca/health-maintenance/

Yossef, H. E. E.-D. (2010). Effect of Calcium and Phosphorus on Nonhaeme Iron Absorption and Haematogenic Characteristics in Rats. *Food and Nutrition Sciences*, *01*(01), 13–18. https://doi.org/10.4236/fns.2010.11003

Zekarias, B., Meleko, A., Hayder, A., Nigatu, A., & Yetagessu, T. (2017). Prevalence of Anemia and its Associated Factors among Pregnant Women Attending Antenatal Care (ANC) In Mizan Tepi University Teaching Hospital, South West Ethiopia. *Health Science Journal*, *11*(5). https://doi.org/10.21767/1791-809X.1000529

Appendix

Appendix I: Knowledge on Anaemia Composite Scale

To calculate overall knowledge on anaemia, scores were awarded to all the questions on knowledge of anaemia. In total, there were 17 scores a respondent could get. The score awarded to each question depends on its level of cognition according to the bloom's taxonomy (Benjamin, Max, D., Edward, J., Walker, H., & David, 1956). The scores were awarded as shown below:

Scoring of knowledge on anaemia (Total 17 scores)

1. Have you ever heard of anaemia? – **total 1 score**
    a. Yes (1 score)
    b. No (0 score)
2. If no, have you ever heard of a someone having "inadequate blood" in his body? – **total 1 score**
    a. Yes (1 score)
    b. No (0 score)

If user answers no for questions 1 and 2, the questioning can end here and the total score is 0

3. What do you think causes anaemia (mention at least 2)? – **total 6 scores**
    Suggested answers:
    a. Inadequate dietary intake of iron-containing food and foods that help in iron absorption (2 score)
        i. Mention at least two iron-containing foods (2 scores)
    b. Infections or other diseases (2 scores)
        i. Mention two morbidities that can result in anaemia (2 scores)
    c. Blood loss (2 scores)
        i. Mention two situations that can result in massive blood loss and possible anaemia (2 scores)
    d. Genetics (2 scores)
        i. Mention two genetic conditions that predispose people to anaemia (2 scores)

Indirect causes of anaemia, like poverty and education should be probed further to identify find a direct link to anaemia, else, 1 score is received for each indirect cause, making 2 scores in all. Only causes with scientific evidence from research should earn marks.

4. What can you do to prevent or cure anaemia (mention at least 2)? – **total 4 scores**
    a. Adequate dietary intake of iron-containing food and foods that help in iron absorption (2 scores)
    b. Use of iron and folic acid supplements (2 scores)
    c. Treating infections that could cause be the cause of anaemia (2 score)
    d. Blood transfusions (2 score)

5. What are the effects of anaemia (mention at least 3)? – **total 6 scores – 2 each**
    a. Dizziness, Fatigue, General body weakness, Shortness of breath, Irregular heartbeats, Impairment in mental and physical development of the baby, Increased risk of morbidity and mortality, Reduction in productivity, Others – specify

Other effects with scientific evidence are acceptable for the same scores

The scores were categorized into three equal intervals, where a person scoring 0 – 5 was categorized as having low knowledge, 6 – 11 as having fair knowledge and 12 – 17 as having high knowledge

Appendix II: Questionnaire

NO.	QUESTION	ANSWER	CODE
SOCIO – DEMOGRAPHIC & SOCIO-ECONOMIC CHARACTERISTICS			
1.	How old are you?		age
2.	What is your level of formal education?	1. ☐ None 2. ☐ Primary 3. ☐ JHS/O-level 4. ☐ SHS/Vocational/A-level 5. ☐ Tertiary	educ
3.	What is your main occupation?	1. ☐ Unemployed 2. ☐ Farming 3. ☐ Teaching 4. ☐ Trading 5. ☐ Other, specify _____	occup
4.	What is your marital status?	1. ☐ Single 2. ☐ Married 3. ☐ Separated 4. ☐ Divorced 5. ☐ Co-habiting	mari_stat
5.	What is your religion	1. ☐ Not religious 2. ☐ Christian 3. ☐ Islamic 4. ☐ ATR 5. ☐ Other, specify _____	religion
6.	To which ethnic group do you belong?	1. ☐ Ewe 2. ☐ Akan 3. ☐ Other, specify _____	ethnic
7.	Household income		income
ANC ATTENDANCE AND RECORDS			
8.	Number of visits to the ANC		anc_visit
9.	Initial Hb		init_hb

10.	Latest Hb		cur_hb
11.	Hb history	1. First trimester	a. trim1_hb
		2. Second trimester	b. trim2_hb
		3. Third trimester	c. trim3_hb
12.	BMI	1. First trimester	a. trim1_bmi
		2. Second trimester	b. trim2_bmi
		3. Third trimester	c. trim3_bmi
13.	Gestational age on first ANC visit		gest_age_visit1
14.	Number of children		num_chd
15.	Number of pregnancies		num_preg
16.	Age of last child		age_last_child

INFECTIONS, PREVENTION AND MEDICATION

17.	Number of times dewormed during pregnancy		deworm
18.	Do you use ITN	1. ☐ Yes	itn
		2. ☐ No	
19.	If yes, did you sleep under it last night?	1. ☐ Yes	sleep_itn
		2. ☐ No	
20.	Malaria diagnosed in pregnancy	1. ☐ Yes	malaria
		2. ☐ No	
21.	How many doses of IPT for pregnancy period?		ipt_doses
22.	Iron supplemented during pregnancy	1. ☐ Yes	iron_sup
		2. ☐ No	
23.	Did you follow the prescribed regime	1. ☐ No	iron_sup_comp
		2. ☐ Once a while	
		3. ☐ Most of the time	
		4. ☐ Always	

KNOWLEDGE ON ANAEMIA

24.	Have you ever heard of anaemia	1. ☐ Yes 2. ☐ No	heard_anaemia
25.	If no, have you ever heard of someone having "inadequate blood" in his body	1. ☐ Yes 2. ☐ No	heard_anaemia2
26.	What do you think causes anaemia? (mention at least 2)	1. ☐ Inadequate dietary intake of iron-containing food and foods that help iron absorption 2. ☐ Infections or other morbidities 3. ☐ Blood loss 4. ☐ Something else, specify _____	anaemia_cause
27.	Mention two foods that can give iron (or blood) or help someone get more blood		iron_food
28.	Mention two sicknesses that could lead to anaemia		illness
29.	Mention two incidents that could lead to enough blood loss to cause anaemia		blood_loss
30.	What are the effects of anaemia?	1. ☐ Dizziness 2. ☐ Fatigue 3. ☐ General body weakness 4. ☐ Shortness of breath 5. ☐ Irregular heartbeats 6. ☐ Impairment in mental and physical development of the baby	anaemia_effects

		7. ☐ Increased risk of morbidity and mortality 8. ☐ Reduction in productivity 9. ☐ Other, specify _____	
31.	What can be done to prevent anaemia?	1. ☐ Adequate dietary intake of iron-containing food and foods that help in iron absorption 2. ☐ Use of iron and folic acid supplements 3. ☐ Treating infections that could cause anaemia 4. ☐ Blood transfusion	anaemia_prevent
NUTRITION			
32.	Number of meals per day		num_meals
33.	The frequency of fruit consumption	1. ☐ No 2. ☐ Once a week 3. ☐ Twice a week 4. ☐ Three or more times a week	fruit_pw
34.	Consumption pattern per week	1. Eggs 2. Fish/meat 3. Snails 4. Vegetables	a. eggs_pw b. fish_pw c. snails_pw d. veg_pw

Appendix III: Information Sheet

Title of study: Determinants of anaemia in pregnancy among post-partum women in Hohoe.

Introduction

I am Emmanuel Enyonam Zeye, a master's degree level student of the School of Public Health of the University of Ghana, Legon. A crucial part of the programme involves carrying out a research work. For my research, I intend to look at anaemia during pregnancy. The number of cases of anaemia is very high, especially in the Volta region. Anaemia is known to negatively affect the health of both mother and child and when not resolved quickly, it can lead to permanent brain damage in affected children. Even though pregnant women are given supplements to prevent anaemia, there are still many pregnant women who have anaemia.

It is my hope that, through my work, the factors that influence the anaemia status of pregnant women in Hohoe will be identified.

Purpose of the study

The goal of this study is to determine the prevalence of anaemia among pregnant women in Hohoe and identify the factors that contribute to the anaemia status of these women.

Eligibility criteria

The study will consider any woman is within fertile age group (15 - 49 years) and has successfully delivered within the 6 weeks and attends Post Natal Clinic (PNC) at the Hohoe Municipal Hospital. Women who did not attend any Ante-Natal Clinic prior to delivering their babies will not be eligible to partake in the study. Pregnant women of reproductive age who attend ANC at the Hohoe Municipal hospital will also be included.

Study Procedure

Participants will be asked short questions about their age, highest level of formal education, occupation, household income, ANC attendance, number of previous births, the spacing

between last birth and current birth, dietary patterns, last diagnosis of malaria and time of last deworming.

Information about blood haemoglobin levels will be retrieved from the maternal records book (red Ante-Natal Clinic (ANC) booklet). Birth weight of the baby/babies will also be extracted from the child records book.

All this information will be filled onto a paper-based questionnaire or a data collection software on the researcher's phone. All things being equal, the process should last for about 20 minutes.

Benefits and Risks

Through this research, we will know the current estimate of pregnant women who suffer from anaemia at various stages of pregnancy within Hohoe. We will also get more understanding about the factors that will cause pregnant women in Hohoe to have anaemia or prevent pregnant women from getting anaemia. We will generate information that can be used to decide on measures to put in place in order to reduce the number of pregnant women who have to battle with anaemia and its complications, where and when to target these measures.

There are no direct risks in partaking in this research. There may however be inconveniences like taking part of a participant's time and asking personal information that a participant may not be very comfortable in divulging, like her age or household income.

Freedom to participate/ Voluntary withdrawal

Even though this research intends to provide information about anaemia status of pregnant women in Hohoe using PNC attendants, participation in this study is not compulsory. You may decline to participate in this study. Intelligence gathered from this research may be used for further research or policy. As such, we implore you to be as honest as possible in providing answers to the questions that will be asked if you agree to partake in the study. You have the

right to request that the interview is stopped at any moment that any question makes you too uncomfortable to continue.

Privacy and Confidentiality

Names of respondents will not be included in any part of the questionnaire or reports that will be generated from this research. Any information provided will be confidential between the researcher and the participant.

The interviews will be carried out at a place within the facility where there is the least likelihood of being overheard.

In the event that a participant considers a question that has been asked as an invasion of her privacy, she is at liberty to decline to answer.

Compensation for participants

Time is precious and much as we will make the interviews as quickly as possible, we will still take part of the time of our participants. Participants will, therefore, be compensated with GHC 2.00 after the interview. It is our hope that this amount will help the participant get back to their homes in time. The amount given is not payment for the information received.

Data storage and protection

All information collected will be temporarily saved online in a location that the principal investigator has the password to. After all information has been collected for the study, the data will be downloaded onto a computer and password protected. Identifying information will be stripped off before presenting the data to the school as part of the requirements for the master's programme.

Cost of the study

The total cost of the study is going to be borne solely from the coffers of the researcher. No financial cost is incurred by any participant for the conduct of this study. Also, no third-party has provided funding for this project.

Declaration of conflict of interest

I, Emmanuel Enyonam Zeye (Principal Investigator), declare that, as far as I can tell, there is no actual, perceived or potential conflict of interest that will or may arise as a result of my involvement with this study.

Who to contact

For further information about this research, please contact:

- GHS/ Ethical Review Committee administrator, Ms Hannah Frimpong at: 0507041223/ 0243235221
- School of Public health, University of Ghana, Legon.

or

- Dr Sackey O. Samuel

  Mobile number: 0242216542/ 0262216542

  Email: sackey492003@yahoo.co.uk
- Mr Zeye Emmanuel Enyonam (Principal Investigator)

  Box 41, Hohoe

  Mobile number: 0245089490 / 0206954674

  Email: starphylococcuz@yahoo.com, eezeye002@st.ug.edu.gh

Appendix IV: Consent Form

Statement of consent

I attest to the fact that, I have received a detailed explanation of the procedure and methods involved in this study and have fully agreed on my own accord to participate in the study. All the questions I have concerning the conduct of the research have all been answered to my satisfaction. I know of my right to withdraw from the study at any time I deem it necessary without my withdrawal or refusal to partake affecting me inversely. I hereby consent to partake fully in this study.

Signature/Thumbprint of participant..... Date...../...../.....

Statement by the Researcher

I certify that the participant has read the information provided in the consent form (or had it read to her) and all the concerns she has have been addressed.

Signature …… Date...../...../.....

Appendix V: Ethical Approval

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

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

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Tel: +233-302-681109
Fax + 233-302-685424
Email: ghserc@gmail.com

MyRef. GHS/RDD/ERC/Admin/App 18/177
Your Ref. No.

16th January, 2018

Emmanuel Enyonam Zeye
University of Ghana
School of Public Health
Legon, Accra

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

GHS-ERC Number	**GHS-ERC: 163/12/17**
Project Title	The Prevalence and Determinants of Anaemia among Pregnant Women in Hohoe
Approval Date	16th January, 2018
Expiry Date	15th January, 2019
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.....
PROFESSOR MOSES AIKINS
(GHS-ERC VICE-CHAIRPERSON)

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

Candidate ID: 10637370

Name: Emmanuel Enyonam Zeye

Dissertation Title: The prevalence and determinants of anaemia among pregnant women in Hohoe

COMMENTS	STUDENT'S RESPONSE TO COMMENTS
Incomplete sentence in literature review.	The sentence, which was the last sentence on literature reviewed, was identified, completed and properly punctuated.
Some inline references not appearing in bibliography and vice versa.	The references cited inline and in the bibliography were synced to match using the Mendeley referencing software and manual verification done