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UNIVERSITY OF GHANA

FACTORS ASSOCIATED WITH ANEMIA IN PREGNANCY AMONG WOMEN ATTENDING ANTENATAL CLINIC AT THE NGLESHIE AMANFRO POLYCLINIC, IN THE GA SOUTH DISTRICT.

BY

ISAAC KYEREMATENG

(10306717)

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DECLARATION

I, Isaac Kyerematen, hereby declare that except for the other people's investigations which have been duly acknowledged, this work is the result of my original research and that this dissertation, either in whole or in part has not been presented elsewhere for another degree

Isaac Kyerematen **Signature:** **Date: 16 /02/2022**

(MPH Candidate)

Dr. Adolphina Addo-Lartey **Signature:** **Date: 16/02/2022**

(Supervisor)

DEDICATION

This project is dedicated to the Almighty God for his immense grace and mercies that has brought me this far and to my family and friends.

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I wish to express my sincere gratitude, first and foremost to the Almighty God for how far he has brought me on the educational ladder.

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God bless you all.

ABSTRACT

Low haemoglobin among pregnant women in developing countries is a serious public health problem. Anaemia in pregnancy is a profound and significant cause of maternal and fetal morbidity and mortality. The purpose of this study was to determine the prevalence and the factors associated with anaemia among pregnant women attending antenatal clinic (ANC) at the Ngleshie Amanfro Polyclinic. A descriptive cross-sectional study was conducted from 14th October – 23rd November 2021 at the Ngleshie Amanfro Polyclinic. Both primary and secondary data were collected. The data was analysed using STATA v.16. Univariate and bivariate analyses were performed. Out of the 402 women studied, 262(65.01%) were found to be anaemic (Hb< 11.0g/dl) at the time of the study, with a mean Hb of 10.5(0.98 SD) and a range of 8g/dl -13g/dl. However, almost half 163(40.4%) of the women were anaemic on their first visit, with a mean Hb of 11.4g/dl (0.06 SD) and a range of 8g/dl – 13.7g/dl. Women aged 32-36years had an 86% significant reduction in the odds of developing anaemia as compared to those aged 17-21 years (aOR=0.14, 95%CI=0.04-0.52, P<0.05). Women who had secondary and tertiary education had 84% and 95% significant reduction in the odds of developing anaemia (aOR=0.16, 95%CI=0.06-0.43, P<0.001) and (aOR=0.05, 95%CI=0.02-0.16, P<0.001) respectively, as compared to those with no formal education. The odds of developing anaemia among married women was 2 times (aOR=1.99, 95%CI=1.08-3.65, P=0.027) and among women cohabiting was 3.5 times (aOR=3.55, 95%CI=1.71-7.36, P=0.001) the odds of developing anaemia among single women. This was statistically significant. Then women who made 4 or more ANC visits had a 51% significant reduction in the odds of developing anaemia as compared to women who had made less than 4 visits. A multisectoral approach will be required by Ngleshie Amanfro Polyclinic to help address this public health concern of maternal anaemia.

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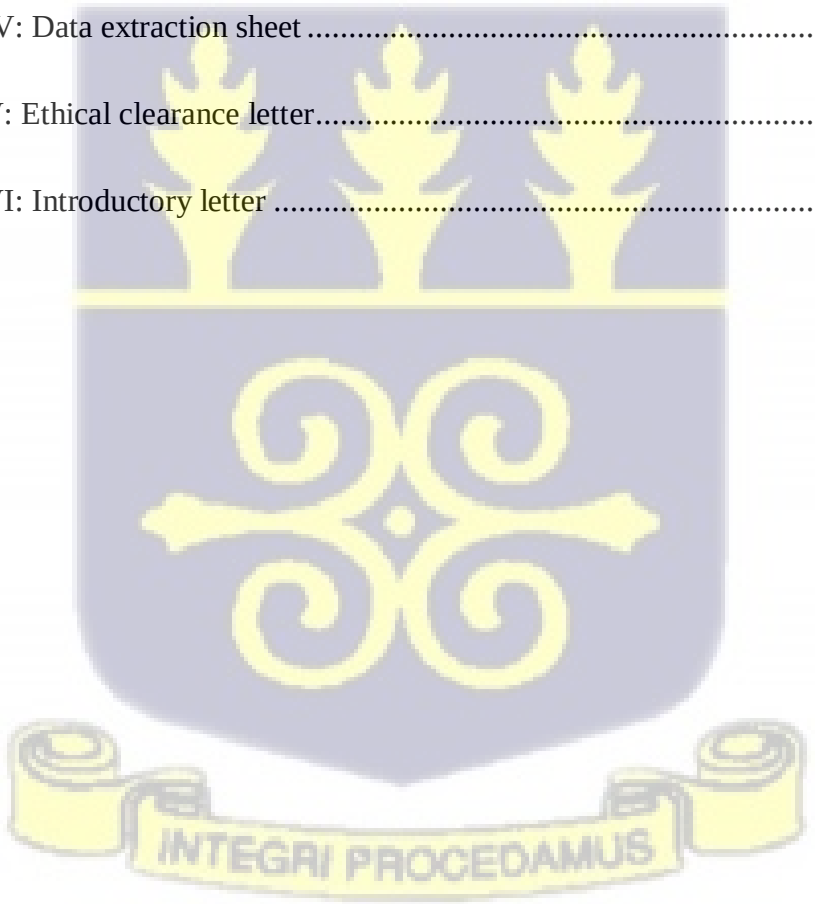

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LIST OF ABBREVIATIONS

ANC	Antenatal Clinic
GDHS	Ghana Demographic and Health Survey
GHS	Ghana Health Service
HB	Haemoglobin
HIV	Human Immunodeficiency Virus
IPT	Intermittent Preventive Treatment
ITN	Insecticide Treated Nets
LMIC	Low- and Middle-Income Countries
MoH	Ministry of Health, Ghana
NAP	Ngleshie Amanfro Polyclinic
SP	Sulfadoxine-pyrimethamine
SSA	Sub-Saharan Africa
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

The physiological state where red blood cells are unable to transport sufficient oxygen to cells and tissues is referred to as anaemia. This may be due to a reduced number or efficiency of red blood cells. The body's requirement for oxygen and other nutrients as carried in the blood varies with a person's age, gender, physiological states such as the different stages of pregnancy, and pathological states such as chronic kidney disease. (WHO & Chan, 2011) According to WHO (2011), about 1.62 billion people across the world were anaemic. Women and children in underdeveloped countries suffer the most from anaemia and its effects. In 2011 approximately 33 million women who were pregnant and 500 million non-pregnant women worldwide suffered from anaemia. Amongst this group were 20.2 million women of reproductive age who had severe anaemia. Anaemia, therefore, is a problem worldwide (Elmardi et al., 2020). Women who are pregnant and have haemoglobin values below 11 g/dl are considered anaemic. Anaemia can be classified as mild (with Hb=10.0–10.9 g/dl), moderate (Hb =7–9.9 g/dl) and severe (Hb less than 7 g/dl) during pregnancy (Omote et al., 2020).

In the reproductive years of women, iron as well as many other blood nutrients lost from mensuration and poor nutrition exposes these women to anaemia even before they get pregnant. Approximately 25-30mls of blood, which contains about 0.5mg of iron, is lost monthly through mensuration. It's thus recorded that the non-pregnant woman requires a daily absorption of 2.4mg of iron as opposed to the 1.1mg needed by men. Nutrient requirement for blood cell production is even greater when a woman becomes pregnant. The majority of women in developing countries begin their pregnancy journey being anaemic. Physiological changes, fetal

growth, and an increase in metabolism create a huge demand for a large amount of circulating blood. (WHO, 1993)

Anaemia may be either relative or absolute during pregnancy. During pregnancy, a higher rise in plasma volume (about 45 percent in a single gestation and 50–60 percent in twin gestations) than in red cell mass causes relative or physiological anaemia. Absolute anaemia is characterized by a true reduction of red cell mass, usually resulting from accelerated red cell death (from conditions like sickle cell and infections such as pneumonia), increased red cell loss, or reduced red cell development (as in malnutrition). (Olatunbosun A et al., 2014)

Maternal anaemia remains a global health concern for women in developing countries even though there have been significant gains and achievements in maternal health programs. Inadequate nutrition with iron, folic acid, vitamin deficiencies, infectious diseases, and poorly treated hemoglobinopathies are the major causes of maternal anaemia. In developing countries, maternal anaemia significantly impacts the physical, social, and economic status of the mother. Pregnant women who are anaemic usually experience fatigue, lightheadedness, weakness and reduced work production with low birth weight, poor fetal development and fetal death being some possible adverse outcomes of the pregnancy. Iron/folic acid supplements, insecticide-treated bed net use, prompt treatment, and intermittent preventative therapy (IPT) for malaria have been sporadic and uneven, resulting in a high prevalence of anaemia in underdeveloped nations. (Rahman et al., 2016 , Ayoya et al., 2012)

The prevalence of maternal anaemia varies significantly across and within countries. Hence to help inform preventive interventions and policies there is the need for local data. In developing countries, 56% of women have anaemia, according to global data (Black, et al., 2013).

Wemakor (2019) identified some risk factors such as poor nutrition of pregnant women during pregnancy, malaria infection, and delay in initiating the malaria prophylactic therapy in pregnancy using sulfadoxine-pyrimethamine as being strongly linked to anaemia in pregnancy. Furthermore, women develop a reduced immune response to the malaria parasite during pregnancy. As such living in a malaria-endemic area puts them at a higher risk of getting malaria compared to a non-pregnant woman. Hailu et al. (2014) added that pregnant women with underlying health conditions are at greater risk of anaemia during pregnancy than those without underlying medical conditions.

The causes of anaemia during pregnancy as outlined by WHO (2012) are iron deficiency, genetic patterns such as haemolytic condition, parasite infection, and worm infestation. Similarly, dietary causes of anaemia include vitamin B12, ascorbic acid and folic acid deficiency. Dizziness, palpitation, pedal welling and easy fatigability are common symptoms of anaemia in pregnant women. (Birhanu, Birarra, & Mekonnen, 2018).

In Nigeria, women who were pregnant desisted from eating nutritious meals such as eggs, snails and fish because of the traditional view that these foods would make their children slow or become liars and thieves (Onyeneho & Igweonu, 2016). The study of Dickson and Adongo (2016) among pregnant women in Ablekuma South, Ghana suggested that they preferred eating non-food substances such as clay because it prevented them from feeling nauseous and gave them a good feeling. Studies conducted by Widyawati et al., (2015) showed that anaemia is a leading cause of maternal death, particularly in underdeveloped countries, where there is a significant link between severe anaemia and maternal mortality. In Ghana, statistics show that 45% of pregnant women had anaemia in 2017 (Ghana Health Service, 2018).

Helminthes infection, malaria infection, lack of iron supplementation, geophagia, poor nutrition, no usage of a bed net, unemployment, gestational age, parity, gravidity, age, and low level of education are the factor influencing low Hb among pregnant women in Ghana (Anlaakuu and Anto, 2017). Anaemia in pregnancy is a treatable illness that can be easily prevented (WHO, 2011). According to the WHO (2011), numerous preventative initiatives have been implemented in Africa to address the fundamental causes of anaemia during pregnancy, with some of these programs proving to be efficient and effective in lowering maternal anaemia.

1.2 Problem statement

Anaemia is a worldwide public health pandemic. Vemulapalli and Rao (2013) stated that, about 500 million women of reproductive age with 50% of pregnant women being anaemic. Haemoglobin level below 11g/dl during pregnancy is termed anaemia in pregnancy. The proportion of pregnant women who suffer from anaemia ranges between 8-23% in developed countries as opposed to the huge 50-90% average in developing countries. This figure is higher in some developing countries such as India which recorded a prevalence of anaemia in pregnancy of about 65%-75%. (Vemulapalli & Rao, 2013). In sub-Saharan Africa, it is estimated that 57% (17.2 million) of pregnant women are anaemic. This however varies between the regions. In Central and West Africa, the occurrence of anaemia among women of reproductive age is 61% in contrast to the 34% recorded in southern Africa, According to a WHO report in 2011. (Ayoya et al., 2012; Dorsamy et al., 2020) According to a study conducted at the University Teaching Hospital in Uyo, Nigeria, there has been little change in the prevalence of maternal aneemia, with 61 percent of mothers having Hb less than 11g/dl at their booking visit, indicating that they are anemic. (Ayoya et al., 2012; Olatunbosun et al., 2014).

Analysis of the Ghana Demographic and Health Survey (GDHS) in 2008 showed that the proportion of women with anaemia in pregnancy was 64.9%. This figure reduced to about 42% in 2014. Between 2008 and 2014, a 25.4% reduction in prevalence was realized. Successfully implemented programs such as iron-folic acid supplementation, dietary education to women, treatment of worm infestations and macronutrient food fortification were attributed to this reduction. (Agbozo et al., 2020) In 2005 a study done in some communities of the Sekyere West District found the average Hb level of pregnant women to be 9.4g/dl and recorded a prevalence of 57.1%. A similar study repeated in a rural community in the northern region in 2014 showed the prevalence of anaemia to be 42.7%. This was highly consistent with the GDHS reports.(Glover-Amengor et al., 2005; Nonterah et al., 2019)

In 2018, a study among women who were pregnant in designated prenatal clinics in Greater Accra revealed the mean (SD) Hb as 10.9g/dl (1.3). The overall prevalence of anaemia was 51%. (Acheampong et al., 2018) In developing countries, women are at a higher risk of anaemia because they are exposed to an increased frequency of dietary iron, folic acid, and other micronutrient deficiency, infections and hemoglobinopathies. (Daru et al., 2018)

Anaemia is a leading cause of maternal mortality. Maternal anaemia dampens the immune system impairing the ability of pregnant women to resist infections (Eghan, 2019). The consequences of anaemia in pregnancy, causes the fetus to be underweight, may lead to birth before term, alongside perinatal and neonatal mortality for the fetus. The mother also becomes highly susceptible to death during or after childbirth. Severe anaemia leads to circulatory system breakdown, increased cardiac output, an increased risk of bleeding usually after birth. This paves the way for a decreased ability to tolerate blood loss, circulatory shock, and eventually death (Young, 2018).

Even though studies have been conducted in other parts of the country on the prevalence of anaemia during pregnancy, no known studies have been conducted in the Ngleshie Amafro Polyclinic. The healthcare team in the Ngleshie Amafro Polyclinic has been carrying out interventions aimed at preventing anaemia during pregnancy, however, observations from the routine Hb level of the pregnant women seem to suggest that anaemia is on the increase. Consequently, the goal of this research is to learn about the prevalence of anaemia in the Ngleshie Amanfro Polyclinic and what factors contribute to it.

1.3 Justification

The results of this study will contribute to academia by filling an important gap that exists on the proportion of women suffering from maternal anaemia and the factors contributing to this occurrence. This current study serves to fill this knowledge gap and provide an insight into the topic within a health facility that is at the bottom tier of the health structure in Ghana.

This study will also contribute to policymaking by helping the health authorities identify a holistic set of factors attributed to anaemia during pregnancy. Also, this study will provide results on the compliance of pregnant women on IPT uptake, iron supplementation, and usage of ITNs. This study will enable the authorities in the various health facilities to gain scientific insight into the problems. It will also help the stakeholders in knowing which aspects of the care of maternal and infant healthcare need to be improved to enhance the well-being and outcome of pregnant women and the health of their children. In addition, this study will contribute to teaching and learning of anaemia in pregnancy, IPT uptake, and the usage of ITNs. Lecturers and students will alike benefit from this study. This study will help health students better apprehend the prevalence of anaemia among pregnant women attending prenatal clinic at the Ngleshie Amanfro, as well as maternal variables linked to anaemia.

1.4 Study objectives

1.4.1 General objective

To determine the prevalence and factors associated with anaemia among pregnant women attending antenatal clinic at the Ngleshie Amanfro Polyclinic in the Ga South District.

1.4.2 Specific objectives

1. To determine the proportion of women attending antenatal clinic who are anaemic at the Ngleshie Amanfro Polyclinic.
2. To examine the association between the socio-demographic characteristics of pregnant women and anaemia status.
3. To assess the interaction between obstetric factors and anaemia status.
4. To determine the proportion of pregnant women on iron supplementation and the level of adherence.

1.5 Research questions

1. What is the prevalence of anaemia among women attending antenatal clinic at Ngleshie Amanfro Polyclinic?
2. What are the sociodemographic factors associated with anaemia among women attending antenatal clinic at Ngleshie Amanfro Polyclinic?
3. What obstetric factors are associated with anaemia among mothers attending antenatal clinic at Ngleshie Amanfro Polyclinic?
4. What is the proportion of pregnant women on iron supplementation and the level of adherence?

1.6 Conceptual framework

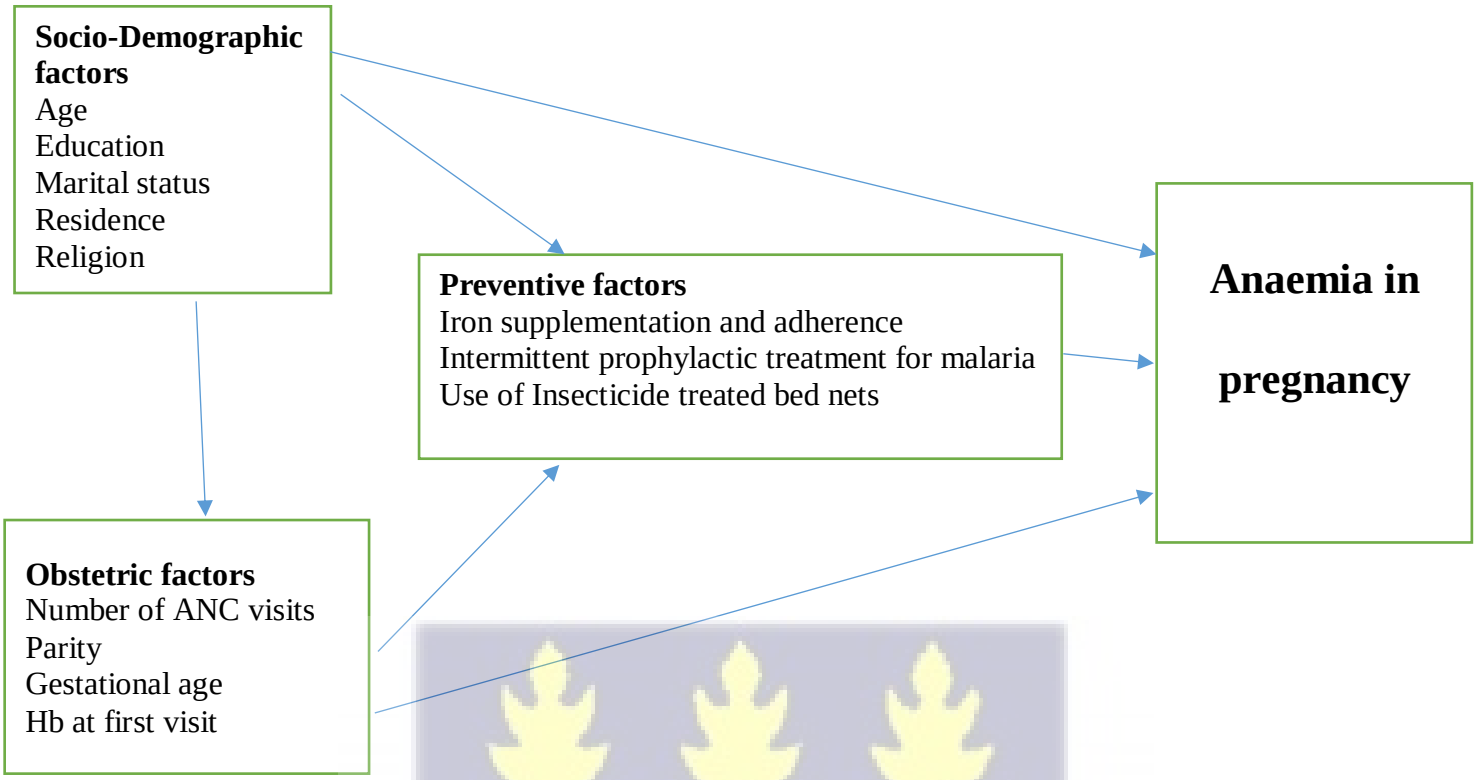

Figure 0.1: Conceptual framework

1.7 The narrative of the conceptual framework

Maternal anaemia remains a major public health concern considering the outcomes for mother and child. The factors associated with maternal anaemia from literature are here grouped into three main blocks. These are the sociodemographic determinants, maternal biological and reproductive factors, and maternal risk factors. Maternal risk factors are further divided into preventive risk factors, curative risk factors, and maternal medical predispositions.

Sociodemographic determinants of maternal anaemia include maternal age, marital status, educational status, occupation. It would be expected that the prevalence of anaemia is higher in

mothers with a lower age, single or divorced mothers, low educational status of mothers, and mothers with low or no income-generating jobs. However, the converse was observed that there was a higher prevalence of anaemia among mothers between 20-30years as compared to mothers between 15-19years (Anlaakuu, 2015; Nduhiu-Githinji, Carolyne, 2013). This was in contrast to the lower prevalence of anaemia associated with increasing age of mothers as found by Glover-Amengor et al. (2005). Mothers with an occupation had a reduced chance of developing anaemia relative to students. According to Nduhiu-Githinji, Carolyne(2013) a higher proportion of mothers with primary or no formal education developed anaemia as compared to mothers with secondary and tertiary education. Similarly, the presence of anaemia was high in single women and unemployed women. The association between the sociodemographic determinants and maternal anemia varied from study to study. Notwithstanding characteristics such as occupation of woman , educational status, religion and marital status did not significantly affect the degree of anaemia thus the association was statistically insignificant for all the studies found.

Obstetric characteristics also play a major role in developing anaemia in pregnancy. These factors are parity, gravidity, gestational age, and multiple (twin) pregnancies. Studies found showed that there was an association between Parity, birth spacing, and gravidity. A high percentage of anaemia was found in first pregnancies and increased gravidity, but the statistical analysis did not show any significant relationship between these maternal characteristics and the prevalence of anaemia. Women presenting for ANC after 14 weeks of pregnancy were at a higher risk of developing low Hb during pregnancy. Maternal anaemia is a noteworthy feature also found in multiple or twin gestations. (Anlaakuu, 2015; Nduhiu-Githinji, Carolyne, 2013; Rani & Lakshmi, 2018). Being underweight was observed to carry a higher risk of developing

maternal anaemia. Whiles overweight and obese mothers were found to have a lower risk of anaemia in pregnancy. (Nonterah et al., 2019)

Maternal risk factors are subdivided into curative, preventive, and medical predisposing factors. Malaria, worm infestations, and other bacterial infections during pregnancy are significantly associated with anaemia in pregnancy. These infections, especially malaria in a pregnant woman, is a significant marker of iron deficiency. Thus, further predisposing them to maternal anaemia. Antimalarial drugs, antihelminthics, IPT, and sleeping in Insecticide-treated bed nets are therefore recognized factors to preventing maternal anaemia. Iron supplementation via oral intake and consumption of iron-containing foods such as snail, eggs, meat, sea-fish, pork, and milk, is strongly linked to a decreased chance of developing anaemia in pregnancy. The frequency of maternal ANC visits also is found to serve as a preventive factor for anaemia in pregnancy. (Anlaakuu, 2015; Glover-Amengor et al., 2005)

Finally, from the framework above its observed medically that maternal medical conditions such as sickle cell disease, HIV, organ diseases (chronic kidney disease, heart diseases) compromise maternal health and thus predispose them to anaemia.

Anaemia in pregnancy has adverse effects on pregnancy. However severe anaemia is associated significantly with negative pregnancy outcomes for both the mother and fetus. Maternal Hb levels below 10g/dl may lead to significant maternal ill health which may present with distressing symptoms such as headache, fatigue, lethargy, paresthesia, palpitations, and breathlessness. Severe cases of maternal anaemia especially during labor can cause severe bleeding post-delivery, life-threatening high-output congestive heart failure, and eventually maternal mortality.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter presents the empirical literature review on anaemia during pregnancy, the prevalence of anaemia during pregnancy, the socio-demographic factors associated with anaemia during pregnancy, the obstetric factors associated with anaemia during pregnancy, and the adherence to iron supplementation during pregnancy.

The literature for the chapter was sourced from a variety of sources including electronic databases such as Google Scholar, Google, PubMed, Science Direct, and Scopus. In addition, other sources of literature for the chapter were periodic publications by authoritative institutions such as the World Health Organization, the Centers for Disease Control and Prevention, the Ghana Health Service, and the Ministry of Health of Ghana. Keywords used in the literature search process were "anaemia," "pregnancy," "maternal," "factors," "determinants," "predictors," "compliance," "adherence," "iron supplementation," and "low Hb."

2.2 Anaemia during pregnancy

Anaemia is a health condition that is characterized by low levels of haemoglobin (Hb) concentration in the blood. This low level of Hb concentration could be due to defective, depleted number of, or the reduced ability of the red blood cells to contain a good amount of Hb. All vertebrates' red blood cells include haemoglobin, an iron-containing oxygen transport protein. (Margwe & Lupindu, 2018). Anaemia affects all age groups with children and pregnant women being the most susceptible.

The clinical signs of anaemia depend on the group of persons within which the anaemia manifests itself. In children, anaemia can manifest through increased heart rate, lack of energy, dizziness or vertigo, headache, and irritability. Much of these signs and symptoms of anaemia in children also presents themselves in adults. In addition to these signs and symptoms, irregular menstrual cycles, or delayed menstrual cycle is typical among female adults. Among pregnant women, the clinical signs of anaemia include fatigue, palpitations, and shortness of breath. Aside from the signs and symptoms of anaemia, some types of anaemia are asymptomatic. As such, there are no clinical manifestations for these types of anaemia.

When there is low haemoglobin in pregnancy, the situation is known as anaemia in pregnancy. In developing and underdeveloped nations, low levels of Hb among women who are pregnant is a significant public health issue. (Onyeneho & Subramanian, 2016). Researchers such as Demis, Geda, Alemayehu, and Abebe (2019) stated that low haemoglobin in pregnancy occurs when the integrity and function of the red blood cell is compromised and does not meet the biological needs of pregnant women.

Normal red blood cell formation involves complex and delicate processes like the biosynthesis of nucleic acid, porphyrin, haem, and proteins. Any of these processes could be hampered, resulting in anaemia. Pregnant women form one of the most vulnerable groups to develop anaemia. This is because of the high iron deficit that needs to be met to ensure both the mother and the foetus are sustained.

The WHO (2011) classifies anaemia in pregnancy as having a haemoglobin level of 10.0-10.9g/dl (mild anaemia), 7-9.9g/dl (moderate anaemia), and less than 7g/dl (severe anaemia) .

Anaemia during pregnancy is a preventable and treatable problem. (WHO, 2011). According to the WHO (2011), numerous preventative initiatives have been implemented in Africa to address the fundamental causes of anaemia during pregnancy, with some of these programs proving to be efficient and effective in lowering anaemia during pregnancy.

2.3 The prevalence of anaemia among pregnant women attending antenatal clinic

According to data gathered across the world, 56% of pregnant women in underdeveloped and developing countries are anaemic. (Black, et al., 2013) The prevalence of anaemia is highest among pregnant women in Sub-Saharan Africa (SSA) (57%), followed by pregnant women in Southeast Asia (48%), and the lowest prevalence (24.1%) was discovered in South American expectant mothers (WHO, 2018). A descriptive research among 384 pregnant women in Maringá, Brazil found a low prevalence of anaemia with only 12.3% of pregnant women affected. (Araújo et al., 2013) The proportion of women with low Hb in some clinics in Islamabad, Pakistan was found to be 42.5% with a mean(SD) Hb level of 11.0g/dl(1.64) in that study. (Ayub et al., 2009).

A Norwegian study sampling a total of 529 women who were pregnant found the proportion with anaemia to be 18.0% with 2% being severely anaemic (Stephen et al., 2018). In furtherance, Randall et al., (2019) examined secondary data of over 31,000 women in the period of their pregnancy in New South Wales and established that 4.0% had HB less than 11.0g/dl and 10.2% had HB less than 14.0g/dl.

In Northeast Ethiopia, anaemia was found in 79 percent of pregnant mothers. (Hailu et al., 2019) Another research sampling 123 pregnant women in the hospital at Ambo, Ethiopia, and found out that, 35.8 percent of mothers studied had low HB level (<11g/dl). This study established a

mean Hb level of 9.7±0.8 in a pregnant woman. (Kefiyalew & Eshetu, 2018). In South Sudan, an analysis of nationally representative data showed that about 53.0% of women carrying pregnancy were anaemic. (Adam et al., 2018).

Wemakor, (2019) conducted an observational study among 400 women who had presented for ANC in the Tamale Teaching Hospital, Ghana. The results of this research showed that the mean Hb(SD) was 10.81 (±1.41) g/dl. It also stated that about half of the women (50.8%) had low Hb. (Wemakor, 2019). Another cross-sectional study in Sunyani at the Municipal Hospital revealed that among 316 sampled participants, 40.8 percent (129) were found to be anaemic. (Anlaakuu & Anto, 2017). In the study, 61.2%(79) had mild anaemia (Hb 9.0–10.9 g/dl), 37.2 percent (48) had moderate anaaemia (Hb 7.0–8.9 g/dl), and 1.6 percent (2) with severe anaemia (Hb less than 7.0 g/dl). Again in another study that sampled 200 women who were attending ANC clinics in Adenta, the proportion of women who were anaemic was 51.0% with the majority of the women (61.0%) being mildly anaemic, 39 percent being moderately anaemic, and none being severely anaemic. (Acheampong et al., 2018)

2.4 The socio-demographic factors associated with anaemia among pregnant women

In Maringá, Brazil, among 384 expectant mothers selected, it was established low HB levels were significantly associated with previous employment and marital status ($p < 0.05$). Pregnant women who were employed and those who were married were less likely to have low HB levels than their counterparts who were unemployed and those who were single or divorced or widowed (Araújo et al., 2013). Similarly, among 200 pregnant women in Islamabad in Pakistan, a cross-sectional study observed that women who earned less using monthly income were less likely to have low HB levels, however, the marital status of the pregnant women and their HB levels were shown to have no significant relationship. (Dzabeng & Adanu, 2019).

Stephen et al., (2018) conducted a cross-sectional study to find the determinants of low Hb among 529 pregnant women sampled from two hospitals in the Moshi Municipality, Norway. Their study found out that mothers who had secondary education or higher were seventy-six percent protected from developing anaemia when pregnant as compared to the other levels. However, occupation, marital status, age, income, and alcohol intake which were also assessed were not found to be significantly associated with anaemia during pregnancy (Stephen et al., 2018). In furtherance, an observational cross-sectional study among 748 pregnant women in Northeastern Ethiopia found out that pregnant women of rural dwellers, farmers in occupation, and those without formal education had a significant risk of low haemoglobin levels (Hailu et al., 2019).

Dzabeng and Adanu (2019) sampled 279 pregnant women from the Kintampo North Municipality of Ghana to determine the determinants of anaemia (defined as low HB level). It came out that the odds of developing low Hb among women with basic education was 1.96 times increased relative to women who had higher education. Also pregnant women who had no form of employment we twice more likely to develop anaemia as compared to employed women. (Dzabeng & Adanu, 2019). Wemakor, (2019) studied 400 pregnant women receiving ANC in the Tamale Teaching Hospital, Ghana to determine the prevalence of anaemia utilizing a classification of low Hb levels and discovered that religion practiced ($p = 0.009$) and household wealth index ($p = 0.043$), had a significant relationship with anaemia. Pregnant women who practiced Islam were more likely to experience low Hb than those who practiced other religions.

2.5 Obstetric factors associated with anaemia during pregnancy

Also as above, in the research among 384 pregnant women in Maringá, Brazil it was established that low Hb levels were associated with previous pregnancy number and gestational age

employment and marital status ($p < 0.05$) (Araújo et al., 2013). Mothers who carried more than three previous pregnancies were more prone to experiencing low Hb level than those that had less than three previous pregnancies. Similarly, teenage pregnant women recorded a significantly high incidence of low Hb in pregnancy than adult pregnant women (Araújo et al., 2013).

In 2018, a study to determine the factors that put pregnant women at risk of low Hb in two hospitals in the Moshi Municipality, Norway was carried out by Stephen et al. . Findings from this study suggested that women who attended prenatal clinic 4 or more times, during the pregnancy, had a lower chance of having anaemia (17.4%) as compared to those who attended only once (35.3%). Also, women who received drug (such as iron and folic acid) supplementation during pregnancy had lower chances (20.2%) than those who have not received any supplementation (29.5%). These associations were however not statistically significant. Some factors that were analysed were gravidity, number of deliveries, history of miscarriages, HIV status, and gestational age, but these were not statistically significant findings. (Stephen et al., 2018)

In addition, an analysis of secondary data of over 8,900 pregnant women from the Gynecology and Obstetrics Unit of an unnamed hospital in the capital city of Turkey established that gestational diabetes mellitus and pregnancy-induced hypertension were risk factors of low Hb levels in pregnancy (Özgen et al., 2020).

An institutional-based unmatched case-control study involving 111 cases and 222 controls in Durame Town, Ethiopia found out that the major determinant factors of low Hb levels in pregnancy were parasitic infection, previous heavy menstrual blood flow (Weldekidan et al., 2018).

Anlaakuu & Anto, (2017) in their study among 316 pregnant women attending ANC at the Sunyani Municipal Hospital also found that women who had malaria had a significantly low Hb as compared those who did not get malaria during the pregnancy. Those infected with malaria had 7.2 times higher risk of developing low Hb relative to the non-infected. In this same study, it was revealed that presenting for the first prenatal visit in the second and third trimesters had a significant association with low Hb as compared to attending the initial visit earlier in the pregnancy. (Anlaakuu & Anto, 2017)

Another study in Ghana, Effia Nkwanta Regional Hospital in the Western Region, showed that the women in their second trimester were twice more prone to experience low Hb during pregnancy than those in their first trimester (Ahenkorah et al., 2020). The study also established that women in their third semester were three times more likely to experience anaemia during pregnancy than women in their first semester (Ahenkorah et al., 2020).

2.6 Intermittent preventive treatment and insecticide-treated nets

Malaria is a serious public health problem in poor countries. Ghana is not spared from malaria either. The effect of malaria is severe among pregnant women. Malaria in pregnancy makes uncertain and increases the adverse outcomes of the pregnancy. Malaria increases the risk of maternal complications such as respiratory diseases and anaemia in pregnancy, and eventual maternal death. Malaria is a major determinant of neonatal death in Ghana. In addition, malaria can lead to low birth weight and brain defects. The burden of malaria in pregnancy in Ghana is high. In Ghana, about 15% of all malaria cases are found in pregnant women (Boateng et al., 2018). This has led the country to adopt certain measures to reduce malaria in pregnancy. In the early parts of the 21st century, Ghana adopted the World Health Organisation's malaria prevention strategy during pregnancy. According to this strategy, a pregnant woman is given

weekly medical prophylaxis of either chloroquine or sulfadoxine-pyrimethamine (SP). Over time, resistance to chloroquine grew. As such, the World Health Organisation recommended that countries avoid the use of chloroquine as a preventive measure against malaria in pregnancy.

SP remains an efficient choice for intermittent preventive therapy in pregnancy (IPT). In Ghana, IPT has been integrated into the antenatal care system. Under the practice, SP is prescribed for pregnant women once a month from the 16th week of the pregnancy (Ako et al., 2020). Insecticide-treated mosquito nets, also known as long-lasting insecticide nets are given, free of charge, to all pregnant women in Ghana (Ako et al., 2020). This policy is part of the National Malaria Control and Prevention Programme. The distribution of insecticide-treated mosquito nets is considered a cornerstone of the malaria prevention programme because available evidence shows that sleeping under these nets could reduce the transmission of malaria by as much as 90% (Manu et al., 2017). The distribution is typically carried out at the antenatal clinics of the various health facilities (Ako et al., 2020). Formerly, the distribution used to be done through a voucher system. In 2010, a nationwide mass distribution exercise was carried out (Manu et al., 2017). Since then, the distribution has been done mainly through the antennal clinics.

2.7 The compliance of pregnant women to iron supplementation, Malaria prophylaxis in pregnancy and insecticide-treated bed nets

In the southern part of Tanzania, it was revealed that the proportion of women who took no SP, one course of SP and two courses of SP was 16%, 54% and 34% respectively. (Ayubu & Kidima, 2017). The pregnant women who were sampled were 36 to 40 weeks pregnant so it was expected that the least number of doses that each of them should have taken was two. As such, the general compliance with IPT was average (Ayubu & Kidima, 2017). Higher compliance was observed in a suburb of Malawi. According to the findings of a study in the Zomba district of

Malawi 70.2% of the pregnant women sampled had received two doses of SP, and 29.8% had received three doses (Azizi et al., 2018). Overall, every pregnant woman had at least a single dose of the IPT treatment (Azizi et al., 2018).

In a research to determine compliance of pregnant women to IPT in the Ekiti State, Nigeria, it was discovered that only about 27.3% of the pregnant women had taken at least one dose of ITP during their pregnancy (Akinleye et al., 2009). Among those who indicated that they had taken at least one dose of ITP, only took the medication at a clinic (Akinleye et al., 2009). This amounted to poor compliance with IPT.

In terms of iron supplementation, overall compliance among women who were pregnant in the Surat municipal corporation area, India, was found to be 67.2% (Dutta et al., 2014). In Africa, a systematic review on the compliance of pregnant women showed that the overall compliance to iron supplementation during pregnancy was 28.7%, ranging from 1.4% in Burundi to 73.0% in Senegal (Ba et al., 2019). Also, Fite et al., (2021) in a systematic review concluded that the overall compliance to iron supplementation was 39.2%.

In the northwestern part of Ethiopia, a research showed that 55.3% of pregnant women complied with iron supplementation (Birhanu et al., 2018a). However, the study did not state which of the frequency with which the pregnant women took the iron supplementation (Birhanu et al., 2018a). Also in the Tigray area of Ethiopia, a one-year retrospective review of ANC data showed that compliance to iron augmentation was 35.4% (Gebremedhin et al., 2014).

Findings from the maternity unit of a health facility in the capital city of Cameroon showed that out of the 304 samples that were recruited, the percentage compliance levels were 16.4%, 27.6%

and 56% for high, moderate and low compliance respectively with respect to iron supplementation during pregnancy (Fouelifack et al., 2019).

Concerning compliance to the use of long-lasting nets, a study in Uganda showed that 35% of pregnant women utilised the nets (Obol et al., 2013). In Jinja, another Ugandan town, the utilization of ITNs by women at any stage during their pregnancy was 78% (Weiss et al., 2012). Lower utilization of ITNs was observed in Kinshasa, DRC. Findings suggested that only 25% of women carrying pregnancy had slept under the ITNs the previous night (Pettifor et al., 2009). A study in the Nkoranza North District of Ghana showed that only about one-fifth of pregnant women regularly slept under the ITNs (Manu et al., 2017).

CHAPTER THREE

3.0 METHODS

3.1 Study design

A quantitative cross-sectional study was conducted at the Ngleshie Amanfro Polyclinic among women attending antenatal clinic. The study was conducted from the 14th of October to the 23rd of November 2021. Using structured questionnaires, quantitative data were collected, and secondary data were gathered from ANC records. The questionnaire obtained information including the socio-demographic, obstetric characteristics, medication adherence, compliance to IPT, and usage of insecticide-treated bed nets. Information will be obtained once from each respondent during the study period.

3.2 Study Location

The study was conducted at the Ngleshie Amanfro Polyclinic. Ngleshie Amanfro Polyclinic is located in the Greater Accra Region, at Ngleshie Amanfro and operates under the Ga South Municipality. It can be located on the Accra – Winneba Highway on the right side of the road adjacent to the Police Station. The Polyclinic Shares boundaries with Domeabra in the North with Tuba in the South, Kasoa in the East, and Machigani in the West. The Polyclinic was formerly a health Centre established in November 1996 by an NGO called Entrelle International with Dr. Addo Aryee as the Director with support from Dr. Laryee. The NGO handed over the Clinic to the Ghana Health Service in 2001 with a staff of 5 persons. The facility was upgraded to a polyclinic in 2018 and provides health services for the Amanfro community with a population of more than 115, 710 and its environs.

The polyclinic shares a boundary with Central Region, it routinely records an overwhelming influx of patients, thus putting huge pressure on the hospital. The facility offers services such as OPD, detention, ANC, pharmacy, laboratory, maternity, RCH, ENT, ophthalmology, and community psychiatry. With 120 trained nurses, one doctor, and ten physician assistants, the center has about 20 beds and about 70 patients averagely attending OPD in a single day. The facility employs 20 midwives. Administration of IPT and education, along with palpation and monitoring of the fetal heartbeat, are among the maternity services provided.

3.3 Study population

The study's population involved all pregnant women who are receiving antenatal care at the Ngleshie Amanfro Polyclinic.

3.4 Variables

The main dependent variable was the Hb at current visit.

Table 0.1: Table of variables

Variables	Definition	Type of variables	Scale of measurement
Hb at the current visit	Hb level of pregnant women at time of interview	Dependent	Continuous
Hb at the first visit	Hb level of pregnant women at the time of first visit recorded in the ANC book.	Independents	Continuous
Age of Participant	Age in years of pregnant women at the time of interview.	Independent	Continuous
Educational level	The educational status mentioned during the interview	Independent	Categorical
Marital status	Refers to the marital status of the pregnant woman	Independent	Categorical

Place of residence	Where the woman stays	Independent	Categorical
Religion	Refers to the religious body the woman belongs to	Independent	Categorical
Occupation	The employment status of the pregnant woman	Independent	Categorical
Number of ANC visits	How many visits the woman has had at the time of the interview	Independent	Continuous
Gestational age at the first visit	Gestational age in weeks at the first ANC visit recorded in the ANC book	Independent	Continuous
Gestational age at the current visit	Gestational age in weeks of pregnancy at the time of interview	Independent	Continuous
Parity	The number of children the woman has	Independent	Continuous
Iron supplementation	Whether a pregnant woman takes iron containing drugs or not	Independent	Categorical
Bed net usage	Refers to whether a pregnant woman sleeps under a treated bed net	Independent	Categorical

3.5 Sample size

This study of anaemia among pregnant women attending antenatal clinic at Ngleshie Amanfro polyclinic appeared to be the first study in the polyclinic and the Ga South district. The sample size was therefore calculated from the prevalence of anaemia in pregnancy in the Greater Accra of 51.0%. (Acheampong et al., 2018)

The sample size for this study was calculated using the formula below:

$$n = \frac{Z^2\ P\ (1 - P)}{d^2}$$

Where:

n = sample size

Z = the z-score corresponding with 95% confidence interval(1.96)

P = the proportion of women from literature with anaemia that is 51% = 0.51

d = precision (that is 5%) =0.05

$$=\frac{1.96^2\ x\ 0.51(1-0.51)}{0.05^2}$$

$$=\frac{0.96002}{0.0025}$$

= 384.008 ~ 385

To cater for non-response and/or incomplete questionnaires, the sample size was increased by 20% = 0.2 x 385 = 77. Giving the final sample to be 77+385 = 462

Therefore, 462 pregnant women were sampled from the NAPC for the study.

3.6 Inclusion and exclusion criteria

The inclusion criteria set the standard that members in the study population must meet before participating in the study, and the exclusion criteria determined the characteristics that if members of the study population possessed that would make them ineligible to participate in the study.

3.6.1 Inclusion criteria

Only pregnant women attending antenatal clinic at the Ngleshie Amanfro Polyclinic were to be included in this study. In addition, a pregnant woman must be at least 18 years old, and she must consent to participate in the study.

3.6.2 Exclusion criteria

Pregnant women who were attending the antenatal clinic of the Ngleshie Amanfro Polyclinic for the first time as of the time of the data collection will not be included. Also, any pregnant woman who reported to the Ngleshie Amanfro Polyclinic in the capacity of a caregiver of another pregnant woman was excluded. In addition, pregnant women who were experiencing medical or obstetric emergencies, as well as received blood transfusion in the past 2 weeks were excluded.

3.7 Data sources

This study employed the use of both primary and secondary data. The primary data was compiled using a structured questionnaire and the secondary data using a structured data retrieval sheet. The primary data was collected by administering the questionnaire to the participants, and the secondary data by capturing information from the ANC attendance register, and the ANC booklet of the participants after the consent of the participant was sought. The secondary data that was collected included Hb at the first visit, Hb at the current visit, number of ANC visits, gestational age at the first visit, SP use, and number of SPs taken. The Hb at the first visit and the

current visit was recorded from the paticipants ANC books after their routine check at the lab. This study did not include taking blood samples or running laboratory analysis. Similarly, the number of ANC visits, gestational age at the first visit, SP use, and number of SPs taken were recorded by the ANC healthcare staff.

3.8 Data collection technique

Data were gathered from 462 participants. The leadership of the facility was informed with an introductory letter and the GHS Ethics Review Board approval letter, to seek permission for data collection. Afterwards, research assistants were allocated to various days from Monday to Friday being the ANC days to collect data. Every day, 20 participants were randomly picked from about 60 prenatal clients, with a 5-sampling interval. Out of the first 5 clients who reported to the ANC and submitted their hospital ID cards to the nurses on duty, the first participant was randomly selected. Each day pieces of paper were cut into 5 and put into a clear container then a nurse was then selected randomly to pick one paper from the bowl. The midwives were then asked to direct the 5th attendant who came from their consultation to a designated consulting room at the Antenatal care unit for the interview. The questionnaire was administered to the participants after they had received antenatal care and cleared by their midwives to return to their various destinations. This was to prevent obstruction and interference with the prime reason for which the participants reported to the facility. Participants who refused to continue with the study had the next individual replacing them. This step was continued until the requisite sample was gotten.

Three research assistants were instrumental in the data collection. The research assistants were recruited based on the recommendation of other researchers who used the services of the research assistants. This was to ensure that only research assistants with the relevant experience are deployed. In addition, the research assistants were trained on data collection by the principal

investigator and the supervisor. Key components of the training process involved consenting, minimizing errors during data collection, and complying with ethical issues in research.

3.9 Data collection tool

The information from the respondents in this study was gathered using a standardized questionnaire. The questions were grouped into four main parts. The first part sought to collect information on the respondents' socio-demographic characteristics. The socio-demographic information included age, educational level, employment status, marital status, and religion.

The second aspect of the questionnaire was based on iron supplementation and compliance. This was done using the standardized 8 items Morisky Medication Adherence Scale (MMAS). The MMAS was first designed by Dr Morisky and colleagues in 1968. The first version of the MMAS was a four-item questionnaire (Cuevas and Peñate, 2015). In 2006, four more items were added to the tool. As such, the current MMAS has eight items. The MMAS is in the form of a structured questionnaire. It measures behavioural aspects of medication or drug-taking (Dutta et al., 2014). One of the key advantages of the MMAS is its reliability and validity. It has been used in over 1,000 to study the compliance to various forms of medication or supplementations, and it has been adapted into 71 languages worldwide (Dutta et al., 2014). Another key advantage of the MMAS lies in its ease of administration and understanding. The responses to question one to seven are either "Yes" or "No." However, unlike other yes/no questionnaires, the MMAS is known to have taken measures to avoid bias and reduce the mental pressure on the participants to select yes (Cuevas and Peñate, 2015). Question eight determines the frequency with which the participants take their medication

(Cuevas and Peñate, 2015). The results of the MMAS can be classified as poor, good, and high depending on the score that a participant obtained.

The third aspect of the questionnaire was on uptake of intermittent preventive therapy. This was done by asking the participants if they have ever taken SP during their pregnancy, and if yes, the stage at which they took it, and the number of doses they have taken.

The fourth aspect of the questionnaire asked questions on the use of ITNs. The questions were to determine whether the participants had ever used ITNs during their pregnancy and if yes, further questions were asked on the stage of the pregnancy at which the participants started using the ITNs, and if they slept under ITN the previous night before the day of the study.

3.10 Quality control

Pre-testing the data collection instrument to ensure that the findings were consistent was also done. This was carried out at the All faith health center in the same district.To assist with the data collection process, three research workers were trained. Ensuring that the process was carried out effectively, the researcher and these trained assistants collected data. The trial was fully disclosed to all participants. To limit the number of missing data, all completed questionnaires were cross-checked to ensure that they were complete. To reduce errors, double-entry data was performed, and data cleaning was performed.

3.11 Data processing and analysis

Collected data were entered into excel then imported into STATA (v.16) for coding and analysis. After entering the data, the data was cleaned. Firstly, the data was cleaned automatically by using features of STATA such as identifying outliers. Afterward, the data was cleaned manually by going through the entry one by one.

Descriptive statistics such as frequency, mean and standard deviation were used to analyse the demographic characteristics and the prevalence of anaemia during pregnancy. Hb was re-categorized into anaemia (Hb <11.0g/dl) and no anaemia (Hb ≥11.0g/dl) during the initial and current visits with their respective mean, standard deviation, and 95%CI stated. The proportion of women with anaemia on their first and current visits was also stated with their corresponding 95% confidence interval.

Inferential statistics in the form of chi-square or fisher analysis and binary logistic regression analysis were used to assess the association between the socio-demographic factors and anaemia in pregnancy, as well as the association between the obstetric factors and anaemia in pregnancy. The analysis took the nature of a two-step analysis. Firstly, the chi-square analysis was performed to determine significance of the socio-demographic and obstetric factors examined and the prevalence of anaemia. Afterward a binary logistic regression analysis was performed between these factors and the prevalence of anaemia in pregnancy. Significance was determined at a 95% confidence interval. The results were summarized into tables and piecharts.

The data processing and analysis also included addressing missing data. Generally, there are two types of missing data: unit level and item level missing data (Fite et al., 2021). Unit level data pertains to the situation that the potential participant declines to participate in the study (Fite et al., 2021). In this case, the researcher will not count such participants as part of the sample. Rather, the researcher will recruit other participants to replace any participant who declines to take part in the study. Item level missing data is when a potential participant accepts to take part in the study, however, the participant declines to answer certain questions during the administration of the questionnaire (Fite et al., 2021). Such questionnaires are considered

incomplete questionnaires. As such, they will be excluded from the data analysis. This exclusion is not, however, expected to affect the results of the study. Prior research has shown that studies of this nature have a non-response rate of 5% to 20 % (Araújo et al., 2013). During the sample size calculation, a non-response rate of 20% was added to compensate for any such pitfalls. Thus, in this study, out of a total of 460 questionnaires that were returned, 48 of them had missing data at the item level and 10 of them not filled at all. These questionnaires were dropped. Consequently bringing the total number of questionnaires analyzed to be 402.

3.12 Ethical considerations

This research work was ethically cleared by the Ethical Review Committee of the Ghana Health Service (Protocol ID: GHS-ERC 043/08/21). Also, an introductory letter was issued by the University of Ghana School of Public Health to the management of the Ngleshie Amanfro Polyclinic, seeking permission on behalf of the researcher for data collection. Permission was granted.

Respondents gave a written informed consent. The study's aims and objectives were fully disclosed to all participants who agreed to take part. Respondents were not obligated to reply to questions or participate in the survey if they did not want to. Respondents could also discontinue the study at any time and no face any sanctions even after they had consented. Opting out will not affect their future care at the facility. The procedure for conducting this research is not invasive. As such, it is not expected that there will be any risk posed to the participants by participating in this researcher. However, some of the questions may appear sensitive to the participants. Participants will receive no immediate gains for taking part in this research.

However, results of this study will be used in influencing programs to lessen anemia in pregnant women., and improve compliance with IPT, iron supplementation, and use of ITNs.

CHAPTER FOUR

4.0 RESULTS

4.1 Socio-Demographic characteristics of Study participants

A total of four hundred and two (402) pregnant women aged 17 – 40years (mean 29.5 years and SD ± 5.7years) who accessed Antenatal Care at the Ngleshie Amanfro Polyclinic participated in the study. The majority, 125(31.0%) of the women were aged 27 - 31years. While 50(12.4%) of the women had no formal education,190(47.3%) had at least basic level education, 121(30.1%) had secondary education and 41(10.2%) had tertiary level education. Out of all the 402 participants, 305(75.9%) were employed, 212(52.7%) were married with 314(78.1%) living in a semi-urban area and 295(73.4%) being Christians (Table 4.1)

Table 0.1: Socio-demographic characteristics of study participants

Variable	Frequency (n=402)	Percentage
Age groups(years)		
17-21	22	5.5
22-26	107	26.5
27-31	125	31.0
32-36	82	20.3
37 and above	67	16.6
Educational level		
No Formal Education	50	12.4
Basic Education	190	47.3
Secondary Education	121	30.1
Tertiary and above	41	10.2
Marital Status		
Single	75	18.7
Married	212	52.7
Divorced	10	2.49
Widowed	5	1.24
Cohabiting	100	24.9
Residence		
Rural	12	3.0
Semi-urban	314	78.1
Urban	76	18.9
Religion		
Christianity	295	73.4
Islam	107	26.6
African traditional religion	-	
Others	-	
Employment		
Employed	305	75.9
Unemployed	97	24.1

4.2 Obstetric characteristics of study participants

The majority of the women, 237(58.8%) made the recommended minimum of four ANC visits and above. The average number of children per woman was approximately 2 (1.3 SD). 290(72%) of the women had less than three children whiles 113(28%) had three or more children. Most of the women 240(59.5%) made their first ANC visit in the second trimester and 163(40.4%) in the first trimester. Almost half 163(40.4%) of the women were anaemic at the time of their first visit with 240(59.5%) not being anaemic. 366(91.0%) of the women had taken SP in this current pregnancy with 321(87.5%) taking at least 1-3 times. 362(96.8%) were using ITN and 389(96.8%) were on iron supplementation (Table 4.2).

Table 0.2: Obstetric characteristics of study participants

Variable	Frequency (n=402)	Percentage
Number of ANC visits		
Less than 4 visits	166	41.2
4 or more visits	237	58.8
Parity		
Less than 3 children	290	72.0
3 or more children	113	28.0
Gestational age at the first visit		
First trimester	163	40.4
Second trimester	240	59.5
Use of SP		
Yes	366	91.0
No	36	9.0
Number of SP taken		
1-3 times	321	87.5
More than 3 times	46	12.5
Use of ITN		
Yes	362	90.1
No	40	9.9
Iron supplementation		
Yes	389	96.8
No	13	3.2
Hb at the first visit		
Anaemic	163	40.4
Not Anaemic	240	59.5

4.3 The prevalence of anaemia among antenatal attendants at Ngleshie Amanfro Polyclinic

Out of the 402 participants, 163(40.5%) had Hb less than 11.0g/dl at the time of their first visit whiles 240(59.6%) had Hb greater or equal to 11g/dl. Also, at the time of study 262(65.0%) had Hb less than 11g/dl with 141(35.0%) having Hb greater or equal to 11g/dl. The mean Hb (SD) at the time of the first visit was 11.4g/dl (0.06) (95%CI:11.2-11.5), as compared to the Hb at the time of the study which was 10.5g/dl(0.98) (95% CI:10.4-10.6). The range of Hb levels recorded was 8.0g/dl to 13.7g/dl at the first visit and 8.0g/dl to 13.0g/dl. (Table 4.3 and 4.4)

Table 0.3: Mean Hb levels of study participants at first and current visit

Variable	Mean (SD)g/dl	95% CI(g/dl)	Range(g/dl)
Hb at the first visit	11.4(0.06)	11.2-11.5	8-13.7
Hb at the current visit	10.5(0.98)	10.4-10.61	8-13

Table 0.4: Prevalence of Anaemia among study participants at the first and current visit

Variable	Proportion	95% CI
Prevalence of anaemia at first the visit	40.4%	35.6%-45.4%
Prevalence of anaemia at the current visit	65.0%	60.1%-69.7%

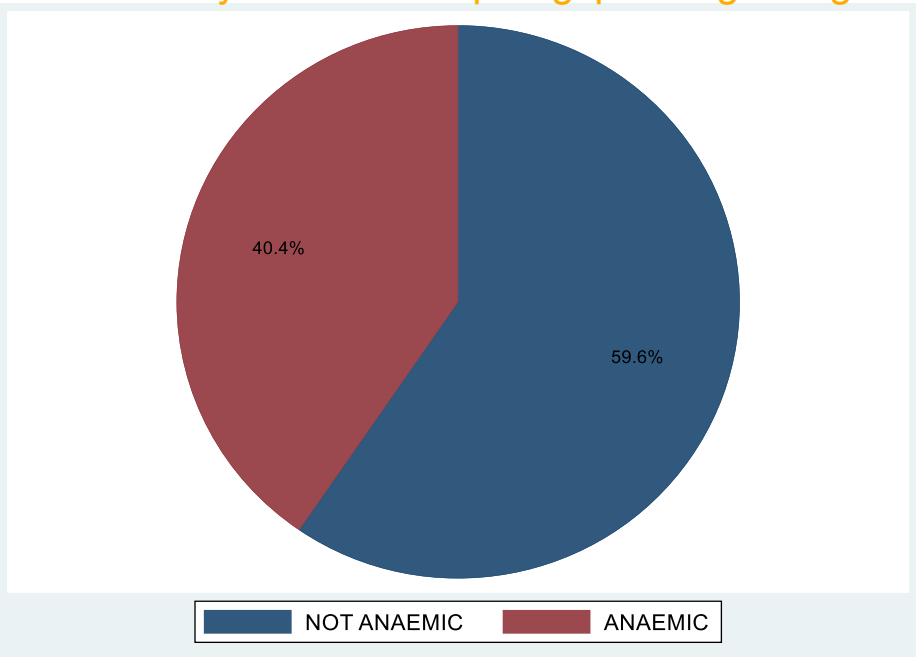

Figure 0.1: Proportion of women who were anaemic during their first visit

Figure 0.2: Proportion of women who were anaemic during their current visit

4.4 Bivariate analysis of anaemia status among pregnant women

The Pearson Chi-square test was used to carry out bivariate analysis between socio-demographic and obstetric factors and the association with maternal anaemia. This test was used to determine whether there was a statistically significant association between factors examined and developing anaemia. The analysis was in two sub-sets. The first subset was the association between socio-demographic factors of the women and anaemia in pregnancy. The second subset was the association between obstetric factors and anaemia in pregnancy. Tables 5 and 6 display the bivariate analysis of the socio-demographic and obstetric factors associated with anaemia.

4.4.1 The socio-demographic factors associated with anaemia in pregnancy

There was a significant association between the age groups of the participants and being anaemic (Chi2= 21.26, P<0.001) (Table 4.5). Eighty-three (31.7%) of the women between 27– 31 years, 70 (26.7%) between 22 – 26 years, 53(20.2%) 37 years and above, 38(14.5%) between 32-36 and 18(6.9%) between 17 - 21 years, had anaemia.

There was also a significant association between the educational levels of the participants and being anaemic (Chi2=33.28, p<0.001). One Hundred and thirty-six (51.9%) of the women who had basic education, 66 (25.2%) women who had secondary education, 44 (16.8%) women who had no formal education and 16 (6.1%) women who had tertiary education and above, had anaemia.

The marital status of the participants was also significantly associated with anaemia (Chi2= 15.97, p=0.003). One hundred and thirty-one (50.0%) were married, 80 (30.5%) were cohabiting, 40 (15.3%) were single with 7 (2.7%) divorced and 4 (1.5%) widowed. There was, however, no significant association found between the residence, religion and employment levels of participants and being anaemic (Table 4.5).

Table 0.5: Bivariate analysis of socio-demographic factors associated with anaemia

Factors	Anaemic N(%)	Not Anaemic N(%)	Chi2*	P-value
Age groups(years)				
17-21	18(6.9)	4(2.8)		
22-26	70(26.7)	37(26.2)		
27-31	**83(31.7)**	42(29.8)	21.26	**<0.001***
32-36	38(14.5)	44(31.2)		
37 and above	53(20.2)	14(9.9)		
Educational level				
No Formal Education	44(16.8)	6(4.3)		
Basic Education	**136(51.9)**	54(38.6)	33.28	**<0.001***
Secondary	66(25.2)	55(39.3)		
Education	16(6.1)	25(17.9)		
Tertiary and above				
Marital Status				
Single	40(15.3)	35(25.0)		
Married	**131(50.0)**	81(57.9)	15.97	**0.003***
Divorced	7(2.7)	3(2.1)		
Widowed	4(1.5)	1(0.7)		
Cohabiting	80(30.5)	20(14.3)		
Residence				
Rural	10(3.8)	2(1.4)		
Semi-urban	201(76.7)	113(80.7)	2.0549	0.358
Urban	51(19.5)	25(17.9)		
Religion				
Christianity	186(71.0)	109(77.9)		
Islam	76(29.0)	31(22.1)	2.2014	0.138
African traditional religion	-	-		
Others	-	-		
Employment				
Employed	203(77.5)	102(72.9)	1.0656	0.302
Unemployed	59(24.1)	38(27.1)		

*Chi2= Pearson chi-square used to determine a significant association between socio-demographic factors and prevalence of anaemia, P< 0.05 is significant

4.4.2 The obstetric factors associated with anaemia in pregnancy

Table 6 shows a significant association between the number of ANC visits and being anaemic (Chi 6.57, P=0.010) (Table 4.6). One hundred and forty-two (54.2%) of the participants who made at least 4 or more visits compared to 120 (45.8%) who made less than 4 visits had anaemia. No significant associations were found between parity, gestational age of the first visit, Hb at the first visit, use of SP, number of SP taken, use of ITN, iron supplementation and being anaemic (Table 4.6).

Table 0.6: Bivariate analysis of obstetric factors associated with anaemia

Factors	Anaemic N(%)	Not Anaemic N(%)	Chi2*	P-value
Number of ANC visits				
Less than 4 visits	120(45.8)	46(32.6)	6.57	**0.010***
4 or more visits	142(54.2)	95(67.4)		
Parity				
Less than 3 children	190(72.5)	100(70.9)	0.12	0.734
3 or more children	72(27.5)	41(29.1)		
Gestational age at the first visit				
First trimester	104(39.7)	59(41.8)	0.17	0.675
Second trimester	158(60.3)	82(58.2)		
Hb at the first visit				
Anaemic	108(41.2)	55(39.0)	0.19	0.666
Not Anaemic	154(58.8)	86(61.0)		
Use of SP				
Yes	242(92.4)	124(88.6)	1.61	0.204
No	20(7.6)	16(11.4)		
Number of SP taken				
1-3 times	215(88.8)	106(84.8)	1.23	0.268
More than 3 times	27(11.2)	19(15.2)		
Use of ITN				
Yes	234(89.3)	128(91.4)	0.45	0.500
No	28(10.7)	12(8.6)		
Iron supplementation				
Yes	254(96.9)	135(96.4)	0.08	0.780
No	8(3.0)	5(3.6)		

* Chi2= Pearson chi-square used to determine a significant association between obstetric factors and prevalence of anaemia , P< 0.05 is significant

4.5 Binary logistic analysis of factors associated with anaemia among pregnant women

The logistic analysis of the factors associated with anaemia among pregnant women was determined. Socio-demographic factors that were associated with anaemia, as well as obstetric factors that were associated with anaemia in pregnancy, were examined. The crude (cOR) and adjusted (aOR) odds ratios were reported with their corresponding 95% CI, P-value, and P <0 .05 was significant.

4.5.1 Socio-demographic factors associated with anaemia in pregnancy

Table 4.7 summarizes the binary logistic analysis of socio-demographic factors associated with anaemia in pregnancy. Amongst the various age groups, the odds of being anaemic in the 32-36 group was significantly reduced by 86% as compared to the age group of 17-21, adjusting for educational level, marital status, residence, religion and employment (aOR=0.14, 95%CI=0.04-0.52, P<0.05).

The odds of being anaemic among women with basic education was significantly decreased by 66% (cOR=0.34, 95%CI=0.14-0.85, p=0.021) and that of women who had secondary education and tertiary education were significantly reduced by 84% and 95% respectively (aOR=0.16, 95%CI=0.06-0.43, P<0.001) and (aOR=0.05, 95%CI=0.02-0.16, P<0.001) respectively, as compared to mothers with no formal education, (adjusting for educational level, marital status, residence, religion and employment).

The odds of being anaemic among women who were married and women who were cohabiting was approximately 2 times and 3.5 times respectively, and the odds of developing anaemia among single women. These relationships were statistically significant (aOR=1.99, 95%CI=1.08-3.65, P=0.027) and (aOR=3.55, 95%CI=1.71-7.36, P=0.001) respectively (adjusting for educational level, marital status, residence, religion and employment). (Table 4.7).

Table 0.7: Socio-demographic factors associated with anaemia in pregnancy

Variable	cOR(95%CI)	P-value	aOR(95%CI)	P-value
Age groups(years)				
17-21	1		1	
22-26	0.42(0.13-1.33)	0.141	0.31(0.09-1.11)	0.072
27-31	0.44(0.14-1.38)	0.159	0.52(0.15-1.81)	0.302
32-36	0.19(0.06-0.62)	**0.006***	0.14(0.04-0.52)	**0.003***
37 and above	0.84(0.24-2.89)	0.784	0.78(0.20-3.13)	0.731
Educational level				
No Formal Education	1		1	
Basic Education	0.34(0.14-0.85)	**0.021***	0.39(0.15-1.01)	0.052
Secondary Education	0.16(0.06-0.41)	**0.000***	0.16(0.06-0.43)	**0.000***
Tertiary and above	0.08(0.03-0.25)	**0.000***	0.05(0.02-0.16)	**0.000***
Marital Status				
Single	1		1	
Married	1.40(0.83-2.41)	0.200	1.99(1.08-3.65)	**0.027***
Divorced	2.00(0.49-8.50)	0.327	1.77(0.36-8.63)	0.479
Widowed	3.50(0.37-32.80)	0.273	6.92(0.64-74.59)	0.111
Cohabiting	3.50(1.79-6.82)	**0.000***	3.55(1.71-7.36)	**0.001***
Residence				
Rural	1		1	
Semi-urban	0.36(0.08-1.65)	0.187	0.44(0.08-2.40)	0.346
Urban	0.41(0.08-2.00)	0.270	0.60(0.10-3.57)	0.574
Religion				
Christianity	1		1	
Islam	1.44(0.89-2.32)	0.139	1.51(0.86-2.64)	0.148
African traditional religion	-		-	
Others	-		-	
Employment				
Unemployed	1		1	
Employed	1.28(0.80-2.06)	0.303	1.89(1.06-3.37)	0.332

* P< 0.05 is significant

4.5.2 Obstetric characteristics associated with Anaemia in pregnancy

The odds of developing anaemia among women who had 4 or more visits was significantly reduced by 51% as compared to women who had less than 4 visits, adjusting for parity, gestational age at first visit use of SP, use of ITN, and iron supplementation (aOR=0.49, 95%CI=0.30-0.78, P=0.003) (Table 4.8).

Table 0.8: Obstetric characteristics associated with Anaemia in pregnancy

Variable	cOR(95%CI)	P-value	aOR(95%CI)	P-value
Number of ANC visits				
Less than 4 visits	1		1	
4 or more visits	0.57(0.37-0.87)	**0.011***	0.49(0.30-0.78)	**0.003***
Parity				
Less than 3 children	1		1	
3 or more children	0.92(0.59-1.45)	0.734	0.93(0.57-1.53)	0.777
Gestational age of the first visit				
First trimester	1		1	
Second trimester	1.09(0.72-1.66)	0.675	1.27(0.81-2.00)	0.291
Use of SP				
No	1		1	
Yes	1.56(0.78-3.12)	0.207	1.34(0.56-3.55)	0.403
Number of SP taken				
1-3 times	1		1	
More than 3 times	0.70(0.37-1.31)	0.269	0.84(0.43-1.65)	0.622
Use of ITN				
No	1		1	
Yes	0.78(0.39-1.59)	0.500	0.89(0.43-1.87)	0.770
Iron supplementation				
No	1		1	
Yes	1.18(0.38-3.67)	0.780	0.92(0.27-3.17)	0.893

*P< 0.05 is significant

4.6 The proportion of pregnant women on iron supplementation

The proportion of women who adhered to iron implementation was assessed using eight questions. The first part of the analysis presents a table on the scores in each question. The second part of the analysis presents the overall adherence of pregnant women to iron supplementation. Twelve questions were asked on adherence to the iron supplementation, and the responses to each of the questions were recoded into numeric values. The highest score that an individual could get was 12 and the lowest was 1. As such, the classification of adherence to iron supplementation during pregnancy was as follows: low (1 to 7); medium (8 to 9); high (9 to 12). In addition, the self-reported use of iron supplementation in pregnancy was assessed.

4.6.1 Self-reported iron supplementation during pregnancy

The iron supplementation of the women on anaemia during pregnancy is presented in a bar chart below (Figure 4.3).

Figure 0.3: Iron supplementation among the pregnant women

Figure 4.3 shows that 13 (3.23%) of the women were not on iron supplementation during pregnancy and 389 (96.77%) were on iron supplementation during pregnancy.

4.6.2 Adherence to iron supplementation among women during pregnancy

The overall adherence to iron supplementation among the women was determined in three levels: low, medium, and high (Figure 4.4).

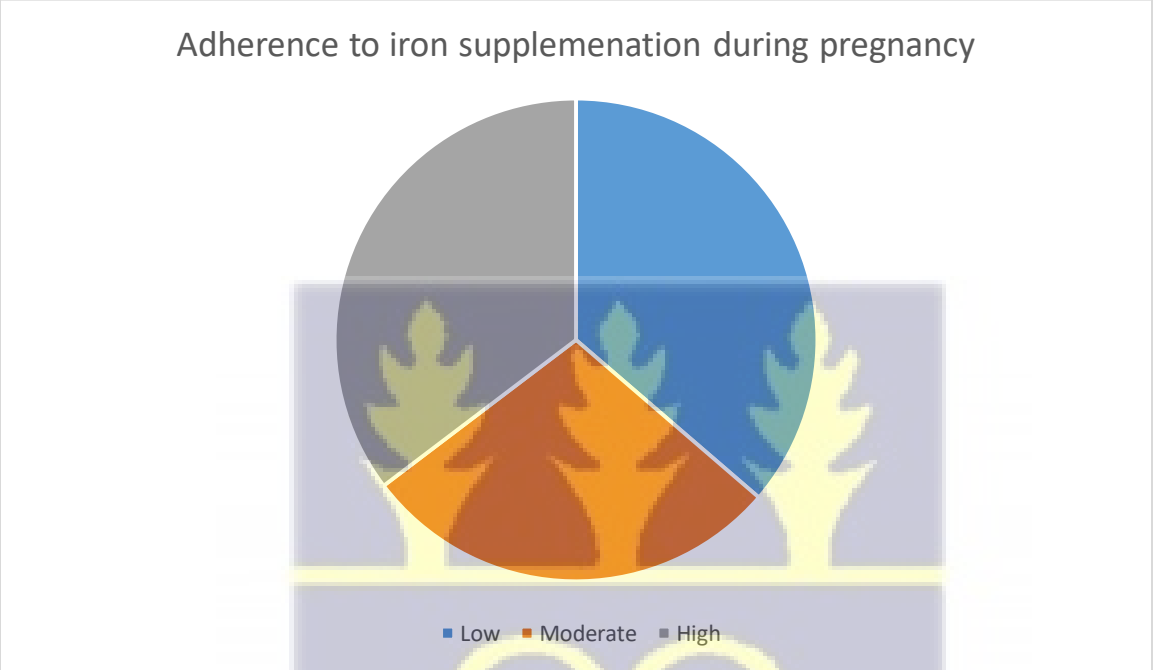

Figure 0.4: Level of adherence to iron supplementation

Most of the participants recorded low adherence to iron supplementation, followed by high adherence to iron supplementation, and moderate adherence to iron supplementation (Figure 4.0). One hundred and forty-six (36.32%) of the participants had low adherence to iron supplementation, 142 (35.32%) had high adherence, and 114 (28.36%) had moderate adherence (Figure 4.4).

CHAPTER FIVE

5.0 DISCUSSIONS

5.1 The prevalence of anaemia among the pregnant women attending antenatal clinic

The current study discovered that the prevalence of anaemia in pregnancy among the participants was 65.0%. This result represents one of the highest findings made on the prevalence of anaemia in pregnancy, not only in sub-Saharan Africa but also in low-and-middle-income countries. The available data showed the average prevalence of anaemia among pregnant women in developing countries to be 56% (Black et al., 2018). Specifically, the prevalence of anaemia in pregnancy in SSA was 57%; in Southeast Asia was 48%; and in South America was 48 % (WHO, 2018). The average prevalence in LMICs is far lower than the finding in this research. Clearly, the proportion of pregnant women with anaemia at Ngleshie Amanfro Polyclinic is higher as compared to similar socio-economic output regions in Ghana.

Other nation-specific studies make contradictory findings to the current study. Firstly, a study conducted to determine the prevalence of a town in Brazil reported the prevalence in pregnancy was 13% (Araújo et al., 2013). In the same vein, a cross-sectional study in Ethiopia revealed that the prevalence of anaemia in pregnancy was 10.6% compared to that of South Sudan, which was 53.0% (Adam et al., 2018). All these studies underscore the unusually high nature of the prevalence of anaemia that was discovered in the current study. Even in a conflict-raged country like South Sudan, the prevalence recorded was appreciably lesser than the prevalence in the current study. The health outcomes in conflict inflicted regions are typically worse than those in stable countries. As such, it comes as a surprise that the prevalence recorded in this study is higher than in South Sudan.

To gain insight into the potential reasons for the high prevalence that was identified in the current study, it may be useful to refer to previous Ghanaian studies to compare the prevalence of anaemia in such studies to the current study. If the available data recorded by prior Ghanaian studies show a higher prevalence of anaemia than that recorded elsewhere, then the findings of the current study are not so contradictorily after all. However, if the prevalence of anaemia in pregnancy in the current study is not consistent with other Ghanaian studies, then it could be that the study setting, Ngleshie Amanfro Polyclinic, has certain unique factors that account for the findings of the current study.

Three Ghanaian studies were referred to. The first was conducted by Wemakor (2019) who studied and found the prevalence of anaemia among pregnant women in the Tamale Teaching hospital to be 50.8%. Similarly, in the Sunyani Municipal Hospital in Ghana the proportion of women attending ANC with anaemia was revealed as 40.8% (Anlaakuu & Anto, 2017). Furthermore, a study conducted in the Adenta Municipal also revealed that 51% of women were anaemic. The prevalence of anaemia among pregnant women from the above studies and this current study is at the higher end of the global average. Thus, it may be fair to infer that the prevalence of anaemia in pregnancy in Ghana is typically higher than that of the global average.

However, the prevalence found in the current study remains higher than even the findings of the Ghanaian studies. The question of the potential reasons for the high prevalence of anaemia in the current study is still open. Theoretically, anaemia during pregnancy could be affected by several factors. These include health systems factors, individual maternal and family factors, and national and local economic factors (WHO, 2018). Each of these factors, except the individual maternal factors, are briefly interrogated. Two of the objectives in the current study examine the

influence of individual and maternal factors on anaemia in pregnancy, so, this aspect of the discussion would be left for the latter part of this research.

Health systems factors are those issues within the healthcare system that may increase the likelihood of anaemia in pregnancy (WHO, 2018). Chief among such issues is access to healthcare (WHO, 2018). Access could be financial or physical. However, in the current study access to healthcare was probably not an issue because the participants were sampled from a health facility and the cost of maternal healthcare is free under the National Health Insurance Scheme (Christmals & Aidam, 2020). The health systems factor that could influence anaemia in pregnancy is the health human resource. Even though it is not possible to make a direct link between the health human resource in the NAP and the findings on anaemia in pregnancy, it may be possible to make some sort of deductions based on the findings in the current study. Perhaps, there is a shortage of staff in the area. Also, it could be that the staff have a negative attitude towards pregnant women.

The other factor, the socioeconomic status of the country, also does little to explain the findings on the high prevalence of anaemia in the country. Ghana is relatively more developed than countries like South Sudan and Ethiopia where a lower prevalence of anaemia was discovered (World Bank, 2018). So, it could not have been that Ghana's socio-economic status influenced the higher prevalence of anaemia during pregnancy. Moreover, other Ghanaian studies showed a lower prevalence of anaemia during pregnancy. Those Ghanaian studies are within the same economic space as the participants of the current study.

Lastly the sample size and the duration of study can not be exempted for the determinants of the high prevalence of anaemia found in this study. In conclusion, the reasons for the high prevalence of anaemia that was discovered in the current study are open to interpretation. One

clear message is that anaemia in pregnancy is a pressing public health problem at NAP. The relevant authorities need to take urgent action to address the challenge.

Another puzzling finding in the current study was that the prevalence of anaemia in pregnancy, based on the Hb of the pregnant women at first ANC visit was 40.4%. This prevalence at the first visit is about 25% points lesser than the prevalence of anaemia at the current ANC visit. The prevalence at the first visit is consistent with studies from elsewhere (WHO, 2018). The World Health Organisation (2018) reported that the prevalence of anaemia at the first visit in LMICs is about 40%. This publication by the World Health Organisation is consistent with the findings of the current study. But no apparent reason appears to exist for the about 25% difference in the prevalence of anaemia in pregnancy at the first visit and current visit. The findings on the compliance of the women to iron supplementation in pregnancy might explain the disparity between the Hb level of the women at the first ANC visit and the Hb level of the women at the current ANC visit. This possible explanation would be discussed under the objectives on the adherence of women to iron supplementation.

5.2 The association between the socio-demographic characteristics of pregnant women and anaemia status

The outcome of this study showed a significant relationship between maternal age and anaemia in pregnancy. Pregnant women who were 32 to 36 years old were 86% less likely to develop anaemia during pregnancy than pregnant women who were 17 to 21 years old. This finding is supported by the report of Stephen et al., (2018) who found that younger pregnant women were more prone to anaemia in pregnancy than older women. Similarly, Dzabeng and Adanu (2019) also discovered that younger women are more likely to have anaemia in pregnancy than older women.

The association between age and anaemia in pregnancy could be due to physiological and social issues. On the physiological front, teenagers and younger women may not have the kind of resilient reproductive system that elderly people seem to have (Stephen et al., 2018). This may predispose the younger pregnant women to diseases that may end up serving as underlying causes of anaemia in pregnancy. On the social front, it could be that younger women are not capable of managing the stress that comes with pregnancy with aplomb as much as older women do (WHO, 2011). Invariably, this stress takes a toll on the activities of daily living of these young ones (Onyeneho & Subramanian, 2016). They may fail to comply with dietary and medical recommendations that would help them avoid the occurrence of anaemia in pregnancy.

In addition, this current study discovered that there was a statistically significant association between level of education and developing anaemia in pregnancy. Pregnant women who had secondary school education and beyond were over 80%, less likely to develop anaemia during pregnancy relative to women with no formal education. The general thought related to this finding is that higher education received by women made them less susceptible to having anaemia in pregnancy relative to women who received lower education. A proponent to this result was found in the study by Stephen et al., (2018) which showed that among 529 pregnant women sampled from two hospitals in the Moshi Municipality, Norway, the odds of developing anaemia among mothers with secondary education or higher, was significantly reduced by 76% compared to mothers with no or basic education. Similarly, the finding is also supported by the study of Dzabeng and Adanu (2019) which established that women with higher levels of education were less likely to have anaemia in pregnancy, in the Kintampo North Municipality of Ghana.

The significant relationship between educational status and anaemia in pregnancy could be explained by the influence of literacy on healthy behaviour and health-seeking behaviour. Literature has established that people who are educated can read and understand (Anlaakuu, 2015). This ability empowers them to seek information on their health and take measures to improve their health. In addition, educated people are more likely to draw a rational nexus between health information that was given to them and the importance of such information to their health and wellbeing (Anlaakuu, 2015). In the case of the findings in this study, the link between the education status and anaemia in pregnancy could be related to the tendency of educated women to actively seek information on maintaining good health and wellbeing during pregnancy. This might have resulted in the lower likelihood of women with higher education getting anaemia in pregnancy. Furthermore, higher educated women were more likely to engage in positive health-seeking behaviour (Carolyne, 2013). Thus, when they feel ill, they seek the appropriate healthcare which improves their overall health and wellbeing, including prevention of anaemia in pregnancy.

In furtherance, a study among Northeastern Ethiopian pregnant women found out that, among rural dwellers, farmers and women without formal education had a significant risk of low haemoglobin levels (Hailu et al., 2019). A suggested explanation to this outcome may be, the fact that counselling on the risks of pregnancy and health education given at ANC visits may not be apprehended well in such women. Women who also had secondary and tertiary education may also understand and adhere to health education given well.

Another finding in the current study was that employment had a significant relationship with anaemia in pregnancy. Other studies have made consistent findings with this outcome in the current study, regarding the link between employment status and developing anaemia. In a

Ghanaian study by Wemakor (2019), the findings showed a positive link between employment status and anaemia in pregnancy. Similarly, Stephen et al., (2018) found that employment status had a significant association with anaemia during pregnancy.

The findings on the association between employment status and anaemia in pregnancy could be explained by the theories relating to economic freedom and its impact on the health and wellbeing of women (Eghan, 2019; Acheampong et al., 2018; Adam et al., 2018). This school of thought attributes health and wellbeing among women to their economic capacity. The employment status of women gives to women such that they can meet their medical needs during pregnancy (Eghan, 2019; Acheampong et al., 2018; Adam et al., 2018). Employed women may not have to rely on third parties to meet their medical needs. Furthermore, employment comes with some level of autonomy for the mother to make determinations on her own health.

However, some other studies noted that employment does not have a significant association with anaemia in pregnancy (Adam et al., 2018; Kefiyalew & Eshetu, 2018). For the academicians who have discovered that employment status has a neutral effect on anaemia during pregnancy, they are of the view that certain social structures absorb any potential impact that employment status may have on the women's ability to afford healthcare (Adam et al., 2018; Kefiyalew & Eshetu, 2018). In the case of the current study, the free maternal health policy under the NHIS shields women from the primary cost associated with maternal care. Of course, accessory costs still need to be catered for by the women, but the main cost is taken up by the government. This may explain the neutral impact of economic status on maternal anaemia as observed in some studies in Ghana.

In the current study, however, no significant differences were found between the residence, religion, and anaemia in pregnancy. Literature reports contrary to this findings are discussed

below. In some studies, religion and residential status were identified to be significantly associated with anaemia in pregnancy. (Acheampong et al., 2018; Hailu et al., 2019; Wemakor, 2019). The findings in this set of studies are inconsistent with the findings in the current study. However, some previous studies support the findings in the current study (Kefiyalew & Eshetu, 2018; Stephen et al., 2018). The difference in the literature suggests that there is no universal finding on the association between religion, residence, and anaemia in pregnancy. As such, it is not beyond the bounds of logic to conclude that religion and residence have a flexible association with anaemia in pregnancy.

This flexible association between religion, residence and anaemia in pregnancy could be due to the manner in which each of these two socio-demographic variables have been shown to influence anaemia in pregnancy. Regarding religion, studies that have sound a significant association between religion and anaemia in pregnancy explained that certain religious practices account for anaemia in pregnancy. For instance, in some religions, seeking biomedical healthcare is proscribed. So, women who belong to such religions and are devout followers are likely to avoid qualified professional health advice on preventing anaemia in pregnancy. In the current study, it could be that the two main religions, Christianity and Islam, that the women belonged to do not preach against the use of biomedical healthcare. Also, it could be that the women are not devout followers. So even if these two religions happen to preach against the use of biomedical care, the women might have ignored such preaching and acted according to their leadings. Another explanation for the neutral effect of religion on the prevalence of anaemia could be related to the collaborative health promotion and education efforts between the health authorities in Ghana and religious bodies to promote healthy behaviours including the prevention of anaemia in pregnancy. Mosques and churches, over the years, have become settings for health

promotion and education in the country. This might have limited any effects of religious doctrines on the health-seeking behaviour of the women. By so doing, pregnant women take active measures to avoid anaemia in pregnancy regardless of their religious affiliations.

Pertaining to the finding on the association between residence and anaemia in pregnancy, it could be argued that residence is not a predictor of anaemia in pregnancy when there are robust primary healthcare systems. This way, pregnant women get access to affordable healthcare irrespective of their location. The common finding in the literature is for pregnant women in rural areas to be more likely to have anaemia in pregnancy than pregnant women in urban areas mainly due to the vast disparities in physical and financial access to healthcare. (Hailu et al., 2019). However, the disparities in both physical and financial access to healthcare in the current study have been mitigated by the relatively good primary healthcare structures in the setting of this study. As indicated above the NHIS policy in Ghana gives free maternal healthcare to pregnant women. This policy greatly reduces financial barriers to accessing healthcare. Also, the NAP is strategically located to ensure that pregnant women from rural and semi-urban areas have access to health. The combination of these two factors might have nullified the effect of residence on anaemia in pregnancy. This finding implies that improvement in primary healthcare can help policymakers to prevent anaemia in pregnancy.

5.3 The association between obstetric factors and anaemia status in Ngleshie Amanfro Polyclinic

This study established that the number of ANC visits significantly influences anaemia in pregnancy. It was found that women who made 4 visits or more, had a 51% decreased chance developing anaemia in comparison to women making below 4 ANC visits. This finding is consistent with the study of Stephen et al., (2018) who discovered that among a group of

Norwegian pregnant women who had more than four ANC visits were likely to record a low prevalence of anaemia.

There appears to be a straightforward explanation for this finding. The Ghana Health Service (2011) recommended that women should have at least four ANC visits during their pregnancy. This recommendation was made because at least four ANC visits give the pregnant sufficient time to cover the materials of the pregnancy school, a crucial component of the ANC practices. Thus, pregnant women who made 4 or more visits were more likely to be adherent to guidelines and protocols during pregnancy. The pregnancy school is one of the most engraved policies in the GHS and this may be an explanation for the improved anaemia status of women attending ANC. Furthermore, pregnant women who have had at least four ANC visits would have had the opportunity to be given medical care regarding any conditions that might have presented themselves during the pregnancy. These conditions include anaemia in pregnancy and its related diseases such as malaria.

In this study, however, some obstetric factors did not show a significant association with anaemia in pregnancy. The first of these obstetric factors that showed no significant association with anaemia in pregnancy was parity. In conformity with the outcomes of this study was the research by Stephen et al., (2018) who established that parity did not have a significant association with anaemia in pregnancy. The findings of the current study, supported by other studies in literature goes to support the increasing academic knowledge that parity does not have much of an influence on anaemia during pregnancy (WHO, 2018).

The inconsistent finding was presented by a study that showed that the number of children was significantly associated with maternal anaemia (Araújo et al., 2013). Perhaps, from a psychosocial point of view, women who have been pregnant and given birth multiple times are

more likely to know the measures that could be taken to prevent anaemia during pregnancy. This could explain the observation in Araujo et al., (2013) where women with a higher number of children were less likely to have anaemia in pregnancy than women with a smaller number of children. On the medical front, no peculiar explanation exists for the influence of parity on anaemia during pregnancy.

Similarly, gestational age at the first ANC visit did not show a statistically significant association with anaemia in pregnancy. In congruence, Stephen et al., (2018) also revealed that the stage of pregnancy in weeks attained by the pregnant woman at the first ANC visit was not significantly associated with anaemia in pregnancy. Contrary to both of the findings above, a study by Araújo et al., (2013) found that gestational age had a significant association with anaemia in pregnancy. The differences in the findings could be explained by the characteristics of the sample that were used in each of the respective studies. In this study, no pregnant woman reported for their first prenatal care visit in the third trimester while in the study of Araujo et al., (2013), about thirty percent of the pregnant women reported to the ANC in their third trimester. The authors in Araujo et al., (2013) then observed that women who first reported to the ANC in their last trimester were more prone to have anaemia in pregnancy than those who reported earlier. Perhaps, if some women in the current study had first reported to the ANC in their third trimester, the gestational age at the first ANC visit would have had a significant influence. The association between gestational age at the first ANC visit and developing anaemia in pregnancy was significant. This was attributed to the fact that women who first visit the ANC in their third trimester lack the comprehensive medical care and health education that is given to their peers who report to the ANC at earlier stages of their pregnancy (Araújo et al., 2013).

Also, Hb at the first visit had no significant association with developing anaemia in pregnancy. Researchers in Ethiopia who discovered that the Hb at the first prenatal visit was not significantly associated with anaemia in pregnancy confirms the finding of the current study (Weldekidan et al., 2018). The finding that Hb at the first visit was not significantly associated with anaemia in pregnancy could be explained by the vast difference between the mean value for Hb at the first visit and Hb at the current visit which was the prevalence of anaemia in pregnancy. In this study, the mean value for Hb at the first visit was 11.4 while the mean value for Hb at the current visit was 10.5. This big difference in the means is demonstrated in the prevalence of anaemia at the first visit and the prevalence at the current visit. The prevalence at the current visit was about 25% higher than the prevalence at the first visit. It could be that these vast disparities in the prevalence at the first ANC visit and current visit brought about no significant association between the Hb at the first visit and the prevalence of anaemia in pregnancy that was observed in the current study.

Furthermore, findings from this current study showed that there was no significant association between the use of SP and developing anaemia. To confirm the findings of the current study, Ahenkorah et al., (2020) observed that the use of SP in pregnancy was not significantly associated with anaemia during pregnancy among women in the Effia Nkwanta Regional Hospital in the Western Region of Ghana. Because the use of SP was not significantly associated with anaemia in pregnancy, it naturally followed that the number of SPs taken was not significantly associated with anaemia during pregnancy. The main reason why SP is taken in pregnancy is to serve as a prophylactic against anaemia by reducing the concentration of the plasmodium parasite in the placenta (WHO, 2018).

Effectively, SP is prescribed to pregnant women as a preventive measure against malaria in pregnancy. Malaria is regarded as an underlying factor of maternal anaemia. This made the finding that no significant association existed between SP use and developing anaemia in pregnancy is a curious one. Essentially, this finding implies that malaria as an underlying cause of anaemia is negligible. But on a second examination, this finding might make scientific sense. The analysis showed that 91% of the women who were sampled in the current study used SP during pregnancy. Presumably, the SP did its function of decreasing placental parasitemia and preventing malaria in pregnancy. Because almost all the women in the study were prevented from malaria, the effects of malaria in pregnancy which would have reflected in disparities in the prevalence of anaemia according to SP use was not present. The premises used in the above arguments are reasonable presumptions because the researcher did not collect actual data on the prevalence of malaria during pregnancy.

A contrary study by Anlaaku and Anto (2017) discovered that among pregnant women in the Sunyani Municipal Hospital, those who were not taking SP were more at risk of developing anaemia as compared to those who took SP during pregnancy. This, however, did not support the results of the current study. The primary difference between the study of Anlaaku and Anto (2017) and the current study is that in the current study, 91% of the women had taken SP whilst in the study of Anlaaku and Anto (2017) only about half of the pregnant women had taken SP. In addition, in the study of Anlaaku and Anto (2017), the authors confirmed that 46% of the pregnant had been infected by malaria during their pregnancy.

The underlying role of malaria in influencing anaemia in pregnancy might explain another finding in the current study. This finding is that the use of ITN did not have a significant effect on anaemia in pregnancy. Just like SP, ITN is also supposed to prevent malaria during pregnancy

except that ITNs work externally while SPs work at the cellular level. In furtherance, no statistically significant relationship was found between iron supplementation and developing anaemia during pregnancy. Similarly, the findings of this study can be related to the study by Stephen et al., (2018) which suggested that there was no significant association between iron supplementation practice and developing anaemia in pregnancy.

5.4 The proportion of pregnant women on iron supplementation in Ngleshie Amanfro Polyclinic

Findings of the current research on the proportion of women who were on iron supplementation showed that almost all the women were on iron supplementation. This finding is generally supported by the literature. A Tanzanian study showed that almost all the participants were on iron supplementation (Ayubu & Kidima, 2017). Similarly, it was discovered in Malawi that about 100% of the pregnant women who were sampled were on iron supplementation during pregnancy (Azizi et al., 2018). Likewise, a study in Nigeria showed that about 100% of the women who were sampled were on iron supplementation (Akinleye et al., 2009).

The above studies which endorse the outcomes of the current study seem to suggest that iron supplementation is a settled practice. Countries have come to recognize that iron supplementation is crucial to the prevention of the fatal incidence of anaemia during pregnancy (WHO, 2018). It is of little surprise that several different countries have rolled out iron supplementation in pregnancy. The response by the women shows that the coverage of iron supplementation, which was almost 100%, is positive. It is not enough, however, to offer iron supplements to pregnant women during their pregnancy. The women must adhere to the supplementation, but adherence to iron supplementation in the current study was poor.

Most of the participants recorded low adherence to iron supplementation, followed by high adherence to iron supplementation, and moderate adherence to iron supplementation. The findings showed that 36.32% of the participants had low adherence to iron supplementation, 35.32% had high adherence, and 28.36% had moderate adherence. These findings, coupled with the finding on the proportion of women who were on iron supplementation, showed that even though the healthcare workers at the polyclinic recommend iron supplements to the pregnant, only 35.32% of the women adhere to the iron prescription. A prescription is only efficacious to the extent that it is adhered to. As such, iron supplementation is meaningless if pregnant women do not adhere to it. It amounts to nothing if the women are given iron supplements, but they fail to adhere. This finding does not augur well for maternal health outcomes. As such, maternal health education and promotion in NAP must focus on improving iron supplementation compliance.

The lack of compliance to iron supplementation could explain the high prevalence of anaemia in pregnancy observed in the current study. One of the most effective strategies to mitigate low

Hb during pregnancy is through iron supplementation. As such, failure to adhere to iron supplementation likely increases anaemia in pregnancy.

5.5 Limitations of the study

This study is not without limitations. A major limitation to the study was that it was undertaken only at the Ngleshie Amanfro Polyclinic, so the results of the study may not be generalizable to other parts of the country. Secondly, about two-thirds of the women were interviewed during their second trimester and this could have affected the statistical analysis. Thirdly, the study failed to examine the health system factors that are linked with developing anaemia during

pregnancy. Lastly, this study adopted a cross-sectional design which cannot be used to establish causality between the socio-demographic factors, maternal and biological factors, and anaemia in pregnancy.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The prevalence of anaemia among the women at the antenatal clinic was 65.01% which represents one of the highest in sub-Saharan Africa and the world. The socio-demographic characteristics such as age, education level, and marital status were significantly associated with developing anaemia during pregnancy. However, there was no statistically significant relationship found between anaemia in pregnancy and residence, religion, and employment status. Regarding the obstetric factors, the study found that the number of ANC visits had a significant association with anaemia in pregnancy. Even though almost all the women reported that they were on iron supplementation, only 35.32% recorded high adherence to iron supplementation.

6.2 Recommendation

6.2.1 Ministry of Health/Ghana Health Service

i. Institute a working committee to understand the high prevalence of anaemia during pregnancy.

ii. Devise and implement policies specifically aimed at reducing anaemia during pregnancy among women.

iii. Define monitoring and evaluations mechanisms to ensure that the targets set in any policies on reducing anaemia during pregnancy are achieved.

iv. Sponsor health promotion and education efforts aimed at improving the compliance of pregnant women to iron supplementation during pregnancy.

6.2.2 Management of the Ngleshie Amanfro Polyclinic

i. Collaborate with the Ghana Health Service to ensure that strategic measures on reducing anaemia during pregnancy and improving iron supplementation are achieved.

ii. Draw up a special plan for ANC for single women and women who had secondary level of education.

iii. Draw up a special ANC protocol for women who first report to ANC in their first trimester and pregnant women who with more than two children.

6.2.3 Health workers

i. Health workers must endeavour to follow strategic plans that have been devised at both local and national levels towards preventing anaemia in pregnancy.

ii. Health workers must focus on the need for compliance to iron supplementation during ANC.

iii. Health workers must use devote special attention to women who are at an increased risk of anaemia during ANC visits.

6.3 Future research

The following are the recommendations for future studies:

i. Study on the health system variables related to the occurrence of anaemia during pregnancy in the polyclinic.

ii. A qualitative study of the barriers to iron supplementation compliance among women during pregnancy.

iii. Region-wide research on the prevalence of anaemia during pregnancy.

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APPENDICES

Appendix I: Participants information sheet

This information sheet is to inform you about the research for you to make an informed decision of whether to participate in the study or not. It also outlines the nature of the research, what the research involves, risks, benefits, and compensation.

Title of Study:

"Factors associated with anemia in pregnancy in women attending antenatal clinic at the Ngleshie Amanfro Polyclinic, a primary referral facility in the Ga South District of the Greater Accra Region."

Introduction:

The principal investigator (PI) is Isaac Kyerematengꓽ a Master of Public Health (MPH) student of the School of Public Health of the College of Health Sciences, University of Ghana. My email address is fascia42@gmail.com. My telephone number is 0207343431

Background and Purpose of Research:

Low haemoglobin during pregnancy is a serious public health problem particularly in developing countries. Low haemoglobin in pregnancy is a condition in which the number of red blood cells or their oxygen-carrying capacity is insufficient to meet the physiological needs of pregnant women. Anaemia in pregnancy is one of the key challenges toward promoting maternal and child health. For this reason, I am investigating the prevalence and factors associated with anaemia in pregnant women attending antenatal clinic at the Ngleshie Amanfro Polyclinic in the Ga South

District of the Greater Accra Region. It is expected that the results of this study is applied towards improving the maternal and child health issues.

Nature of Research:

The research is a cross-sectional study with a quantitative approach. I will ask you series of questions and will require that you genuinely tell me what you have experienced. An accurate response is necessary to understand the research topic. I will be administering a questionnaire to you to aid me analyze, present the results, and discuss appropriately. It will take about 30 minutes to administer the questionnaire. The polyclinic will not know of the information you provide, and your name will not be written on the transcribed information. There will be trained personnel to assist me in collecting the information so feel free to tell her anything you do not want to tell me.

PARTICIPANTS INVOLVEMENT

Duration/ what is involved:

A structured questionnaire would be used to elicit information from you, and secondary data would be extracted from their ANC books after the aim of the study has been explained to you and you are interested in participating. The questionnaire would be administered in the English Language for literate respondents and translated into Twi or Ga for non-English literate respondents.

Potential Risks:

The data collection process does not include any invasive procedure. However, you are at the risk of contracting Covid-19 under the current circumstances of the Covid-19 pandemic.

Therefore, the following interventions will be put in place to ensure your safety and the safety of the research team;

- The researcher and assistants will be in personal protective equipment that includes full gown, facemask, face shield, gloves and boot covers
- Participants will wash their hands with soap under running water as observed by the research assistants before receiving the questionnaire
- Participants will sanitize their hands with alcohol-based rubs after filling the questionnaires
- Social distancing will be maintained between the participants and the research assistants

In addition, you may find some of the questions as sensitive and intrusive.

Benefits:

There are no direct benefits to you by virtue of your participation in this research. However, the findings of this research may be used to reduce anaemia in pregnancy among other pregnant women.

Cost:

You will not incur any cost for taking part of the study except their time.

Compensation:

There would compensation due you for participating in the study.

Confidentiality:

To ensure your confidentiality, your name will not be collected during the data collection process. Instead, codes and numbers will be assigned to you. The information you provide will not be traceable to you. At no stage of the research would your name be revealed. The questionnaires would be kept under lock and key, with only the principal investigator having access to the data.

Voluntary participation/ withdrawal:

Participation in the study is voluntary and not compulsory. You have the right to decide whether you want to be part of the study. You may withdraw your consent at any stage of the study. If you withdraw your consent, I will immediately stop the administration of the questionnaire, and destroy any information I have collected in your presence. Your refusal to participate in this study will not affect the care you receive in this facility.

Outcome and feedback:

Findings of the study will be shared with the selected hospital which may improve health service delivery at the hospitals.

Feedback to participants:

A report would be presented to various stakeholders such as the Ministry of Health(MOH), Ghana Health Service, and GARH who formulate policies in antenatal care and its related issues. The report will be published in a journal.

Funding information:

This study is funded by the Principal Investigator.

Sharing of Participants Information/Data:

Participant information or data would be kept by principal investigator. Filled questionnaires would be kept under lock and key, with only the principal investigator having access. It would not be shared with anyone else.

Provision of Information and Consent for participants:

A copy of the information sheet and consent form will be given to you to sign or thumb-print before participation in the study

Who to Contact for Further Clarification/Questions:

For any clarifications or concerns concerning this research, please contact Isaac Kyeremateng at the Epidemiology Department, School of Public Health on telephone number 0207343431. You can also contact me by e-mail at fascia42@gmail.com. For further clarification on ethical issues kindly contact the Ghana Health Service Ethical Review Committee Administrator, Nana Abena Apatu on phone number 0503539896.

Appendix II: Consent form

STUDY TITLE: Factors associated with anemia in pregnancy among women attending antenatal clinic at the Ngleshie Amanfro Polyclinic in the Ga South District .

PART I: PARTICIPANTS' CONSENT FORM/ CERTIFICATE OF CONSENT

I acknowledge that I have read or have had the purpose and contents of the Participants' Information Sheet read and all questions satisfactorily explained to me in a language I understand (……). I fully understand the contents and any potential implications as well as my right to change my mind (i.e. withdraw from the research) even after I have signed this form.

I voluntarily agree to be part of this research.

_____	_____		_____	
Full name of participant	Signature	or	Thumbprint	Date

INTERPRETERS' STATEMENT

I interpreted the purpose and contents of the Participants' Information Sheet to the afore named participant to the best of my ability in the (……) language to his proper understanding.

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

Full name of participant Signature or Thumb print Date

Contact Details …….

DECLARATION BY WITNESS (IF PARTICIPANT CANNOT READ BY HIM/HERSELF)

I was present when the purpose and contents of the Participant Information Sheet was read and explained satisfactorily to the participant in the language he/she understood (……) language

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

Full name of participant Signature or Thumb print Date

RESEARCHERS SIGNATURE COLUMN

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this study have been explained to the above individual to the best of my ability. I confirm that the participant was given an opportunity to ask questions about the study, and all the

questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the consent has been given freely and voluntarily.

_____ _____ _____

Name of researcher Signature Date

Appendix III: Q**uestionnaire**

Question on the factors associated with anemia in pregnancy in women attending antenatal clinic at the Ngleshie Amanfro Polyclinic, a primary referral facility in the Ga South district of the Greater Accra Region.

Date: ____/____/2021

[1]	How old are you? (in years)	
[2]	What level your level of education	○ No formal education ○ Basic education ○ Secondary education ○ Tertiary education
[3]	Marital status	○ Married ○ Single ○ Divorced ○ Widowed ○ Cohabitating
[4]	Where do you live	○ Rural area ○ Semi-urban ○ Urban area
[5]	What is your religion?	○ Christianity ○ Islam ○ Africa Traditional Religion
[6]	What is your employment status	○ Employed ○ Unemployed

		○
MEDICATION ADHERENCE RATING SCALE		
[7]	Do you sometimes forget to take your iron supplementation?	○ Yes ○ No
[8]	People sometimes miss taking their iron supplementation for reasons other than forgetting. Thinking over the past 2 weeks, were there any days when you did not take your iron supplementation?	○ Yes ○ No
[9]	Have you ever cut back or stopped taking your iron supplementation without telling your doctor because you felt worse when you took it?	○ Yes ○ No
[10]	When you travel or leave home, do you sometimes forget to bring along your iron supplementation?	○ Yes ○ No
[11]	Did you take all your iron supplementation yesterday?	○ Yes ○ No
[12]	When you feel like your symptoms are under control, do you sometimes stop taking your iron supplementation?	○ Yes ○ No
[13]	Taking iron supplementation every day is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?	○ Yes ○ No
[14]	How often do you have difficulty remembering to take all your iron supplementation?	○ Never/rarely ○ Once in a while ○ Sometimes ○ Usually ○ All the time
COMPLIANCE TO INTERMITTENT PREVENTIVE THERAPY		
[15]	Have you ever taken sulfadoxine–pyrimethamine (SP) during your pregnancy? *(If, yes proceed to question 24, if not, skip the rest of the question 26)*	○ Yes ○ No ○ I don't remember
[16]	When was the first time that you took the sulfadoxine–pyrimethamine (SP)	○ First trimester ○ Second trimester ○ Third trimester

[17]	In total, how many doses of sulfadoxine–pyrimethamine (SP)	○ One ○ Two ○ Three ○ Four ○ Five
COMPLIANCE WITH THE USE OF INSECTICIDE TREATED NETS (ITN)		
[18]	Have ever slept under insecticide treat net during your pregnancy? *(If, yes proceed to question 27, if not, skip the rest of the questions)*	○ Yes ○ No ○ I don't remember
[19]	At what stage of the pregnancy did you start sleeping under ITN	○ First trimester ○ Second trimester ○ Third trimester
[20]	Did you sleep under ITN last night?	○ Yes ○ No ○ I don't remember

Appendix IV: Data extraction sheet

MATERNAL AND OBSTETRIC CHARACTERISTICS		
[21]	No. of ANC visit	
[22]	Hb at first visit	
[23]	Hb at current visit	
[24]	Gestational age at first visit	
[25]	Gestational age at current visit	
[26]	Parity (Number of Children)	
[27]	Use of iron supplementation	○ Yes ○ No

Appendix V: Ethical clearance letter

GHANA HEALTH SERVICE ETHICS REVIEW COMMITTEE

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

Research & Development Division
Ghana Health Service
P. O. Box MB 190
Accra
Digital Address: GA-050-3303
Mob: +233-50-3539896
Tel: +233-302-681109
Fax + 233-302-685424
Email: ethics.research@ghsmail.org

My Ref. GHS/RDD/ERC/Admin/App 121429
Your Ref. No.

11th October, 2021

Isaac Kyeremateng
University of Ghana
School of Public Health

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

GHS-ERC Number	**GHS-ERC 043/08/21**
Study Title	Factors associated with anemia in pregnancy in women attending antenatal clinic at the Ngleshie Amanfro Polyclinic, a primary referral facility in the Ga South district of the Greater Accra Region
Approval Date	11th October, 2021
Expiry Date	10th October, 2022
GHS-ERC Decision	**Approved**

This approval requires the following from the Principal Investigator

- Submission of a 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.

You are kindly advised to adhere to the national guidelines or protocols on the prevention of COVID -19

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

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

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

SIGNED.....
Dr. James Akazili
(Head, Ethics & Research Management Department)

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

Appendix VI: Introductory letter

UNIVERSITY OF GHANA
DEPARTMENT OF EPIDEMIOLOGY AND DISEASE CONTROL
SCHOOL OF PUBLIC HEALTH

23rd July 2021

THE MEDICAL DIRECTOR

NGLESHIE AMANFRO POLYCLINIC

GA SOUTH

ACCRA

Dear Madam,

INTRODUCTORY LETTER

I write to introduce to you **ISAAC KYEREMATENG, a Master of Public Health** a student in the Department of Epidemiology and Disease Control (EPDC), School of Public Health, College of Health Sciences, University of Ghana Legon.

He is conducting a research on the topic **"Factors associated with anemia in pregnancy in women attending antenatal clinic at the Ngleshie Amanfro Polyclinic, a primary referral facility in the Ga South district of the Greater Accra Region".**

I will be grateful if you can give him the necessary support to undertake his research work in your institution.

Counting on your cooperation.

Thank you.

Yours sincerely,

Dr Bismark Sarfo

(Head of Department)