SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

FACTORS ASSOCIATED WITH ANAEMIA IN PREGNANCY AMONG ANTENATAL CARE ATTENDANTS IN KETA MUNICIPALITY

BY

HOPE EDEM KOFI KORDORWU

10636959

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

JULY, 2018

DECLARATION

I, Hope Edem Kofi Kordorwu, Master of Public Health student at the Department of Epidemiology and Disease Control in the School of Public Health, University of Ghana, declares that this dissertation is the outcome of my independent work under the guidance of Dr. Bismark Sarfo (Head of Epidemiology and Diseases Control Department). All articles and relevant information used were duly acknowledged.

_____ ____ / ____ / 20___

Hope Edem Kofi Kordorwu Date

(Student)

_____ ____ / ____ / 20___

Dr. Bismark Sarfo Date

(Academic Supervisor)

DEDICATION

This dissertation is dedicated to my beloved wife, Mrs. Diana Dzifa Kordorwu and son, Sean Kekeli Kordorwu for their tolerance, support and prayers. I also dedicate this work to Staff and Management of Keta Municipal Hospital and Sacred Heart Hospital, Abor.

ACKNOWLEDGEMENT

I respectfully appreciate Almighty God for grace, strength and wisdom in writing out this dissertation. I appreciate Dr. Bismark Sarfo for his supervision as well as Dr. Richmond Nii Okai Aryeetey. I am grateful to Harriet Affran Bonful, PhD for guidance. My appreciation also goes to Keta Municipal Director of Health Services, Ms. Perfect Titiati, Management and Antenatal Staff of Keta Municipal Hospital and Sacred Heart Hospital, Abor. I am grateful to research assistants who helped in diverse ways. God richly bless you all.

ABSTRACT

Background: Globally, anaemia in pregnancy has been a public health challenge, especially in developing countries like Ghana. Ghana has achieved remarkable decline in the prevalence of anaemia in pregnancy from 70% in 2008 to 45% in 2014. However, anaemia in pregnancy remains a threat to maternal and foetal outcomes. To reduce the risk, indigenous factors associated with anaemia must be identified. Few studies were conducted in Ghana, but no study was carried out in Keta Municipality in the Volta Region on factors associated with anaemia in pregnancy.

Methods: Hospital-based cross-sectional study design was employed to determine the prevalence of anaemia in pregnancy and associated factors in Keta Municipality in the Volta region. Participants were pregnant women attending antenatal care at Keta Municipal Hospital and Sacred Heart Hospital between May and June, 2018. Pregnant women who consented to be part of the study, attended antenatal care for at least four times and were not haemotransfused four weeks prior to data collection were included in the study. Participants' haemoglobin level were assessed by qualified phlebotomists. Structured questionnaires were used to collect information on sociodemographic, obstetric and behavioural characteristics, as well as nutritional adequacy using a 24-hour recall. Maternal haemoglobin levels at first and current visit were retrieved from antenatal record booklets. Current haemoglobin level was used as outcome variable for this study. Multivariable logistic regression was performed to determine associations between current haemoglobin level and independent variables at 95% confidence interval. Independent variables with p-value less than 0.05 were considered statistically significant.

Results: A total of 426 pregnant women partook in the study. Out of 426 participants, 330/426 (77.5%) participants were anaemic (haemoglobin < 11 grams per deciliter). While 216/426 (50.7%) participants were moderately anaemic at first visit, 167/426 (39.2%) participants were moderately anaemic on day of interview (current visit). The median current haemoglobin level was 10.2 g/dl. Factors associated with anaemia in pregnancy were maternal age (AOR: 0.02, 95% CI: 0.00-0.53, $p < 0.05$), sickle cell status (AOR: 0.08, 95% CI: 0.02-0.44, $p < 0.05$), moderate anaemia at first visit (AOR: 5.1, 95% CI:1.19-21.74, $p < 0.05$), food taboos (AOR: 0.25, 95% CI: 0.06-0.96, $p < 0.05$) and mode of abortion (AOR: 4.58, CI: 1.14-18.46, $p < 0.05$).

Conclusion: The prevalence of anaemia in pregnancy in Keta Municipality was high. Participants' age, sickle cell status, moderate anaemia at first visit, food taboos and mode of abortion were significantly associated with anaemia in pregnancy.

TABLE OF CONTENTS

CONTENTS **PAGE**

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AIDS – Acquired Immune Deficiency Syndrome

AIP – Anaemia in Pregnancy

ANC – Antenatal Care

BMI – Body Mass Index

CHPS – Community-Based Health Planning and Services

CO_2 - Carbon Dioxide

Fe^{2+} - Ion in Ferrous State

G6PD - Glucose 6-Phosphate Dehydrogenase Deficiency

GDHS – Ghana Demographic and Health Survey

Hb – Haemoglobin

HIV – Human Immunodeficiency Virus

IPTp – Intermittent Preventive Treatment in Pregnancy

SP – Sulfadoxine Pyrimithamine

ITN – Insecticide Treated Nets

KMH – Keta Municipal Hospital

MMAS – Morisky medication Adherence Scale

MMDS- Minimum Dietary Diversity Score

NHIS – National Health Insurance Scheme

O_2 – Oxygen

PI – Principal Investigator

RBC – Red blood cell

RCOG - Royal College of Obstetrician and Gynaecologists

SHH – Sacred Heart Hospital, Abor

WHO – World Health Organisation

WRA - Women of Reproductive Age

UNIT OF MEASUREMENT

g/dl – grams per deciliter

DEFINITION OF TERMS

- Antenatal care registrants – Pregnant women who visit antenatal care clinic for the first time and are registered.
- Antenatal care attendants – Pregnant women who had first antenatal care and return for subsequent care.
- Current visit – Day of interview
- First visit – First time pregnant women report to antenatal clinic for antenatal care.
- Anaemia in pregnancy – Blood haemoglobin concentration below 11 grams per deciliter.
- Pregnant women screening questionnaire – Five-item questionnaire for identifying pregnant women who meet inclusion criteria for this study.

CHAPTER ONE

Introduction

1.1 Background

The occurrence of anaemia during pregnancy, referred to as anaemia in pregnancy (AIP) has been an important public health concern recognised internationally (Räisänen, Kancherla, Gissler, Kramer, & Heinonen, 2014). The World Health Organization (WHO) described anaemia as reduced (lower) blood haemoglobin (Hb) concentration or level in any individual (WHO, 2014). Anaemia affects people of all ages in all countries of the world, but it is more prevalent in poorer countries (WHO, 2013). Anaemia has extensive adverse health effects on all manner of people and can impede socioeconomic development of any country (WHO, 2014). Over 56 million women worldwide and over 80% of countries are affected by more than 20% prevalence of anaemia in pregnancy (AIP) (Goonewardene, Shehata, & Hamad, 2012). In 2011, worldwide prevalence of anaemia among women indicated that, half a billion women in their reproductive age were affected with anaemia, and pregnant women were more anaemic than non-pregnant women. It was reported that 38% (32.4 million) of pregnant women and 29% (496 million) of non-pregnant women aged 15 – 49 years were anaemic (WHO, 2014). Women in South-East Asia and Africa had higher burden of anaemia with estimated prevalence of 48.2% and 57.1% respectively than those in America and Europe whose prevalence were lower (24.1% and 25.1% respectively) (WHO, 2014).

In pregnancy, normal physiological changes give rise to increased plasma volume by 46-65% whereas red blood cell (RBC) volume increases by 18-25%. This heamodilution has been misconstrued as the pathophysiology of AIP (Munasinghe & Broek, 2006). Although

it is expected that healthy pregnant women would maintain an appreciable level of Hb throughout pregnancy, many pregnant women have reduced Hb concentration, RBC count, or packed-cell volume, resulting in poor oxygen supply to the body (Balarajan, Ramakrishnan, Özaltin, Shankar, & Subramanian, 2011). Some studies reported that the physiological heamodilution of pregnancy alone cannot explain decreased Hb concentration below 10 grams per decilitre (g/dl), thereby allowing a cut-off point for diagnosing AIP (Nwizu, Iliyasu, Ibrahim, & Galadanci, 2011). The WHO classifies Hb concentration less than 11 g/dl in the first half of pregnancy or 10.5 g/dl in the second half of pregnancy as AIP. AIP is also categorised into mild anaemia (Hb between 10.9 -10 g/dl), moderate anaemia (Hb between 9.9 - 7.0 g/dl) and severe anaemia (Hb < 7g/dl) (WHO, 2002).

The main causes of pregnancy anaemia identified by several studies include deficiencies from iron, folic acid, vitamin B12, C, A and protein in diets (WHO, 2013). Frequent breakdown of RBCs and anomalous Hb production due to malaria infections and genetic conditions such as glucose 6-phosphate dehydrogenase deficiency (G6PD) and sickle cell disease, were also identified (Balarajan et al., 2011; Goonewardene et al., 2012). Other causes of AIP include inadequate iron absorption and metabolism in pregnancy, antepartum haemorrhage and sexually transmitted infections (Okoh, Iyalla, Omunakwe, Iwo-Amah, & Nwabuko, 2016). Some chronic conditions also precipitate AIP. For instance, pregnant women who have human immune deficiency virus (HIV) infection, tuberculosis (TB) and malaria, have higher risk of developing AIP (Balarajan et al., 2011; Goonewardene et al., 2012). Studies conducted in Sub-Saharan Africa documented iron and folate deficiencies,

malaria and parasitic infections as the most common causes of anaemia in pregnant women (Gebre & Mulugeta, 2015; Nwizu et al., 2011). Additionally, multi-gravida, grand multi-parity, low socioeconomic status, low maternal body mass index, short inter-pregnancy interval (IPI), mothers' age before pregnancy, illiteracy, family size, cultural beliefs and practices, non-usage of insecticide treated nets (ITNs) as well as inadequate iron, folic acid and multivitamin intake during pregnancy are factors identified to be associated with AIP (Anlaakuu & Anto, 2017; Stephens, Ofori, Quakyi, Wilson, & Akanmori, 2014). The relative influence of each of the above mentioned causes varies significantly by place of residence, season, and nutritional preferences (Gebre & Mulugeta, 2015).

Pregnant women suffering from anaemia experience general fatigue, weakness and shortness of breath, as well as reduced physical and mental performance (WHO, 2015). Their foetus are at risk of foetal distress, preterm delivery and low birth weight (Nguyen et al., 2015; Nwizu et al., 2011; Sarin, Podder, Kumari, & Sujata, 2008). Expectant mothers with AIP experience decreased productivity due to high costs of increased morbidity and sometimes post-partum haemorrhage (Ahanhari, Myles, Dixit, Tata, & Fogarty, 2017; Satyam & Khushbu, 2015). Studies have shown that, pregnant women with severe anaemia have increased risk of maternal, perinatal and infant mortality (Nwizu et al., 2011). According to Lincetto, Mothebesoane-anoh, Gomez, and Munjanja (2013), 3 million neonatal mortalities occurred in 2013 as a result of AIP in developing countries.

In Ghana, studies have shown that about 50% of all anaemia cases were as a result of iron deficiency (Anlaakuu & Anto, 2017). However, interventions such as nutritional counselling in pregnancy, food fortification with iron, iron and folic acid supplementations,

malaria and helminths prophylactic treatment, exist to prevent and correct AIP (WHO, 2016). In the midst of these interventions, it is worth studying factors associated with high prevalence of AIP especially in developing countries, since factors may vary geologically. Knowledge acquired from these location specific studies are very relevant for effective control and prevention.

1.2 Problem Statement

The World Health Organisation stated that any country with 40% or higher prevalence of anaemia in vulnerable groups has severe public health problem (WHO, 2014). However, prevalence of anaemia in Ghana over the years was higher than the 40% (GSS, GHS, & ICF International, 2015). In 2011, Ghana was classified as a country with severe public health implication of anaemia since estimated prevalence were 56% (non-pregnant women) and 62% (pregnant women) (WHO, 2014). According to Ghana Demographic Health Survey (GDHS) report, the prevalence of anemia in pregnant women was 65% in 2003, 70% in 2008 and 45% in 2014. Meanwhile in the Volta region, it was reported that anaemia was prevalent among 49% of women aged 15 – 49 years (GSS et al., 2015). Health facility based information recorded by the District Health Information Management System in Ghana (DHIMS2) (2017), also revealed that, the proportion of women anaemic at 36 weeks gestation in the country over 3-year period were 26.8% (2014), 23.3% (2015) and 17.7% (2016). In the Volta region the proportion of those anaemic at 36 weeks gestation were 30.2% (2014), 24.4% (2015) and 25.7% (2016). On the contrary, hospitals in Keta Municipality in the Volta region recorded much higher proportion over the same 3-year period. The proportion of pregnant women anaemic at 36weeks gestation in the

municipality were 48.5% (2014), 54.2% (2015) and 47% (2016) (DHIMS2) (2017). Though interventions provided at antenatal care including, oral iron and folic acid supplementation, provision of insecticide treated nets (ITN), administration of intermittent preventive treatment with sulfadoxine pyrimithamine (IPTp-SP), prophylactic treatment of helminthiasis and nutritional counseling were shown to have reduced anaemia in pregnancy and improved the lives of expectant mothers over the years (WHO, 2016), there remain enormous consequences of anaemia in pregnancy. This study therefore sought to identify factors associated with anaemia in pregnancy in Keta Municipality.

1.3 Justification

Anaemia affected over 40% of pregnant women in Keta municipality over the past three years (DHIMS2) (2017). This high prevalence necessitated investigation into factors contributing to the occurrence of AIP in the municipality. This study provides adequate information on factors which will be used to fill gaps in knowledge on the prevalence of AIP in Keta municipality. The findings will also provide useful information to key stakeholders in maternal care that will guide health education and counselling programmes on improving maternal and neonatal health in the municipality and beyond.

1.4 Conceptual Framework

It was conceptualised that the outcome variable herein referred to as anaemia in pregnancy was directly affected by variables such as nutritional factors, obstetric factors and infectious diseases in pregnancy. Other associated variables included genetic factors, demographic, socioeconomic and sociocultural factors as well as behavioural factors.

Figure 1.1 below shows the relationship between these variables and the outcome variable.

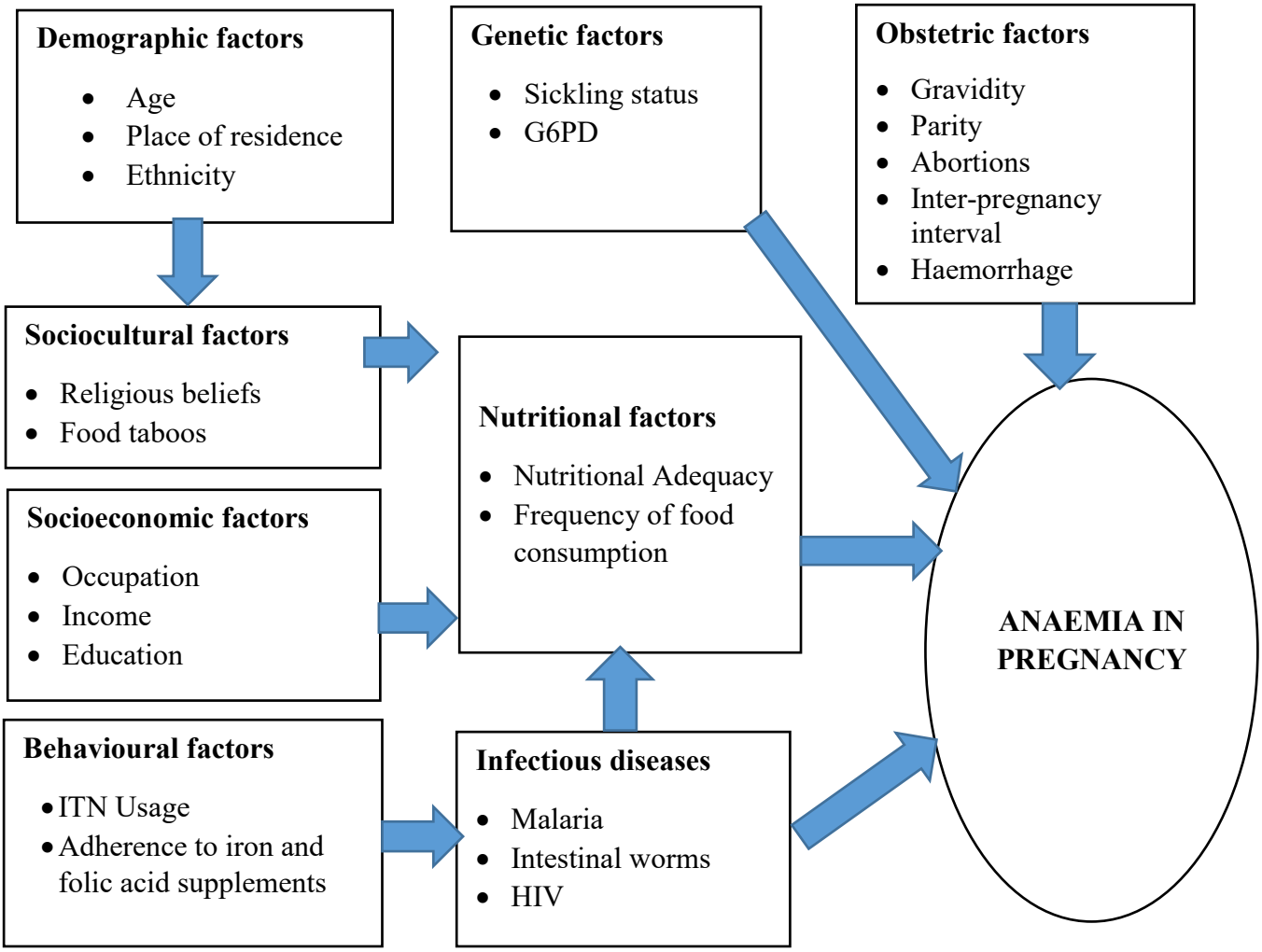

Figure 1.1: Conceptual Framework on Factors Associated with AIP

1.5 Research Questions

1. What is the burden of anaemia in pregnant women attending antenatal care in Keta Municipality?
2. What factors are associated with anaemia among pregnant women attending antenatal care in Keta Municipality?

1.6 General Objectives

To determine the factors associated with anaemia in pregnancy among women attending antenatal care in hospitals in Keta Municipality.

1.7 Specific Objectives

1. To determine the proportion of anaemia in pregnancy among antenatal care (ANC) attendants in Keta Municipality.
2. To identify factors contributing to anaemia in pregnancy amongst ANC attendants in Keta Municipality.

CHAPTER TWO

Literature Review

2.1 Defining Anaemia

Anaemia is described based on either haemoglobin (Hb) or haematocrit (Hct) concentration in an individual (Mackerras & Singh, 2007). Nonetheless WHO (2015) explains anaemia as a medical disorder in which the number and size of RBC, or the Hb concentration falls below an established threshold. In other words, if the oxygen carrying capacity of the blood is insufficient to meet physiologic needs in an individual, anaemia develops. In a study to provide clear-cut definition of anaemia, it was documented that pregnancy, altitude, cigarette smoking and possibly ethnicity must be accounted for whenever Hb is used to define anaemia (Sullivan, Mei, Grummer-Strawn & Parvanta 2008).

2.2 Defining Anaemia in Pregnancy

During pregnancy, anaemia is defined as Hb concentration below 11.0 g/dl or haematocrit level below 33% at sea level (WHO, 2002). It is usually two standard deviations below the mean Hb expected (Goonewardene et al., 2012). Hb levels differ within pregnancy due to physiological heamodilution which is highest during 20 to 24 weeks of gestation, (Goonewardene et al., 2012). According to WHO (2002) anaemia in pregnancy is Hb concentration below 11 g/dl in the first half of pregnancy or 10.5 g/dl in the second half of pregnancy. WHO additionally categorised AIP into mild anaemia (Hb = 10-10.9g/dl), moderate anaemia (Hb = 7.0-9.9g/dl) and severe anaemia (Hb < 7g/dl).

2.3 Prevalence of Anaemia in Pregnancy

In Africa, anaemia affects 57% pregnant women and 48% non-pregnant women exposing women to higher risk of morbidity and mortality (Munasinghe & Broek, 2006). Sub-Saharan African countries with the highest anaemia prevalence include Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Liberia, Mali, Niger, Senegal, and Togo (Stevens et al., 2013).

A study in Dhaka city on associated factors with maternal anaemia, reported that 63% of study participants had normal Hb level but 37% had Hb below 11g/dl, 26% were mildly anaemic while 11 % were moderately anaemic (Chowdhury et al. 2015). There was no record of severe anaemia. According to Meda et al. (1999), prevalence of AIP in Burkina Faso was 66%. Those who had mild anaemia were 30.8%, 33.5% participants were moderately anaemic and 1.7% had severe anaemia. Another study in Enugu, Southeast Nigeria on the prevalence of AIP at ANC registration to determine factors associated with its occurrence, reported 64.1% prevalence of AIP (Ezugwu, Mbah, Chigbu, & Onah, 2013). About 95% of pregnant women in this study were mildly anaemic, 4.3% were moderately anaemic and 1.1% were severely anaemic (Ezugwu et al., 2013). A similar study on prevalence of AIP and sociodemographic factors in Aurangabad city, India also identified 87% prevalence AIP (Lokare, Gattani, Karanjekar, & Kulkarni 2012).

In Ghana, WHO estimated 56% of women in their reproductive age (15-49) to be anaemic whereas those pregnant with anaemia were estimated at 62% prevalence, classifying Ghana as one of the countries with severe public health implication (WHO, 2015). Moreover, Ghana Demographic Health Surveys (GDHS) in 2003, 2008 and 2014, recorded 65%, 70% and 45% prevalence of anaemia in pregnancy, respectively (GSS, GHS, & ICF

International, 2015b; GSS, GHS, & ICF Macro, 2009; GSS, NMIMR, & ORC Macro, 2003). A study in Sekyere West district of Ghana on AIP determinants using Hb threshold of Hb <10g/dl, indicated that 57.1% of respondents were anaemic (Owusu, Akanmori, & Glover-Amengbor, 2005). Another study among pregnant women at Sunyani municipal hospital using a cut-off value of Hb<11.0g/dl showed 41.5% prevalence of AIP (Anlaakuu & Anto, 2017).

2.4 Causes of Anaemia in Pregnancy

Anaemia is not considered a disease but a crucial indicator of many disease condition (McLean, Cogswell, Egli, Wojdyla, & De Benoist, 2009). There are many underlying factors contributing to anaemia in pregnant women (Onyeneho & Igweonu, 2016). Knowledge of these factors is very crucial in prevention and control of anaemia effectively among vulnerable groups (Ikeanyi & Ibrahim, 2015). Anaemia results from varied causes that can be isolated, but generally coexist. Largely, 50% of all cases of anaemia are assumed to occur from iron deficiency, however different populations report different proportion according to numerous indigenous contributing factors/causes (World Health Organization, 2014). Several studies however recognise iron deficiency as the most common cause of AIP (Anlaakuu & Anto, 2017; Macdonald et al., 2010). Other causes of AIP pregnancy include antepartum haemorrhage, parasitic infections like hookworms and schistosomiasis (WHO, 2013). Other infectious diseases such as TB, HIV/AIDS and malaria also reduce blood Hb concentrations (Balarajan et al., 2011; Goonewardene et al., 2012). The risk of AIP is increased by the presence of haemoglobinopathies and micronutrient deficiencies (McLean et al., 2009).

2.5 Types of Anaemia in Pregnancy

The various types of anaemia identified from literature include nutritional anaemia, iron deficiency anaemia, folic acid deficiency anaemia, vitamin B12 deficiency anaemia, vitamin A deficiency anaemia, sickle cell anaemia and anaemia due to soil transmitted helminth, malaria, HIV, and schistosomiasis (Balarajan, Ramakrishnan, Özaltin, Shankar, & Subramanian, 2011)

2.5.1 Nutritional Anaemia

According to Bendich (2008), nutritional anaemias are consequences of inadequate consumption of nutrients or their non-availability to support the production of erythrocytes and Hb in the individual. Inadequate nutrient intake could be due to changes in food preparations overtime or physiological changes in women such as pregnancy (Freire, Kahn, McGuire, & Post, 2003). Cereal and green leafy diets are being exposed to more heat during food preparations, thereby loosing nutrients such as iron, vitamin B12, and folic acid, which support Hb production (Karaoglu et al., 2010). Also, studies have shown that nutrients such as vitamin C that helps in the absorption of iron are inadequately consumed (Ramakrishnan, 2017). Besides other food products such as polyphenols (for example spices, coffee and tea), phytates (for example whole grains and legumes) and calcium from dairy food products inhibit iron absorption but are increasingly consumed by people who may even be at risk of anaemia (Hurrell, Reddy, & Cook, 1999). Also micronutrient absorption that supports production of Hb and RBCs may be inhibited in the presence of some disease processes (e.g. peptic ulcer disease) (Muhsen & Cohen, 2008).

2.5.2 Iron Deficiency Anaemia

The iron deficiency usually results from imbalanced iron levels due to poor consumption of nutritious foods, higher iron demands in pregnancy, iron loss through menstruation and poor absorption of iron and worm infestation (WHO, 2014, Keshav & Stevens, 2017). Iron plays very significant role in various biological processes. It is an essential component of Hb molecule. Non-availability of iron leads to very low haemoglobin levels and this results in hypochromic microcytic anaemia (Pavord et al., 2012). Usually children and women are susceptible to anaemia due to developmental demands and physiological need of more iron for growth, but iron is inadequately absorbed. Majority of these women tend to loose large amounts of iron during their monthly menstruation (Nguyen et al., 2015). Also pregnancy physiology requests more iron to sustain the placental unit for foetal survival (Bothwell, 2000). Anaemia in pregnancy is widely being experienced by women in richer countries compared to poorer countries, but inadequate iron consumption especially in pregnancy aggravates its severity (Arifulla et al., 2013).

2.5.3 Folic Acid Deficiency Anaemia

According to Perry and Morrison (2004), folic acid is essential for the production and growth of RBC but inadequate levels of folate in the individual changes the structure and function of red blood cells and even its death leading to megaloblastic anaemia. Studies show that, pregnant women need more folate in pregnancy because those who had low folate prior to pregnancy develop megaloblastic anaemia in pregnancy (Goonewardene et al., 2012).

2.5.4 Vitamin B12 Deficiency Anaemia

Vitamin B12 is mainly derived from animal products. The body needs Vitamin B12 for erythropoiesis and studies show that lack or inadequate vitamin B12 levels lead to erythrocyte loss resulting in megaloblastic anaemia (Satyam & Khushbu, 2015). A study conducted by Casey et al. (2010) measured vitamin B12 levels to determine whether it contributes to anaemia or not. The result was that 25% of those with low vitamin B1 levels were anaemic (Casey et al., 2010). Vitamin B12 deficiency affects many individuals, but a real global estimate has not been identified. However, some studies reported at least 40% and 70% prevalence in both children and adults in South America and Africa respectively (Casey et al., 2010; de Silva, Sirisena, Gunasekera, Ismail, & de Silva, 1999). Furthermore, it is unknown how vitamin B12 contributes to development of anaemia especially in pregnancy though some information points to its haematological effect in the general population (de Silva et al., 1999).

2.5.5 Vitamin A Deficiency Anaemia

Vitamin A deficiency is due to inadequate consumption carotenoids from fruits, vegetables and meat (Freire et al., 2003). A study reported 21% children and 6% pregnant women lack vitamin A, leading to higher mortalities among children and pregnant women globally (Scholl, 2011).. Studies have shown that Vitamin A is very crucial in erythropoiesis, improvement of Hb concentration and increase effectiveness of iron consumption (Oppenheimer, 2001). Unfortunately this mechanisms is also unclear though studies suggested that vitamin A helps in iron absorption which stimulates the bone marrow for the production of RBCs (Perry & Morrison, 2004).

2.6 Factors Associated with Anaemia in Pregnancy

Several factors were identified to affect the haemoglobin level of pregnant women. These factors can be broadly categorised into demographic factors, sociocultural factors, socioeconomic factors, behavioural factors, genetic factors, nutritional factors, obstetric factors and some infectious diseases in pregnancy.

2.6.1 Demographic Factors

Demographic factors like maternal age, marital status, place of residence and ethnicity are known to affect anaemia in pregnancy. A study in Bangladesh to recognise factors associated with AIP reported maternal age as a predictor of AIP ($p = 0.036$) (Chowdhury et al., 2015). In a population-based study to recognise risk factors and AIP consequences, older maternal age was associated with Hb levels ($p < 0.05$) (Gaillard et al., 2014). However, in Uganda, a similar study to identify predictors of AIP reported that maternal age had a weak association with AIP (Ononge, Campbell, & Mirembe, 2014).

A study on risk factor for anaemia in pregnancy in Tanzania reported that pregnant women who never married had increased odds of anaemia compared to those who were married (Marchant et al., 2002). A study in Arab Gulf countries reported that geographical location is essentially associated with AIP (Musaiger, 2002). Gordeuk and Brannon (2017) found out from their study on AIP prevalence and predictors among women of reproductive age, that ethnicity was associated with anaemia. They reported that Asian American ethnicity decreased risk of anaemia in pregnant women but Hispanic ethnicity and African American ethnicity were associated with increased risk of anaemia (Gordeuk & Brannon, 2017).

2.6.2 Sociocultural Factors

In a study to determine challenges to iron consumption to reduce anaemia in pregnancy in eight countries, Galloway et al. (2002) identified that pregnant women's beliefs about iron and folic acid consumption were associated with anaemia in pregnancy. According to Vasilevski and Carolan-Olah (2016), cultural factors such as food taboos in pregnancy are associated with low socioeconomic status and nutritional deficiencies such as anaemia in pregnancy. Marchant et al., (2002). Also identified food taboos such as fish and meat consumption in southern Tanzania to be associated with AIP.

2.6.3 Socioeconomic Factors

Mothers' socioeconomic status comprising their educational level, income level and employment status have been identified to affect their health seeking behaviour and therefore impact their Hb levels during pregnancy (Adanikin & Awoleke, 2016). Lokare, Gattani, Karanjekar, and Kulkarni (2012) identified pregnant women's level of education and that of their spouses to be associated with anaemia in pregnancy. They concluded that low socioeconomic class and illiteracy significantly increased the odds of AIP in Indian women. In Nigeria, anaemia was common among pregnant women who had no formal education, unemployed expectant mothers, and women who book lately for antenatal care (Okunade and Adegbesan-Omilabu 2014).

2.6.4 Behavioural Factors

In pregnancy, it is prudent to observe and adhere to prophylactic treatment of helminth, iron and folic acid supplementation and preventive measures to ensure anaemia-free pregnancy. However, pregnant women in poor communities poorly patronise antenatal care

services making it difficult to promptly prevent anaemia in pregnancy (Adanikin & Awoleke, 2016). Onyeneho et al. (2016) studied how pregnant women adhere to micronutrients supplementation in different communities in Southeast Nigeria. The study disclosed that those in urban communities complied more than those in rural communities. Also, those whose homes were closer to antenatal care clinics complied far better than those far away and those who frequently visit ANC for care also complied more than those who hardly attend ANC. It was reported that ANC follow up in pregnancy was beneficial to pregnant women since anaemia could be detected early and counselling be provided on preventive measures such as the importance of consuming iron rich foods, sleeping in insecticide treated nets (ITNs) and benefiting from prompt treatment. Getahun, Belachew and Wolide (2017) in their study reported that, pregnant women who had ANC follow up had reduced odds of anaemia than those who refused ANC follow-ups. According to Mponda et al. (2002), the burden of AIP among pregnant women who sleep under ITNs was lesser than those who did not sleep under ITN (72% versus 82%). It was also identified that using ITNs protects pregnant women from becoming anaemic as it is very effective in preventing malaria (Mponda et al., 2002)

2.6.5 Obstetric factors

In Ethiopia, a case-control study on determinants of anaemia among pregnant women discovered that higher gravida and iron, folic acid supplementation were associated with AIP (Ebuy, Alemayehu, Mitiku, & Goba, 2017). They also reported that those who had haemorrhage in pregnancy had 6.6 odds of severe anaemia (Ebuy et al., 2017). Among nulliparous, uniparous and multiparous women, the high gravidity and parity have serious

effects on their irons stores (Milman, 2006). Anaemia was common during the first trimester of pregnancy (Mengist, Zewdie, & Belew, 2017). McClure, Goldenberg, Dent and Meshnick (2013) in their study reported that, administration of IPTp-SP, consistently reduced anaemia in pregnancy. Studies have also shown that, Iron, folic acid and multivitamin supplementation reduced anaemia significantly in pregnancy (Imdad & Bhutta, 2012; Sanghvi, Harvey, & Wainwright, 2010). Mocking et al. (2018), in their study to identify the role of body mass index in early pregnancy, compared Indonesian and Ghanaian women. The study showed that pregnant women with low BMI had higher Hb levels in early pregnancy. The BMI for Indonesian women were lower than Ghanaian women in early pregnancy, thereby reducing the odds of anaemia among Indonesian women than Ghanaian women (Mocking et al., 2018).

Abortions are associated with AIP. Uche-Nwachi et al. (2010) in their study found out that pregnant women with 2–3 spontaneous abortions were more likely to have anaemia than those who had 1. According to Feleke and Feleke (2018) in their comparative study of pregnant women and lactating mothers on prevalence of AIP, pregnant women were more prevalent than lactating mothers and women with the history of abortion had 6.6 times odds of AIP.

2.6.6 Genetic Factors

Stephansson (2000) reported that anaemia can result from some hereditary Hb anomalies, due to structural changes or reduced Hb globin chains production. Global estimates suggested that at least 5.2% of the general population and more than 7% of pregnant women may be carriers of genetic Hb disorders. This burden is more prevalent in poorer regions

such as Africa (18.2%) and Southeast Asia also recording 6.6% (Stephansson, 2000). Currently it is unclear how these genetic disorders contribute to the development of anaemia though detailed studies were conducted in that regard (Hallberg, 1998). For instance, the Royal College of Obstetrician and Gynaecologists (RCOG) published that about 330,000 infants delivered yearly may be at risk of sickle-cell disorders and thalassaemia (Royal College of Obstetrician and Gynaecologists, 2011). It was also reported that an estimated 2.28 per 1000 pregnancies could be affected globally with sickle-cell disorders which was associated with chronic haemolytic anaemia (Stephansson, 2000). To reduce the risk, improved diagnostics systems and pharmacological treatments have been developed over the years, but these are uncommon in low resourced settings for early diagnosis, identification and management of clients with sickle cell traits or disease to avert anaemia and other chronic diseases (Hallberg, 1998).

2.6.7 Helminth Infections in Pregnancy

Balarajan et al. (2011) reported that approximately one billion people are infected with hookworms which results in intestinal bleeding. This significantly contributes to moderate and severe anaemia (Gillespie & Johnston, 1998). In worm infestation, there is attachment of the adult worm to the linings of the small intestine leading to destruction of capillaries and arterioles. The worm then secretes anticlotting agents and ingests blood. When the loss of blood becomes more than iron reserves of the individual through the activities of the worm, hookworm infection results leading to iron deficiency anaemia (Goonewardene et al., 2012). Goonewardene et al. (2012), reported on hookworm infection in 12 studies that considered deworming during pregnancy. They reported that those women who had light

hookworm infection had lower Hb level compared with women without hookworm infection (OR=0.24, 95% CI: 0.36 – 0.13). Pregnant women with helminth infections in Ethiopia had higher odds of anaemia (Mengist et al., 2017). In Ghana, helminth infections were identified as factors associated with anaemia in pregnancy (Strengthening Partnerships, Results, and Innovations in Nutrition Globally & Ghana Health Service, 2016). Studies reported that prophylactic treatment of hookworms using single dose Albendazole (400mg) reduces the occurrence of anaemia in pregnancy in localities where anaemia is a severe public health problem (Smith & Brooker, 2010; WHO, 2016).

2.6.8 Malaria in Pregnancy

It was reported that women with their first pregnancy in vulnerable localities of malaria infection are more susceptible to severe anaemia in pregnancy (WHO, 2014). Malaria is known to cause an overwhelming burden on Africa (Menaca et al., 2013). About 1-3 million deaths occur due to malaria in Africa (Munasinghe & Broek, 2006). It was estimated that malaria accounts for 10% of diseases in Africa (Getahun et al., 2017). In endemic regions such as Ghana, malaria infection has been known as the most cause of parasitic infections in our hospitals accounting for higher morbidity among pregnant women and children (Strengthening Partnerships, Results, and Innovations in Nutrition Globally & Ghana Health Service, 2016). Malaria causes unpredictable anaemia with Hb below 5g/dl or a little less than 11g/dl. This is due to weakened immunity and frequent breakdown of RBCs during malaria infection in pregnancy. It has been found that the simultaneous increased RBCs breakdown and low production of RBCs in pregnancy aggravates AIP (Douglas et al., 2013). Primigravidae women stand the highest risk of

developing malaria in pregnancy, and its subsequent morbidity patterns. The risk decreased with increased number of the etiologic factors responsible for anaemia. The findings from studies that prophylactic treatment of malaria in pregnancy with IPTp-SP reduces severe anaemia, suggests that malaria and AIP are significantly related (Verhoeff et al., 1999). The most causative organism of malaria that leads to severe anaemia, and subsequent hypoxia and congestive heart failure is *Plasmodium falciparum* (Douglas et al., 2013). The use of ITNs while pregnant is advantageous in controlling AIP (Messick, 2015). Pregnant women who had malaria infections in Ethiopia had higher odds of anaemia (Mengist et al., 2017). Studying predictors of AIP in Uganda, the odds of AIP was 1.32 for pregnant women who had malaria infection (Ononge, Campbell, & Mirembe, 2014). Studies in Ghana revealed that malaria in pregnancy contributed more to AIP because most mothers who tested positive for malaria in pregnancy were also seen to be anaemic (Intiful, Wiredu, Asare, Asante, & Adjei, 2016; Stephens et al., 2014).

2.6.9 HIV/AIDS in Pregnancy

There is a strong association between HIV infection and anaemia, mainly in Africa; those who have HIV/AIDS have higher chance of developing severe anaemia (Uneke, Duhlinska, & Igbinedion, 2007). More than 70% of individuals who are anaemic had acquired immune deficiency syndrome (AIDS) (Ramakrishnan, 2017). Women and children in sub-Saharan Africa are more vulnerable to developing HIV/AIDS related to anaemia (Garg & Bharambe, 2015). Anaemia may develop among HIV/AIDS patients due to chronic diseases, anti-red cell antibodies, medication overdose and lack or inadequate intake of nutritious foods (Parinitha & Kulkarni, 2012). Those who were haemotransfused to treat

anaemia were at higher risk of HIV infection from donors' blood where adequate systems are not in place to screen blood before transfusion, but over a decade ago the risk had greatly reduced due to improved screening strategies adopted by health facilities (Parinitha & Kulkarni, 2012). Nandlal et al. (2014) in their study found out that HIV infection was associated with AIP as anaemia was common among women whose cluster of differentiation 4 (CD4) count was below 200 cells/mm^3. In another study to determine the effect of HIV severity on anaemia in pregnancy, Meda et al. (1999) reported that anaemia was more common among women with HIV (78.4%) than women without HIV (64.7%).

2.7 Anaemia as Public Heath Importance

Globally anaemia is known as a public health challenge that affects the health and wellbeing of women and children and socioeconomic development of nations (Scott, Chen-Edinboro, Caulfield, & Murray-Kolb, 2014). Studies have shown that, all countries have some level of anaemia as a public health problem (McLean, Cogswell, Egli, Wojdyla, & De Benoist, 2009). More than 80% of countries worldwide have moderate to severe public health significance of AIP (McLean et al., 2009). The prevalence of anaemia as a public health challenge is categorized into mild, moderate and severe. Countries with less than 5% prevalence have no public health problem, but those with 5% -19.9% prevalence of anaemia in pregnancy have mild public health problem and others with 20% - 39.9% prevalence, have moderate public health problem (McLean et al., 2009). Significantly, those countries with higher than 40% prevalence are classified as countries with severe public health problem, of which Ghana is one (McLean et al., 2009). The table below shows classification of anaemia as public health problem.

Table 2.1: Classification of Anaemia as Public Health Problem (Lynch, 2007)

Prevalence of Anaemia (%)	Category of Public Health Significance
≤4.9	No public health problem/Normal
5.0–19.9	Mild public health problem
20.0–39.9	Moderate public health problem
≥40.0	Severe public health problem

Furthermore, McLean, Cogswell, Egli, Wojdyla, and de Benoist (2009) studied worldwide prevalence of anaemia from 1993–2005 and classified countries into various categories of public health importance. Table 2.2 below shows the number of countries per public health problems of anaemia.

Table 2.2: Number of Countries Categorised by Public Health Significance of Anaemia

Public Health Problem	Preschool Aged Children (Number of Countries)	Pregnant Women (Number of countries)	Non-pregnant women (Number of countries)
None	2	0	1
Mild	40	33	59
Moderate	81	91	78
Severe	69	68	54

2.8 Clinical Features of Anaemia in Pregnancy

Many anaemias initially are asymptomatic. Usually diagnosis of AIP is achieved through antenatal routine Hb check, but anaemia may exist over a long period since pregnant women adjust to the symptoms without realising it (Sam-Wobo, Akinboroye, Anosike, & Adewale, 2008). The signs and symptoms are non-specific and difficult to detect. The clinical symptoms are severe in the presence of comorbid conditions (Peterson,

Cornacchia, & General, 2017). Tissue hypoxia due to low Hb in pregnancy accounts for symptoms such as fatigue, dyspnoea, lack of appetite and paleness of skin and mucous membranes. More severe manifestations are tachycardia, congestive heart failure and jaundice (Peterson et al., 2017).

2.9 Consequences of Anaemia in Pregnancy

A reduction in Hb concentration below acceptable levels can be detrimental to mother and foetus (McLean et al., 2009). Asphyxia, preterm delivery, neonatal anaemia, low birth weight, intrauterine growth restriction and perinatal mortality are associated with anaemia (Kalaivani, 2009). Pregnant women experience low physical activity and they are at bigger risk of morbidity and mortality, especially in those with severe anaemia (De Benoist, McLean, & Egli, 2005). A study in northern Tanzania noticed that birth weight of babies born to women with severe anaemia was 2.30kg less than women without anaemia. The risk of LBW increased with severity of anaemia. Compared with non-anaemic women, the risk for low birth weight was 1.3 times higher in women with mild anaemia, 1.7 times higher among moderately anaemic women and 5.3 times increased in women with severe anaemia (Msuya, Hussein, Uriyo, Sam, & Stray-Pedersen, 2011). Severe anaemia in pregnancy needs critical medical treatment and attention but Hb < 4.0g/dl in pregnancy is an emergency situation which puts the pregnant woman at risk of congestive cardiac failure (Goonewardene et al., 2012).

2.10 Addressing Anaemia in Pregnancy

The significance of high Hb levels in pregnancy cannot be overemphasized as haemoglobin remains the major means of transporting adequate oxygen to the tissues of both mother and

foetus (McLean et al., 2009). Several attempts have been made to address anaemia in the different populations all over the world. Earlier attempts such as the use of parenteral iron therapy were unsafe, but now there are new body iron replenishment that are helpful in treating iron deficiency (Jabareen, 2009). In pregnancy, current international recommendation of iron intake is consumption of 60 mg iron with 400 µg folic acid daily for 6 months and 3 months during postpartum periods in areas where AIP prevalence is greater than 40% (Pasricha, Drakesmith, Black, Hipgrave, & Biggs, 2013). For severely anaemic women, the recommended iron dose is 120 mg/day (Scott et al., 2014). The ANC package to address anaemia in pregnancy according to McLean et al. (2009) encompasses the following activities:

- Awareness creation on maternal and new-born needs and adherence to iron folic acid and multivitamin supplementation through pregnancy to postpartum period.
- Promoting healthy behaviours in the home, including healthy lifestyles and adequate nutrients intake, safety, injury disease prevention through the use of insecticide bed nets.
- Supporting care seeking behaviour, through recognition of danger signs (such as haemorrhage and tachycardia) for the woman and the new-born as well as transport and funding plans in case of emergencies.
- Promoting postnatal family planning/birth spacing.

2.11 Adherence to Iron, Folic Acid and Multivitamins

The eight-item Morisky Medication Adherence Scale (MMAS-8) was adopted to assess participants medication taking behaviour because it is considered as one of the most useful

medication adherence questionnaires (Lam & Fresco, 2015). The scale was developed by Morisky, Green, and Levine, (1986). The items focused on issues such as forgetfulness, refusal to take medication due to adverse effects and ability to observe medication regimen. The scale is widely accepted as the most self-reported measure for medication adherence due to its validity and reliability (Lam & Fresco, 2015). In a study in Ethiopia, pregnant women who failed to adhere to their supplements had anaemia more than those who adhered (Mengist et al., 2017)

2.12 Nutritional Adequacy in Pregnancy

The Minimum Dietary Diversity for Women in their Reproductive Age (WRA)(MDD-W) is a dichotomous indicator of whether or not women 15–49 years of age have consumed at least five out of ten defined food groups the previous day or night (FAO & FHI 360, 2016). This tool was adopted to assess nutritional adequacy of pregnant women since it is universally accepted and recommended that foods be consumed from different food groups for maximum absorption of nutrients. Most importantly, the physiology of pregnancy demands adequate nutrient/food intake to support the optimal development of the foetus and prevention of anaemia (Kahanya, 2016). Pregnant women with less than five food groups in a study in Ethiopia had 3.3 times odds of anaemia using dietary diversity score (Mengist et al., 2017).

CHAPTER THREE

Methodology

3.1 Study Type

Hospital-based cross-sectional study design was employed to determine the prevalence of anaemia in pregnancy and factors associated with its occurrence in Keta Municipality. The study was carried out between May and June, 2018.

3.2 Study Location

The study was conducted in two hospitals in Keta municipality namely, Keta Municipal hospital, Keta and Sacred Heart Catholic hospital, Abor all in the Volta Region of Ghana.

3.2.1 Keta Municipal District Profile

Keta municipality is one of the two hundred and sixteen districts of Ghana located in the Volta region. The municipality can be located along the eastern part the Volta estuary, about 160km from Accra. It lies within Longitudes 0.30^0E and 1.05^0E and Latitudes 5.45^0N and 6.005^0N. The municipality shares common boundaries with Akatsi South District to the north, Ketu North and South District to the east, South Tongu District to the west and the Gulf of Guinea to the south. The total surface area is 753.1km^2 with the largest lagoon in Ghana. According to 2010 population and housing census, there were 147,168 people in the municipality representing 7.0% of Volta region's population. Males constitute 46.4% and females represent 53.6% of the total population of the Municipality. More than half (53.3%) of the population live in urban areas and there are 87 males per 100 females.

3.2.2 Health Zones in Keta Municipality

To successfully manage and promote health, the municipality was demarcated into six health zones namely Keta, Anloga, Tegbi, Anyako, Anyanui and Shime. Healthcare services are provided mainly by government through Ghana Health Service (GHS) supported by Christian Health Association of Ghana (CHAG). Twenty eight (28) health facilities exist in the municipality comprising of Keta Government (Municipal) hospital and Sacred Heart hospital, Abor, 13 health centres, 4 community-based health planning and services (CHPS) zones, 5 maternity homes and 4 private clinics.

3.2.3 Keta Municipal Hospital

Keta Municipal Hospital is the major referral facility within the municipality and serves averagely over 60, 000 clients yearly. The hospital was established in 1926 at Fort Prinzenstein, to provide basic health care, comprising basic clinical care, maternal and child health, communicable disease control and environmental health. Due to the devastating effects of sea erosion, the hospital was relocated to Dzelukope, its present site since 1935. Services provided include out-patient and in-patient medical/ surgical services, obstetrics and gynecological care, dental care, eye care, ear nose and throat (ENT), HIV testing and counselling, antenatal and postnatal care as well as public health services. The antenatal care clinic serves averagely 100 new clients (registrants) and 700 attendants (old clients) monthly.

3.2.4 Sacred Heart Catholic Hospital

Sacred Heart Catholic Hospital, Weme-Abor was established in November 1954 as a maternity home to initially cater for maternal and pediatric patients in the Anyako sub

district of Keta Municipality, but was elevated to a hospital status on December 19, 1997 due to high patronage of hospital services by clients. This hospital is situated along the Accra-Aflao-Lomé international highway in the Keta Municipality of the Volta region and serves as the second largest hospital after Keta municipal hospital. Services provided include primary health care through out-patient and in-patient consultation and admission respectively, medical and surgical services, laboratory services, radiology, mammography, sonography, pharmacy and mortuary services. Currently, the hospital has 90 beds for inpatient services. The antenatal clinic serves averagely 843 clients on monthly basis.

Figure 3.1 is a map showing Keta Municipal Hospital and Sacred Heart Hospital

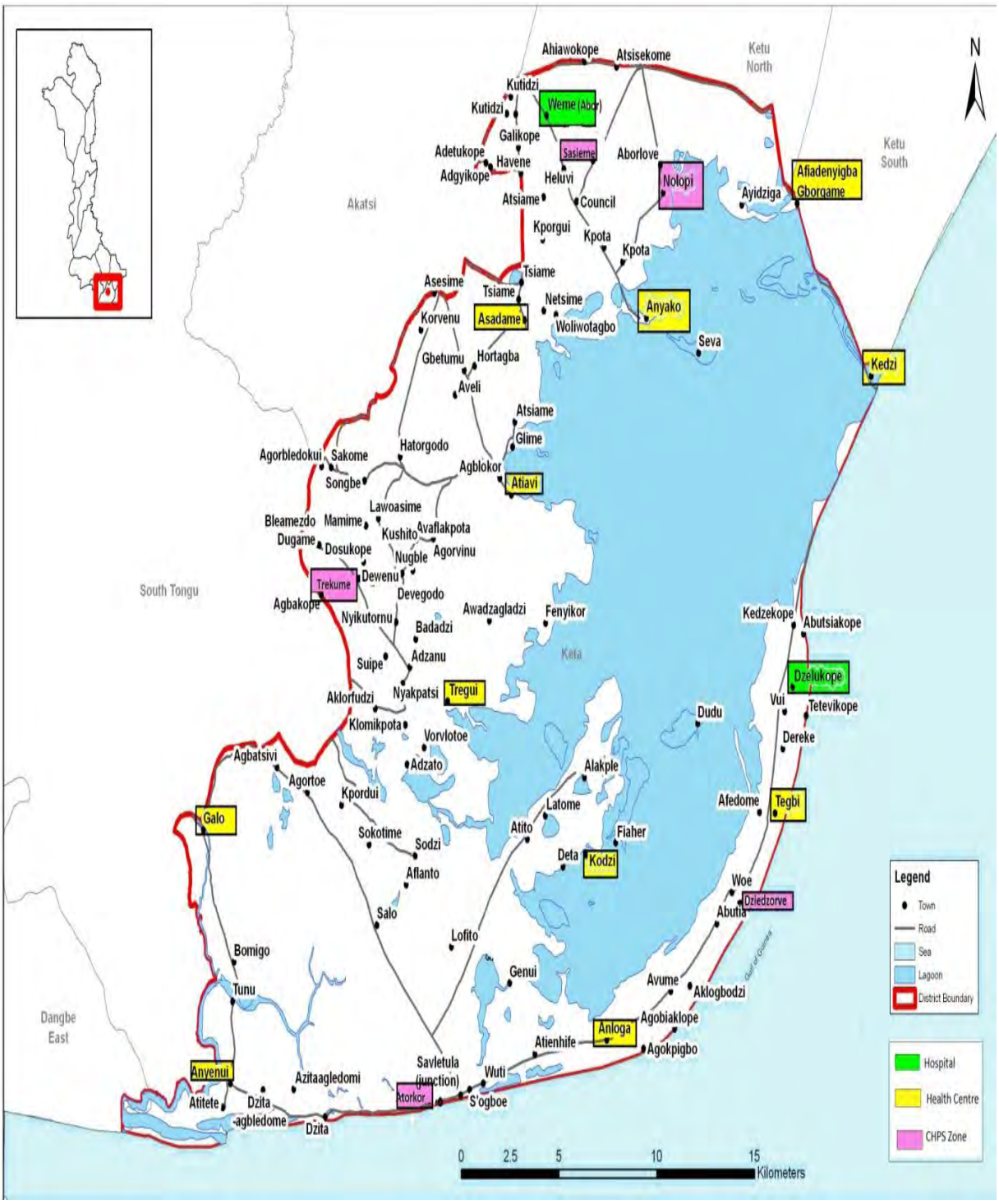

Figure 3.1: Map of Keta Municipality with Health Facilities

3.3 Study Variables

The dependent variable was current haemoglobin level checked during antenatal care and all other factors were independent variables. Table 3.1 elaborates on the variables of interest in this study.

Table 3.1: Study Variables

No.	Variables	Type of Variables	Operational Definition	Scale of Measurement
1	Current Hb	Dependent	Recent Hb during interview	Categorical 0.No-Anaemia(Hb>11 g/dl) 1.Anaemia (Hb<11 g/dl)
2	Age	Independent	Maternal age in years	Continuous
3	Ethnicity	Independent	Ethnic group to which a pregnant woman belongs	Categorical 1.Ewe 2.Akan 3.Ga 4.Others
4	Religion	Independent	Belief/religion of the pregnant woman	Categorical 1.Christian 2.Islam 3.Traditional 4.Others
5	Marital Status	Independent	Participant's relation with male partner	Categorical 1.Married 2.Unmarried
6	Residence	Independent	Participant's place of residence	Categorical 1.Keta Sub 2.Tegbi Sub 3.Anloga Sub 4.Anyarko Sub 5. Anyanyui sub 6.Shime Sub 7.Others
7	Educational status	Independent	Level of formal education	Categorical 1.No formal education 2.Primary education 3.Secondary education 4.Tertiary education

No.	Variables	Type of Variables	Operational Definition	Scale of Measurement
8	Occupation	Independent	Means of income	Categorical 1.Professional 2.Business 3.Informal
10	Gravida	Independent	Number of times a woman has been pregnant	Continuous
11	Parity	Independent	Number of children participant has	Continuous
12	Abortion	Independent	Number of abortions participant had	Continuous
13	ITN usage	Independent	Whether participant slept in insecticide bed net the previous night	Binary 0.No 1.Yes
14	Food Taboos	Independent	The beliefs and practices of pregnant woman in relation to food	Binary 0.No 1.Yes
15	Gestational age at first visit	Independent	Gestational age in weeks at ANC registration	Categorical 1.First trimester: 1-12 weeks 2.Second trimester: 13-27 weeks 3.Third trimester: 28- 40 weeks
16	Gestational age at current visit	Independent	Gestational age in weeks at the time of interview	Categorical 1.First trimester: 1-12 weeks 2.Second trimester: 13-27 weeks 3.Third trimester: 28- 40 weeks
17	ANC visits	Independent	Number of times pregnant woman visited antenatal clinic for care	Categorical 0.< 4 visits 1.> 4 visits
18	Adherence to folic acid and iron supplements	Independent	Whether pregnant woman adheres to supplements by use of Morisky medication adherence scale (MMAS-8 item)	Categorical 0.Adherence (6-8) 1.Non-Adherence (0-5)
19	Bleeding in pregnancy	Independent	Whether participant is currently bleeding	Binary 0.No 1.Yes

No.	Variables	Type of Variables	Operational Definition	Scale of Measurement
20	Malaria	Independent	Whether participant was treated for malaria in current pregnancy	Binary 0.No 1.Yes
21	Sickling Status	Independent	Participant's sickling status	Binary 0.No 1.Yes
22	Helminth	Independent	Whether participant was treated for helminthiasis	Binary 0.No 1.Yes
23	HIV status	Independent	Whether pregnant woman is HIV positive or negative	Binary 0.Non-reactive 1.Reactive 2.Not done
24	BMI	Independent	Whether pregnant woman has normal basal metabolic rate or not	Categorical 1.Underweight 2.Normal 3.Overweight 4.Obese
25	Maternal dietary diversity score	Independent	The number of food groups mothers consumed the previous day using Minimum Dietary Diversity for Women (10-item)	0.<5 food groups 1. >5 food groups
26	Geophagia (Pica)	Independent	Deliberate consumption of earth, soil, or clay in pregnancy	Binary 0.No 1.Yes
27	Intermittent Preventive Treatment (IPTp)	Independent	Number of times pregnant woman took Sulfadoxine-pyrimithamine (SP)	Continuous

3.4 Study Population

Study participants were pregnant women attending antenatal care at Keta Municipal Hospital and Sacred Heart Hospital between May and June 2018.

3.5 Sample Size Determination

The sample size was calculated using Cochrane's formula for determining proportions for single population. Formula used was $n = \frac{z^2 * p(1-p)}{e^2}$, where n represents sample size, p – proportion, e – level of precision and $z = z_{1-\frac{\alpha}{2}}$ was the standard normal variate for level of significance (α). The estimated proportion used was based on the national prevalence of anaemia in pregnancy as reported by GDHS (2014) = 45%, thus $p = 0.45$. In the formula, z was the corresponding z-score for 95% confidence interval, $z = 1.96$. The level of precision or margin of error was set at of 5% ($e = 0.05$) and the proportion of pregnant women who were not anaemic was expressed in the formula as (1- p). Values were inserted into the formula as, $n = \frac{1.96^2 * 0.45(1-0.45)}{0.05^2}$ $n = \frac{3.8416 * 0.2475}{0.0025}$ $n = 380.3$

Calculated sample size was 380 participants but due to unforeseen incomplete responses that may occur, 10% non-response rate was added to estimate the minimum sample size. Minimum sample size was $n = 418$.

3.6. Inclusion Criteria

All pregnant women attending antenatal care, willing to participant in this study, who attended antenatal care clinic, four or more times were included.

3.7 Exclusion Criteria

All pregnant women who had less than four antenatal care visit or were ANC registrants as well as those who were haemotransfused within four weeks prior to data collection were excluded from this study.

3.8 Sampling Method

Consecutive sampling was used to collect data from participants. Thus, inclusion and exclusion criteria were used to select participants for the study. Each day at the antenatal care clinic, pregnant women were screened using "pregnant women screening questionnaire" (see Appendix B) to identify those who met the inclusion criteria. All qualified clients were included in the study.

3.9 Data Collection Method

Each day at the antenatal care clinic of both hospitals, the research team provided adequate information on the study using the participant information sheet. Pregnant women who visited the antenatal clinic were screened individually using the pregnant women screening questionnaire. Informed consent was obtained from those who were willing to participate in the study. For each participant, midwives requested for haemoglobin test which was covered by National Health Insurance Scheme (NHIS). In addition, the research team retrieved relevant data from participants' antenatal record booklet.

3.10 Data Collection Technique and Instruments

Participants were interviewed face to face using structured questionnaires and relevant data were retrieved from their antenatal record booklet using data extraction tools. The questionnaire had 6 sections (See Appendix). Section A considered of sociodemographic factors such as complete age, ethnicity, religion, marital status, sub district (place) of residence, educational status, maternal and partners' employment status. Section B included obstetric history such as gravidity, parity, mode of delivering last child prior to current pregnancy, history of abortion, number of abortions, mode of abortion and history

of bleeding in current pregnancy. Section C included behavioural factors such as alcohol intake, smoking status, last night's use of insecticide treated nets (ITN), consumption of pica (geophagia) and period of consumption in current pregnancy. Also, the use of herbal medicines and intake of iron, folic acid and multivitamins (referred to as supplements) were assessed in section C. Section D, made use of Morisky Medication Adherence Scale (8-item) (Morisky et al., 1986) to determine adherence to supplements. These supplements include iron, folic acid, multivite and ferrous sulfate or Iron III Polymatose. Section E was also composed of Minimum Dietary Diversity for women questionnaire (FAO and FHI 360, 2016).

The data extraction tool entailed booking gestational age, maternal height and weight, HIV status, sickle cell status, haemoglobin levels, number of IPTp-SP administered, provision of ITNs, treatment of malaria in pregnancy and prophylactic treatment of helminthiasis.

3.10.1 Haemoglobin Estimation

Qualified Phlebotomist at the laboratory unit collected blood sample from participants' arm by applying tourniquet tightly on upper arm, cleaned skin area with spirit and withdrew 2-3 ml of blood using sterile syringe and needle. Blood sample was emptied into individualized coded Ethylenediaminetetraacetic acid (EDTA) tubes for analysis. Haemoglobin concentration was estimated using Sysmex XN-550 at KMH and Hematology analyser at SHH.

3.11 Data Processing and Analysis

Questionnaires were inspected for completeness and consistencies daily. Raw data collected were entered into designed data collection template in Statistical Package for the

Social Sciences (SPSS) Version 20, daily until data collection from the field was completed. Data was double checked to ensure there were no mistakes. Data were exported to Stata version 15 for data analyses. Microsoft Excel 2013 was used to draw bar graphs for descriptive purposes. Continuous variables such as age were categorized into 5 age groups. Body mass index was derived from weight and height measures and categorised into underweight, normal weight, overweight and obese using the WHO cut off points. Haemoglobin at registration (first visit) and on day of interview (current visit) were categorised into anaemia (Hb<11.0 g/dl) and no anaemia (Hb>11.0 g/dl). They were further categorised into mild anaemia (Hb: 10 – 10.9 g/dl), moderate anaemia (Hb: 7 – 9.9 g/dl) and severe anaemia (Hb < 7 g/dl). Categorical variables were summarized using frequencies and proportions and continuous variables were summarized using means and standard deviations. Bivariate analyses were run using Pearson Chi square test of independence to examine relationship between factors and anaemia at current visit. Two-sample Wilcoxon rank-sum test and Kruskal Wallis test was also used to determine difference in median anaemia among groups. Binomial logistic regression analyses were then performed to determine the odds of anaemia. Statistically significant variables were included in a multivariable analysis. Variables with p–value (p) less than 0.05 at 95% confidence interval (CI) were considered to be predictors of anaemia in pregnancy.

3.12 Quality Control

Six research assistants (RAs) were used in data collection. Research assistants were graduate nurses awaiting posting and a Public health graduate student. They were trained for four days at Keta Municipal hospital. The training covered the purpose of the study,

components of data collection tools, how to collect data and professional skills to enable them engage participants professionally in data collection. Data collection tools were examined for clarity and ambiguity.

Data collection tools were pre-tested at SHH, Abor from February 19 - 23, 2018. However participants who responded to the pre-test questionnaires were identified and excluded from actual data collection. During analysis of the pretested questionnaire, it was realised that some questions were unclear and others combined more than one variable. These anomalies were corrected and each question coded. Data entry templates created in SPSS version 20, were validated and coded. The Principal Investigator and a Bachelor of Public Health graduate from the University of Health and Allied Sciences, Ho were solely responsible for data entry.

3.13 Ethical Clearance

Ethical approval was obtained from Ghana Health Service Ethical Review Committee (GHSERC) with Protocol ID Number: GHSERC134/12/17. Permission was sought from Management of Keta Municipal Hospital and Sacred Heart Hospital, Abor prior to the commencement of this study. Participants' were provided adequate information on the study and confidentiality was assured. Informed consent was obtained as participants signed/thumb printed. They were encouraged to participate voluntarily in the study and request to withdraw if they felt uncomfortable. Those who were anaemic were encouraged to eat nutritious diet, desist from consuming iron inhibitors such as tea and coffee while taking their prescribed medications appropriately and must report for reviews. Data collected was saved and stored under lock and key.

CHAPTER FOUR

Results

4.1 Introduction

A total of 426 pregnant women attending antenatal care in Keta municipality met the inclusion criteria and were recruited for the study. At KMH 234/426 (54.9%) participated while 192/426 (45.1%) participated at SHH.

4.2 Sociodemographic Characteristics of Participants

The mean age of participants was 28.3±6.1 years. Participants' age were between 15 – 45 years. A majority of participants 129/426 (30.3%) were aged between 25 – 29 years. Generally, 367/426 (86.2%) of the participants were Ewes, 356/426 (83.6%) were Christians, and 324/426 (76.1%) were married. Among participants, 174/426 (40.9%) had Junior High School education and 45/426 (10.6%) were not formally educated. A total of 340/426 (79.8%) participants and 409/426 (96%) partners were employed. Table 4.1 below shows details of sociodemographic characteristics of participants.

Table 4.1a: Sociodemographic Characteristics of Participants

	KMH (*n*=234)		SHH (*n*=192)		Total(*N*=426)	
Variables	**n**	**%**	**n**	**%**	**N**	**%**
	Mean Age				28.3 ± 6.1	
Age categories						
15-19	18	54.6	15	45.5	33	7.8
20-24	41	46.1	48	53.9	89	20.9
25-29	84	65.1	45	34.9	129	30.3
30-34	55	51.9	51	48.1	106	24.9
35 and above	36	52.2	33	47.8	69	16.2

Table 4.1b: Sociodemographic Characteristics of Participants

	KMH (*n*=234)		SHH (*n*=192)		Total(*N*=426)	
Variables	**n**	**%**	**n**	**%**	**n**	**%**
Ethnicity						
Ewe	201	54.8	166	45.2	367	86.2
Akan	15	60.0	10	40.0	25	5.9
Ga	5	62.5	3	37.5	8	1.9
Others[a]	13	50.0	13	50.0	26	6.1
Religion						
Christian	196	55.1	160	44.9	356	83.6
Islam	17	68.0	8	32.0	25	5.9
Traditional	21	48.8	22	51.2	43	10.1
Others[b]	0	0.0	2	100.0	2	0.5
Marital Status						
Unmarried	64	62.8	38	37.3	102	23.9
Married	170	52.5	154	47.5	324	76.1
Sub district of residence						
Keta Sub	108	85.7	18	14.3	126	29.6
Tegbi Sub	54	67.5	26	32.5	80	18.8
Anloga Sub	44	73.3	16	26.7	60	14.1
Anyanui Sub	12	70.6	5	29.4	17	4.0
Shime Sub	4	26.7	11	73.3	15	3.5
Anyako Sub	0	0.0	70	100.0	70	16.4
Other district[c]	12	20.7	46	79.3	58	13.6
Educational Level						
No formal education	29	64.4	16	35.6	45	10.6
Primary education	49	54.4	41	45.6	90	21.1
Junior High	78	44.8	96	55.2	174	40.9
Senior High	64	72.7	24	27.3	88	20.7
Tertiary	14	48.3	15	51.7	29	6.8
Maternal employment status						
Unemployed	35	40.7	51	59.3	86	20.2
Employed	199	58.5	141	41.5	340	79.8
Partner's employment status						
Unemployed	10	58.8	7	41.2	17	4.0
Employed	224	54.8	185	45.2	409	96.0

Footnote: Others[a] include Guan (3), Ga-Adangbe (7), Ashanti (4), and Togolese (15). Others[b] refers to Pagans (2). Other district[c] include Ketu South (47), Akatsi (4), South Tongu (3), Ada West (3) and Tema (1). SD means standard deviation

4.3 Obstetric Characteristics of Participant

Majority 266/426 (62.4%) of participants registered for antenatal care in their first trimester of pregnancy. At first visit (ANC registration), 197/426 (46.2%) had normal body mass index (BMI) but 132/426 (31%) were with normal BMI on day of interview. HIV prevalence among participants was 1.64% (7/426 participants) and those with positive sickle cell status were 52/426 (12.2%). The median gravidity and parity were 2. Among those with children, 45/292 (15.4%) delivered their last child by caesarean section and 216/292 (74%) delivered spontaneously per vagina. Among 168/426 (39.4%) participants who had abortion, 68/168 (40.5%) had induced abortion and 100/168 (59.5%) had spontaneous abortion. Only 60/426 (14.1%) participants reported history of bleeding in current pregnancy. Table 4.2 shows detail results of participants' obstetric characteristics.

Table 4.2a: Obstetric Characteristic of Participants

	KMH (*n*=234)		SHH (*n*=192)		Total (*N*=426)	
Variables	**n**	**%**	**n**	**%**	**n**	**%**
Gestational age (weeks) at first ANC						
First trimester	147	55.3	119	44.7	266	62.4
Second trimester	85	54.1	72	45.9	157	36.9
Third trimester	2	66.7	1	33.3	3	0.7
Gestational age (weeks) at current[a] ANC						
Second trimester	35	53.0	31	47.0	66	15.5
Third trimester	199	55.3	161	44.7	360	84.5
Gravidity						
1-2 pregnancies	129	60.3	85	39.7	214	50.2
3-4 pregnancies	71	48.3	76	51.7	147	34.5
5 or more pregnancies	34	52.3	31	47.7	65	15.3

Current[a] means day of interview

Table 4.2b: Obstetric Characteristic of Participants

	KMH (*n*=234)		SHH (*n*=192)		Total (*N*=426)	
Variables	**n**	**%**	**n**	**%**	**n**	**%**
Parity						
Do not have a child	76	56.7	58	43.3	134	31.5
Has child/children	158	54.1	134	45.9	292	68.5
Number of children						
1-2 children	124	56.1	97	43.9	221	75.7
3-4 children	32	50.8	31	49.2	63	21.6
5 or more children	2	25.0	6	75.0	8	2.7
Mode of delivering last child						
Spontaneous vaginal delivery	121	56.0	95	44.0	216	74.0
Assisted vaginal delivery	21	67.7	10	32.3	31	10.6
Caesarean section	16	35.6	29	64.4	45	15.4
BMI at first visit						
Underweight	28	93.3	2	6.7	30	7.0
Normal weight	106	53.8	91	46.2	197	46.2
Overweight	63	55.3	51	44.7	114	26.8
Obese	37	43.5	48	56.5	85	20.0
BMI at current[a] visit						
Underweight	6	85.7	1	14.3	7	1.6
Normal weight	79	59.9	53	40.2	132	31.0
Overweight	89	56.7	68	43.3	157	36.9
Obese	60	46.2	70	53.9	130	30.5
HIV status						
Negative	226	55.0	185	45.0	411	96.5
Positive	3	42.9	4	57.1	7	1.6
HIV Test not done	5	62.5	3	37.5	8	1.9
Sickling status						
Negative	208	55.6	166	44.4	374	87.8
Positive	26	50.0	26	50.0	52	12.2
History of abortion						
No	143	55.4	115	44.6	258	60.6
Yes	91	54.2	77	45.8	168	39.4
Number of abortion						
1-2 abortions	85	53.8	73	46.2	158	94.0
3 or more abortions	6	60.0	4	40.0	10	6.0

Table 4.2c: Obstetric Characteristic of Participants

	KMH (*n*=234)		SHH (*n*=192)		Total (*N*=426)	
Variables	**n**	**%**	**n**	**%**	**n**	**%**
Type of abortion						
Spontaneous abortion	49	49.0	51	51.0	100	59.5
Induced abortion	42	61.8	26	38.2	68	40.5
History of bleeding in current[a] pregnancy						
No	207	56.6	159	43.4	366	85.9
Yes	27	45.0	33	55.0	60	14.1
Anaemia status at first visit						
Severe anaemia	3	60.0	2	40.0	5	1.2
Moderate anaemia	126	58.3	90	41.7	216	50.7
Mild anaemia	55	48.7	58	51.3	113	26.5
No anaemia	50	54.4	42	45.7	92	21.6
Anaemia status at current[a] visit						
Severe anaemia	0	0.0	3	100.0	3	0.7
Moderate anaemia	70	41.9	97	58.1	167	39.2
Mild anaemia	93	58.1	67	41.9	160	37.6
No anaemia	71	74.0	25	26.0	96	22.5

4.4 Prevalence of Anaemia in Pregnancy.

Among participants, 334/426 (78.4%) were anaemic (Hb<11.0 g/dl) at first visit (registration) while 330/426 (77.5%) were anaemic on current visit (day of interview). On first visit 216/426 (50.7%) participants had moderate anaemia but on current visit 167/426 (39.2%) had moderate anaemia. In KMH on current visit 163/234 (69.7%) participants were anaemic whereas 167/192 (86.9%) were anaemic at SHH. There was statistically significant difference in the median Hb among 234 participants at KMH compared to 192 participants at SHH ($p < 0.001$). Overall, prevalence of anaemia in pregnancy in Keta Municipality was 77.5% (95% CI: 73.2%-81.3%). Figure 4.1 below illustrates the prevalence of anaemia in pregnancy in Keta Municipality.

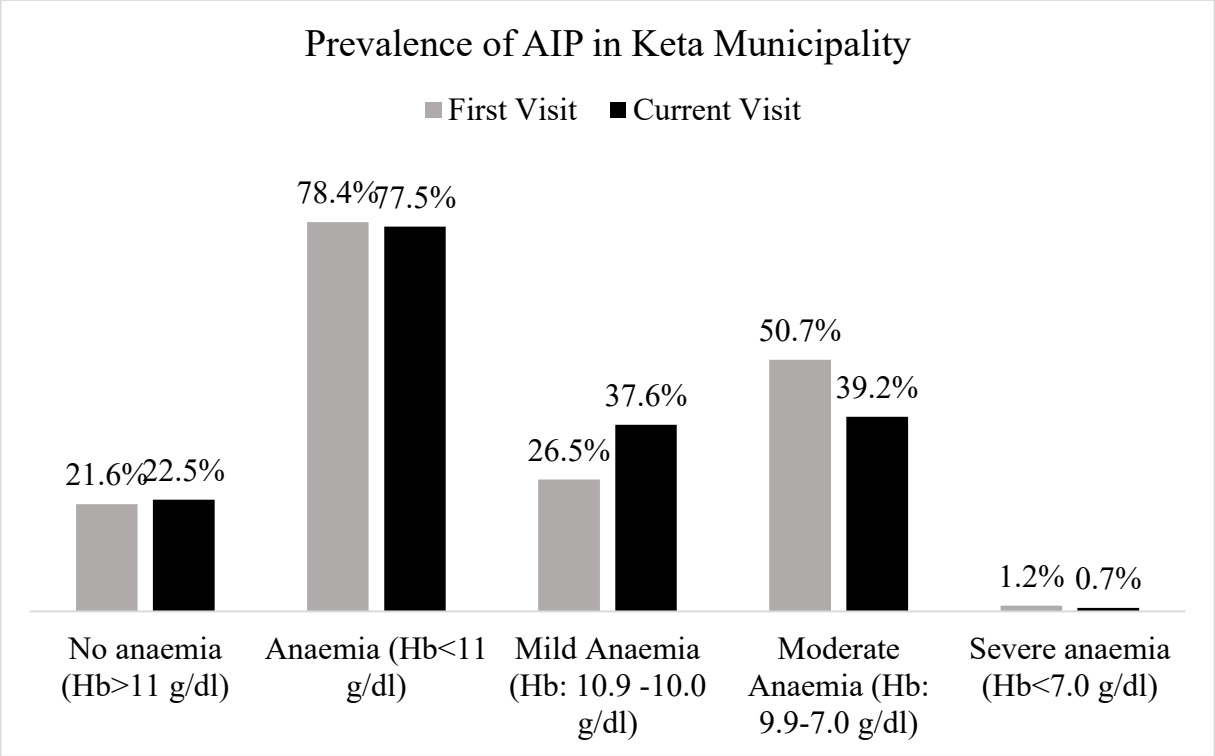

Figure 4.1: Prevalence of Anaemia in Pregnancy at First and Current Visit

4.5 Bivariate Analyses of AIP

Factors associated with anaemia in pregnancy from Pearson chi-square test were place of residence and maternal educational level ($p < 0.05$). Also, gestational age at current visit, mode of delivery of last child prior to current pregnancy, mode of abortion and sickle cell status were statistically significantly related to anaemia in pregnancy. Others included administration of IPTp-SP, prophylactic treatment of helminth in pregnancy, consumption of iron, folic acid and multivitamins as well as participants' nutritional adequacy.

Tables 4.3, 4.4, 4.5, 4.6 and 4.7 below describe in detailed bivariate analyses of factors associated with anaemia in pregnancy.

Table 4.3a: Bivariate Analyses of Sociodemographic Factors

Factors	No Anaemia *n* (%)	Anaemia *n* (%)	Total *N* (col %)	χ^2	P-value
Age categories					
15-19	7(21.2)	26(78.8)	33(7.8)	8.34	0.08
20-24	21(23.6)	68(76.4)	89(20.9)		
25-29	31(24.0)	98(76.0)	129(30.3)		
30-34	30(28.3)	76(71.7)	106(24.9)		
35 and above	7(10.1)	62(89.9)	69(16.2)		
Ethnicity					
Ewe	79(21.5)	288(78.5)	367(86.2)	5.05	0.177*
Akan	10(40.0)	15(60.0)	25(5.9)		
Ga	1(12.5)	7(87.5)	8(1.9)		
Others	6(23.1)	20(76.9)	26(6.10)		
Religion					
Christian	79(22.2)	277(77.8)	356(83.6)	1.41	0.795*
Islam	5(20.0)	20(80.0)	25(5.9)		
Traditional	12(27.9)	31(72.1)	43(10.1)		
Others	0(0)	2(100.0)	2(100.0)		
Marital Status					
Unmarried	20(19.6)	82(80.4)	102(23.9)	0.66	0.417
Married	76(23.5)	248(76.5)	325(76.1)		
Place of residence					
Keta Sub	30(23.8)	96(76.2)	126(29.6)	21.23	**0.001***
Tegbi Sub	28(35.0)	52(65.0)	80(18.8)		
Anloga Sub	19(31.7)	41(68.3)	60(14.1)		
Anyanui Sub	2(11.8)	15(88.2)	17(4.0)		
Shime Sub	3(20.0)	12(80.0)	15(3.5)		
Anyako Sub	7(10.0)	63(90.0)	90(16.4)		
Other district	7(12.1)	51(87.9)	58(13.6)		
Educational Level					
No formal education	11(24.4)	34(75.6)	45(10.6)	14.62	**0.006**
Primary education	21(23.3)	69(76.7)	90(21.1)		
Junior High	25(14.4)	149(85.6)	174(40.9)		
Senior High	29(33.0)	59(67.1)	88(20.7)		
Tertiary	10(34.5)	19(65.5)	29(6.81)		

Footnote: Pearson chi-square (χ^2) was used to examine relationship between different factors and anaemia status at current visit. P-value <0.05 are statistically significant. * represents p-values from Fisher's exact.

Table 4.3b: Bivariate Analyses of Sociodemographic Factors

Factors	No Anaemia *n* (%)	Anaemia *n* (%)	Total *N* (col %)	χ^2	P-value
Maternal employment status					
Unemployed	16(18.6)	70(81.4)	86(20.2)	0.95	0.329
Employed	80(23.5)	260(76.5)	340(79.8)		
Partner's employment status					
Unemployed	6(35.3)	11(64.7)	17(4.0)	1.65	0.199
Employed	90(22.0)	319(78.0)	409(96.0)		

Table 4.4a: Bivariate Analyses of Obstetric Factors

Factors	No Anaemia *n* (%)	Anaemia *n* (%)	Total *N* (col %)	χ^2	P-value
Gestational age at first visit					
First trimester	69(25.9)	197(74.1)	266(62.4)	5.18	**0.047***
Second trimester	26(16.6)	131(83.4)	157(36.9)		
Third trimester	1(33.3)	2(66.7)	3(0.7)		
Gestational age at current visit					
Second trimester	24(36.4)	42(63.6)	66(15.5)	8.56	**0.003**
Third trimester	72(20.0)	288(20.0)	360(84.5)		
Gravidity					
1-2 pregnancies	51(23.8)	163(76.2)	214(50.2)	0.82	0.662
3-4 pregnancies	33(22.5)	114(77.5)	147(34.5)		
5 or more pregnancies	12(18.5)	53(81.5)	65(15.3)		
Parity					
Do not have a child	32(23.9)	102(76.1)	134(31.5)	0.20	0.653
Has child/children	64(21.9)	228(78.1)	292(68.5)		
Number of children					
1-2 children	50(22.6)	171(77.4)	221(75.7)	0.54	0.874*
3-4 children	13(20.6)	50(79.4)	63(21.6)		
5 or more children	1(12.5)	7(87.5)	8(2.7)		

Footnote: Pearson chi-square (χ^2) was used to examine relationship between different factors and anaemia status at current visit. P-value <0.05 are statistically significant. * represents p-values from Fisher's exact.

Table 4.4b: Bivariate Analyses of Obstetric Factors

Factors	No Anaemia *n* (%)	Anaemia *n* (%)	Total *N* (col %)	χ^2	P-value
Mode of delivering last child					
Spontaneous vaginal delivery	50(23.1)	166(76.9)	216(74.0)	9.64	**0.008**
Assisted vaginal delivery	11(35.5)	20(64.5)	31(10.6)		
Caesarean section	3(6.7)	42(93.3)	45(15.4)		
BMI at first visit					
Underweight	11(36.7)	19(63.3)	30(7.0)	6.57	0.087
Normal weight	38(19.3)	159(80.7)	197(46.2)		
Overweight	23(20.2)	91(79.82)	114(26.8)		
Obese	24(28.2)	61(71.8)	85(20.0)		
BMI at current visit					
Underweight	2(28.2)	5(71.4)	7(1.6)	1.50	0.648*
Normal weight	25(18.9)	107(81.1)	132(31.0)		
Overweight	38(24.2)	119(75.8)	157(36.9)		
Obese	31(23.9)	99(76.1)	130(30.5)		
HIV status					
Negative	95(23.1)	316(76.9)	411(96.5)	2.68	0.302*
Positive	1(14.3)	6(85.7)	7(1.6)		
HIV Test not done	0(0)	8(100.0)	8(1.8)		
Sickling status					
Negative	78(20.9)	296(79.1)	374(87.8)	4.95	**0.026**
Positive	18(34.6)	34(65.4)	52(12.2)		
Anaemia status at first visit					
Severe anaemia	2(40.0)	3(60.0)	5(1.2)	26.92	**<0.001**
Moderate anaemia	32(14.8)	184(85.2)	216(50.7)		
Mild anaemia	24(21.2)	89(78.8)	113(26.5)		
No anaemia	38(41.3)	54(58.7)	92(21.6)		
History of bleeding in current pregnancy					
No	83(22.7)	283(77.3)	366(85.9)	0.03	0.862
Yes	13(21.7)	47(78.3)	60(14.1)		

Pearson chi-square (χ^2) was used to examine relationship between different factors and anaemia status at current visit. P-value <0.05 are statistically significant. * represents p-values from Fisher's exact.

Table 4.4c: Bivariate Analyses of Obstetric Factors

Factors	No Anaemia *n* (%)	Anaemia *n* (%)	Total *N* (col %)	χ^2	P-value
History of abortion					
No	62(24.0)	196(76.0)	258(60.6)	0.84	0.36
Yes	34(20.2)	134(79.8)	168(39.4)		
Number of abortion					
1-2 abortions	33(20.9)	125(79.1)	158(94.1)	0.69	0.689*
3 or more abortions	1(10.0)	9(90.0)	10(5.9)		
Type of abortion					
Spontaneous abortion	13(13.0)	87(87.0)	100(59.5)	8.02	**0.005**
Induced abortion	21(30.9)	47(69.1)	68(40.5)		

Pearson chi-square (χ^2) was used to examine relationship between different factors and anaemia status at current visit. P-value <0.05 are statistically significant. * represents p-values from Fisher's exact.

Table 4.5: Bivariate Analyses of ANC Interventions

Factors	No Anaemia *n* (%)	Anaemia *n* (%)	Total *N* (%)	χ^2	P-value
History of malaria treatment					
No	59(21.1)	221(78.9)	280(65.7)	1.00	0.317
Yes	37(25.3)	109(74.7)	146(34.3)		
Prophylactic treatment of helminthiasis					
No	17(12.7)	117(87.3)	134(31.5)	10.86	**0.001**
Yes	79(27.1)	213(72.9)	292(68.5)		
Provision of ITNs					
No	6(16.7)	30(83.3)	36(8.5)	0.77	0.378
Yes	90(23.1)	300(76.9)	390(91.5)		
Administration of IPTp-SP					
Less than 3 doses	33(21.4)	121(78.6)	154(36.2)	6.16	**0.046**
3 doses	29(18.0)	132(82.0)	161(37.8)		
More than 3 doses	34(30.6)	77(69.4)	111(26.1)		

Pearson chi-square (χ^2) was used to examine relationship between different factors and anaemia status at current visit. P-value <0.05 are statistically significant.

Table 4.6: Bivariate Analyses of Behavioural Factors

Factors	No Anaemia *n* (%)	Anaemia *n* (%)	Total *N* (%)	χ^2	P-value
Alcohol beverage intake					
No	84(23.2)	278(76.8)	362(85.0)	0.62	0.432
Yes	12(18.8)	52(18.2)	64(15.0)		
Frequency of alcohol intake					
Once per week	2(12.5)	14(87.5)	16(25.0)	0.84	0.847*
Less than thrice per week	2(22.2)	7(77.8)	9(14.1)		
Occasionally	8(21.1)	30(78.9)	38(59.4)		
Others	0(0)	1(100.0)	1(1.5)		
Use of ITN (last night)					
No	26(22.0)	92(78.0)	118(27.7)	0.02	0.878
Yes	70(22.7)	238(77.3)	308(72.3)		
Food Taboos					
Not observed	69(21.6)	251(78.4)	320(75.1)	0.70	0.404
Observed	27(25.5)	79(74.5)	106(24.9)		
Pica intake					
No	73(24.2)	229(75.8)	302(70.9)	1.59	0.207
Yes	23(18.5)	101(81.5)	124(29.1)		
Use of herbal medicine					
No	93(23.6)	301(76.4)	394(92.5)	3.43	0.077*
Yes	3(9.4)	29(90.6)	32(7.5)		
Iron and folic acid intake					
No	9(45.0)	11(55.0)	20(4.7)	6.07	**0.014**
Yes	87(21.4)	319(78.6)	406(95.3)		

Pearson chi-square (χ^2) was used to examine relationship between different factors and anaemia status at current visit. P-value <0.05 are statistically significant. * represents p-values from Fisher's exact

Table 4.7: Bivariate Analyses of Maternal Adherence to Iron, Folic Acid and Multivitamin and Nutritional Adequacy

Factors	No Anaemia *n* (%)	Anaemia *n* (%)	Total *N* (%)	χ^2	P-value
Adherence to supplements					
Non-adherent	28(22.9)	94(77.1)	122(28.6)	0.02	0.897
Adherent	68(22.4)	236(77.6)	304(71.4)		
Maternal minimum dietary diversity					
Inadequate (< 5 food groups)	63(20.1)	251(79.9)	314(73.7)	4.18	**0.041**
Adequate (5 or more food groups)	33(29.5)	79(70.5)	112(26.3)		

4.6 Multivariable Regression Analyses of Factors Associated with AIP

All variables from literature examined in this study and those statistically significant from bivariate analyses were included in the multivariable logistic regression. Predictors of anaemia in pregnancy were maternal age, sickling status, mode of abortion and food taboos, controlling for place of residence, gestational age at first visit, BMI at first visit, anaemia status at first visit, prophylactic treatment of helminth infection, administration of IPTp-SP, iron supplement intake and minimum dietary diversity status.

The odds of anaemia in pregnancy among participants from Tegbi sub-district was 75% reduced compared to participants from other districts (COR = 0.25, 95% CI: 0.10-0.64, p = 0.013) and those from Anloga sub-district had 71% reduced odds of anaemia in pregnancy compared to participants from other districts (COR = 0.29, 95% CI: 0.11-0.77, p = 0.013). The odds of anaemia in pregnancy was 1.8 times among participants in their second trimester at first visit compared to those in their first trimester at first visit (COR =

1.76, 95% CI: 1.07-2.92, p = 0.027). On the day of interview, women who were in their third trimester had 2.3 times odds of anaemia in pregnancy compared to those in second trimester (COR = 2.29, 95% CI: 1.30-4.01, p = 0.004). Participants who delivered their last child prior to current pregnancy through caesarean section had 4 times odds of anaemia in pregnancy compared to those who delivered vaginally (spontaneous) (COR = 4.22, 95% CI: 1.25-14.19, p = 0.020). At first visit, the odds of anaemia in pregnancy was 59% lower among those who were underweight compared to those who had normal BMI (COR = 0.41, 95% CI: 0.18-0.94, p = 0.035). After controlling for other variables, there was 92% reduced odds of anaemia among positive sickle cell participants (AOR = 0.08, 95% CI: 0.02-0.44, p = 0.004).

Controlling for other variables in the multivariable logistic regression analysis, those who had spontaneous abortion are 5 times more likely to be anaemic compared to those who had induced abortion (AOR = 4.58, 95% CI: 1.41-18.46, p = 0.032). At first visit, participants were 4 times likely to be anaemic if they were moderately anaemic and 3 times if they were mildly anaemic compared to those who were not anaemic (COR moderate anaemia = 4.05, 95% CI: 2.31-7.08, p <0.001, COR mild anaemia = 2.61, 95% CI: 1.41-4.82, p = 0.002). Those who were given prophylactic treatment for helminth infection in current pregnancy had 61% reduced odds of anaemia compared to those who were not treated (COR = 0.39, 95% CI: 0.22-0.69, p = 0.001). Participants who received more than 3 doses of IPTp-SP had 50% reduced odds of anaemia in pregnancy compared to those who received 3 doses (COR = 0.50, 95% CI: 0.28-0.88, p = 0.016).

Women who reported consumption of iron, folic acid and multivitamin had 3 times odds of anaemia compared to those who did not take their supplements (COR = 3.00, 95% CI: 1.20-7.47, p = 0.018). However, there was no relationship between adherence to supplements and anaemia in pregnancy using MMAS-8 item. There was also 75% reduced odds of anaemia among those who reported food taboos in current pregnancy compared to those without food taboos (AOR = 0.25, 95% CI: 0.06-0.96, p = 0.043). Those who consumed less than 5 food groups had 2 times the odds of anaemia in pregnancy compared with those who ate more than 5 food groups (COR = 1.67, 95% CI: 1.01-2.72, p = 0.042). Table 4.10 below describes all factors in both univariable and multivariable logistic regression analyses.

Table 4.8a: Univariable and Multivariable Analyses of Factors Associated with AIP

Variables	COR	95% CI	P-value	AOR	95% CI	P-value
Age categories						
35 and above*	1.00					
15-19	0.42	0.13-1.32	0.136	0.02	0.00-0.53	**0.021**
20-24	0.37	0.15-0.92	**0.032**	0.05	0.00-0.96	**0.047**
25-29	0.36	0.15-0.86	**0.022**	0.09	0.01-1.28	0.076
30-34	0.29	0.12-0.69	**0.006**	0.07	0.00-0.98	**0.048**
Ethnicity						
Others*	1.00					
Ewe	1.09	0.42-2.82	0.850			
Akan	0.45	0.13-1.51	0.190			
Ga	2.10	0.21-8.30	0.530			
Marital Status						
Unmarried	1.00					
Married	0.79	0.46-1.38	0.420			

Table 4.8b: Univariable and Multivariable Analyses of Factors Associated with AIP

Variables	COR	95% CI	P-value	AOR	95% CI	P-value
Place of residence						
Other district*	1.00					
Keta Sub	0.44	0.18-1.07	0.070	2.53	0.26-24.61	0.424
Tegbi Sub	0.25	0.10-0.64	**0.003**	0.57	0.06-5.71	0.632
Anloga Sub	0.29	0.11-0.77	**0.013**	0.91	0.07-12.35	0.94
Anyanui Sub	1.03	0.19-5.49	0.970	2.69	0.10-71.51	0.555
Shime Sub	0.54	0.12-2.44	0.430	1.74	0.08-37.35	0.723
Anyako Sub	1.24	0.41-3.76	0.710	23.31	0.67-812.14	0.082
Educational Level						
No formal education*	1.00					
Primary education	1.06	0.46-2.46	0.890			
Junior high	1.93	0.87-4.29	0.110			
Senior high	10.66	0.29-1.40	0.310			
Tertiary	0.61	0.22-1.71	0.350			
Maternal employment status						
Unemployed*	1.00					
Employed	0.74	0.41-1.35	0.330			
Gestational age at first visit						
First trimester*	1.00					
Second trimester	1.76	1.07-2.92	**0.027**	1.86	0.45-7.65	0.389
Third trimester	0.70	0.06-7.85	0.770			
Gestational age at current visit						
Second trimester*	1.00					
Third trimester	2.29	1.30-4.01	**0.004**			
Gravidity						
1-2 pregnancies*	1.00					
3-4 pregnancies	1.08	0.65-1.78	0.760			
5 or more pregnancies	1.38	0.69-2.78	0.366			
Parity						
1-2 children*	1.00					
3-4 children	1.12	0.57-2.23	0.738			
5 or more children	2.05	0.25-17.03	0.508			
Mode of delivering last child						
Spontaneous vaginal delivery*	1.00					
Assisted vaginal delivery	0.55	0.25-1.22	0.140			
Caesarean section	4.22	1.25-14.19	**0.020**			

Table 4.8c: Univariable and Multivariable Analyses of Factors Associated with AIP

Variables	COR	95% CI	P-value	AOR	95% CI	P-value
BMI at first visit						
Underweight	0.41	0.18-0.94	**0.035**	0.80	0.64-9.81	0.857
Normal weight*	1.00					
Overweight	0.95	0.53-1.69	0.850	1.02	0.19-5.59	0.983
Obese	0.61	0.34-1.10	0.098	1.20	0.20-7.11	0.841
Sickling status						
Negative*	1.00					
Positive	0.50	0.27-0.93	**0.028**	0.08	0.02-0.44	**0.004**
Mode of abortion						
Induced abortion*	1.00					
Spontaneous abortion	2.99	1.37-6.51	**0.006**	4.58	1.14-18.46	**0.032**
Anaemia status at first visit						
No anaemia*	1.00					
Severe anaemia	1.06	0.17-6.62	0.954	0.02	0.00-19.29	0.494
Moderate anaemia	4.05	2.31-7.08	**<0.001**	5.08	1.19-21.74	**0.029**
Mild anaemia	2.61	1.41-4.82	**0.002**	6.35	0.96-42.17	0.056
Use of ITN						
No*	1.00					
Yes	0.96	0.58-1.60	0.878			
Food Taboos						
Not Observed*	1.00					
Observed	0.80	0.48-1.34	0.404	0.25	0.06-0.96	**0.043**
Anthelminthic						
No*	1.00					
Yes	0.39	0.22-0.69	**0.001**	0.73	0.15-3.54	0.692
Administration of IPTp-SP						
3 doses*	1.00					
Less than 3 doses	0.81	0.46-1.41	0.446	2.39	0.49-11.62	0.278
More than 3 doses	0.50	0.28-0.88	**0.016**	2.75	0.39-18.98	0.303
Iron supplement intake						
No*	1.00					
Yes	3.00	1.20-7.47	**0.018**	2.46	0.06-109.46	0.64
Adherence to iron and folic acid supplement						
Non-adherent*	1.00					
Adherent	1.03	0.63-1.71	0.897			
Minimum dietary diversity status						
Adequate (5 or more food groups)*	1.00					
Inadequate (< 5 food groups)	1.67	1.01-2.72	**0.042**	0.86	0.19-3.87	0.846

CHAPTER FIVE

Discussion

5.1 Prevalence of Anaemia in Pregnancy

From the study, the prevalence of anaemia was 77.5% (95% CI: 73.2 – 81.3). Prevalence for mild anaemia (Hb = 10-10.9g/dl) was 37.6%, moderate anaemia (Hb = 7.0-9.9g/dl) accounted for 39.2%, and severe anaemia (Hb < 7g/dl) was 0.7%. This is consistent with previous anaemia studies conducted in Ghana and elsewhere. A study by Owusu et al., (2005) in Ghana using Hb< 10g/dl as cut off for anaemia revealed that 57.1% of the pregnant women were anaemic. Another study by Crowther, Tay, Nani, and Walana (2017) in Dangme East district of Ghana also reported high prevalence of 66.4% anaemia in pregnancy. However in other sub-Saharan countries, some studies reported prevalence less than 40%. For example, a study by Stephen et al. (2018) in northern Tanzania reported that, the prevalence was 18% while in rural Sidama, southern Ethiopia it was 31.6% (Gebremedhin, Enquselassie, & Umeta, 2014). According to a study carried out between 2003 and 2005 by McLean et al. (2009), Africa had the highest anaemia in pregnancy (56.1%), but the greatest number of people affected were in Asia. Globally, the estimated anaemia among pregnant women was 30.2% (McLean et al., 2009).

5.2 Age and Anaemia in Pregnancy

Age was inversely related to the odds of anaemia comparing adolescent girls to older women. In the adjusted analyses, pregnant adolescent girls (15-19 years) had 98% reduced odds of anaemia compared to those aged 35 and above. This is also consistent with the findings of Uche-Nwachi et al. (2010), who found out that age was inversely related to

anaemia in pregnancy. Other studies also confirmed inverse relationship between age and anaemia in pregnancy (Adebisi & Strayhorn, 2005). This is partly due to possible multiple pregnancies, nutritional deficiencies and gynaecological problems as women grow older (Singh, Nagesh, & Ray, 2018).

5.3 Sickle Cell Traits and Anaemia in Pregnancy

Sickle cell disease is a known risk factor to the occurrence of anaemia in pregnancy (Kassebaum et al., 2014), but some studies reported no relationship between sickle cell trait and anaemia in pregnancy, since it is a rare situation (Nitin, 2010). Pregnant women with sickle cell traits (HbAS) were described by WHO (2002) to be asymptomatic with normal haemoglobin level, however this study found a strong association between sickle cell trait status and anaemia in pregnancy. Participants with positive sickle cell status had 92% odds of anaemia compared to those without sickle cell trait, controlling for other factors in the adjusted logistic regression (AOR: 0.08, 95% CI: 0.02-0.44, $p = 0.004$). This is consistent with a review on complications associated with sickle cell traits, that reported sickle cell trait to be associated with anaemia in pregnancy (Tsaras, Owusu-Ansah, Boateng, & Amoateng-Adjepong, 2009). Contrary to these findings, a review on clinical conditions and their association with sickle cell traits identified no relationship between anaemia and sickle cell traits, rather, urinary tract infections and haematuria (Nitin, 2010). These condition could lead to anaemia if not well treated in pregnancy.

5.4 Abortion and Anaemia in Pregnancy

Pregnant women who had experienced spontaneous abortion, had approximately 5 times odds of anaemia compared to participants who induced abortion. Uche-Nwachi et al.

(2010) in their study also found out that pregnant women with 2–3 spontaneous abortions were more likely to have anaemia than those who had 1, but in another study by Gedefaw, Ayele, Asres and Mossie (2015) there was no relationship between the mode of abortion and anaemia in pregnancy.

5.5 Food Taboos and Anaemia in Pregnancy

Cultural taboos are contributing factors to developing anaemia in pregnancy (Freire et al., 2003). However, in this study, those who were observing some food taboos in their current pregnancy had 75% reduced odds of anaemia compared to those without food taboos adjusting for other variables in the model. The study findings are contrary to reports from Liberia which showed that food taboos contributed to the occurrence of anaemia amongst pregnant women (Jackson and Jackson 1987).

5.6 Study Limitation

The study being a hospital-based cross sectional design was limited in determining significant predictors of anaemia in pregnancy in Keta Municipality. Simply because participants may incorrectly provide responses to some variables of interest. Conducting the study in the two major hospitals in Keta municipality only reflected the prevalence of anaemia amongst pregnant women attending antenatal care in these two health facilities. The prevalence cannot be generalized to the whole Keta Municipality. Similarly, there were many pregnant women who attend antenatal care at clinics and health centers within the municipality but were not considered in this study, though participants were from all six health zones of the municipality.

CHAPTER SIX

Conclusion and Recommendation

The prevalence of anaemia in pregnancy in Keta municipality is high. Maternal age, sickling status, previous anaemia and mode of abortion as well as food taboos appears to affect haemoglobin level of pregnant women in this study. This is the first study to identify that mode of abortion is associated with anaemia in pregnancy.

Pregnant women and their families must be educated on significant factors to curb high prevalence of AIP. Stakeholders must also consider the high prevalence and associated factors in planning maternal and child interventions.

References

Adanikin, A. I., & Awoleke, J. O. (2016). Sociodemographic factors associated with anaemia in pregnancy at booking for antenatal care. *Journal of Obstetrics and Gynaecology : The Journal of the Institute of Obstetrics and Gynaecology*, *36*(1), 44–7. https://doi.org/10.3109/01443615.2015.1025727

Adebisi, O. Y., & Strayhorn, G. (2005). Anemia in pregnancy and race in the United States: blacks at risk. *Family Medicine*, *37*(9), 655–62. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/16193419

Ahanhari, A. ., Myles, P. ., Dixit, J. ., Tata, L. ., & Fogarty, A. . (2017). Risk factors for maternal anaemia and low birth weight in pregnant women living in rural India a prospective cohort study. *Public Health*, *22*(151), 63–73. https://doi.org/http://dx.doi.org/10.1016/j.puhe.2017.06.023

Anlaakuu, P., & Anto, F. (2017). Anaemia in pregnancy and associated factors: a cross sectional study of antenatal attendants at the Sunyani Municipal Hospital, Ghana. *BMC Research Notes*, *10*(1), 402. https://doi.org/10.1186/s13104-017-2742-2

Arifulla, M., Patil, A., Sajjanar, B., Yendigeri, S., Honakeri, V., Fathima, N., & Nausheen, N. (2013). Prevalence Of Anaemia In Pregnancy In Hospital Based Population In Bijapur, Karnataka. *Journal of Evolution of Medical and Dental Science*, *2*(35), 6673–81.

Balarajan, Y., Ramakrishnan, U., Özaltin, E., Shankar, A. H., & Subramanian, S. V. (2011). Anaemia in low-income and middle-income countries. *The Lancet*, *378*(9809), 2123–2135. https://doi.org/10.1016/S0140-6736(10)62304-5

Bendich, A. (2008). *Nutrition and Health in Developing Countries*. (R. D. Semba & M. W. Bloem, Eds.), *Journal of Chemical Information and Modeling* (Second Edi, Vol. 53). Humana Press.

Bothwell, T. H. (2000). Iron requirements in pregnancy and strategies to meet them. *The American Journal of Clinical Nutrition*, *72*(1), 257S–264S. https://doi.org/10.1093/ajcn/72.1.257S

Casey, G. J., Jolley, D., Phuc, T. Q., Tinh, T. T., Tho, D. H., Montresor, A., & Biggs, B.-A. (2010). Long-Term Weekly Iron-Folic Acid and De-Worming Is Associated with Stabilised Haemoglobin and Increasing Iron Stores in Non-Pregnant Women in Vietnam. *PLoS ONE*, *5*(12), e15691. https://doi.org/10.1371/journal.pone.0015691

Chowdhury, H. A., Ahmed, K. R., Jebunessa, F., Akter, J., Hossain, S., & Shahjahan, M. (2015). Factors associated with maternal anaemia among pregnant women in Dhaka city. *BMC Women's Health*, *15*(1). https://doi.org/10.1186/s12905-015-0234-x

Crowther, S., Tay, K., Nani, E. A., & Walana, W. (2017). Parasitic infections and maternal anaemia among expectant mothers in the Dangme East District of Ghana, 1–10. https://doi.org/10.1186/s13104-016-2327-5

De Benoist, B., McLean, E., & Egli, I. (2005). *Worldwide prevalence of anaemia*. *WHO Global Database on Anaemia*.

de Silva, N., Sirisena, J., Gunasekera, D., Ismail, M., & de Silva, H. (1999). Effect of mebendazole therapy during pregnancy on birth outcome. *The Lancet*, *353*(9159), 1145–1149. https://doi.org/10.1016/S0140-6736(98)06308-9

DHIMS2. (2017). Keta Municipal. Retrieved from http://keta.ghanadistricts.gov.gh/

Douglas, N. M., Lampah, D. A., Kenangalem, E., Simpson, J. A., Poespoprodjo, J. R., Sugiarto, P., … Price, R. N. (2013). Major Burden of Severe Anemia from Non-Falciparum Malaria Species in Southern Papua: A Hospital-Based Surveillance Study. *PLoS Medicine*, *10*(12), 1–17. https://doi.org/10.1371/journal.pmed.1001575

Ebuy, Y., Alemayehu, M., Mitiku, M., & Goba, G. K. (2017). Determinants of severe anemia among laboring mothers in Mekelle city public hospitals, Tigray region, Ethiopia. *PLOS ONE*, *12*(11), e0186724. https://doi.org/10.1371/journal.pone.0186724

Ezugwu, E. C., Mbah, B. O., Chigbu, C. O., & Onah, H. E. (2013). Anaemia in pregnancy: A public health problem in Enugu, South-east Nigeria. *Journal of Obstetrics and Gynaecology*, *33*(5), 451–454. https://doi.org/10.3109/01443615.2013.771158

FAO. (2016). *Minimum Dietary Diversity for Women: A Guide to Measurement*. Food and Agriculture Organization of the United Nations and USAID's Food and Nutrition Technical Assistance III Project (FANTA), managed by FHI 360 Rome, 2016. Retrieved from www.fao.org/publications

FAO and FHI 360. (2016). *Minimum Dietary Diversity for Women- A Guide to Measurement*. *Food And Nutrition Technical Assistance Ⅲ*.

Feleke, B. E., & Feleke, T. E. (2018). Pregnant mothers are more anemic than lactating mothers, a comparative cross-sectional study, Bahir Dar, Ethiopia. *BMC Hematology*, *18*(1), 2. https://doi.org/10.1186/s12878-018-0096-1

Freire, W. B., Kahn, G. S., McGuire, J., & Post, L. G. (2003). *Anemia Prevention and Control; What Works.*

Gaillard, R., Eilers, P. H. C., Yassine, S., Hofman, A., Steegers, E. A. P., & Jaddoe, V. W. V. (2014). Risk Factors and Consequences of Maternal Anaemia and Elevated Haemoglobin Levels during Pregnancy: a Population-Based Prospective Cohort Study. *Paediatric and Perinatal Epidemiology*, *28*(3), 213–226. https://doi.org/10.1111/ppe.12112

Galloway, R., Dusch, E., Elder, L., Achadi, E., Grajeda, R., Hurtado, E., … Stephen, C. (2002). Women's perceptions of iron deficiency and anemia prevention and control in eight developing countries. *Social Science & Medicine (1982)*, *55*(4), 529–44. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12188461

Garg, B. S., & Bharambe, M. S. (2015). Effectiveness of Weekly Supplementation of Iron to Control Anaemia Among Adolescent Girls of Nashik, Maharashtra, India, *26*(1), 74–78.

Gebre, A., & Mulugeta, A. (2015). Prevalence of anemia and associated factors among pregnant women in north western zone of tigray, northern ethiopia: A cross-sectional study. *Journal of Nutrition and Metabolism*, *2015*(May 2013). https://doi.org/10.1155/2015/165430

Gebremedhin, S., Enquselassie, F., & Umeta, M. (2014). Prevalence and correlates of maternal anemia in rural Sidama, Southern Ethiopia. *African Journal of Reproductive Health*, *18*(1), 44–53. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/24796168

Gedefaw, L., Ayele, A., Asres, Y., & Mossie, A. (2015). Anemia and Associated Factors Among Pregnant Women Attending Antenatal Care Clinic in Wolayita Sodo Town, Southern Ethiopia. *Ethiopian Journal of Health Sciences*, *25*(2), 155–62. https://doi.org/10.4314/ejhs.v25i2.8

Getahun, W., Belachew, T., & Wolide, A. D. (2017). Burden and associated factors of anemia among pregnant women attending antenatal care in southern Ethiopia: Cross sectional study. *BMC Research Notes*, *10*(1). https://doi.org/10.1186/s13104-017-2605-x

Gillespie, S., & Johnston, J. L. (1998). *Expert consultation on anemia determinants and interventions*.

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

Gordeuk, V. R., & Brannon, P. M. (2017). Ethnic and genetic factors of iron status in women of reproductive age. *The American Journal of Clinical Nutrition*, *106*(Supplement 6), 1594S–1599S. https://doi.org/10.3945/ajcn.117.155853

GSS, GHS, & ICF International. (2015). *Ghana 2014 Demographic and Health Survey Key Findings*. https://doi.org/10.5261/2013.GEN1.04

GSS, GHS, & ICF Macro. (2009). *Ghana Demographic and Health Survey 2008*. Accra.

GSS, NMIMR, & ORC Macro. (2003). *Ghana Demographic and Health Survey 2003*. Calverton, Maryland. https://doi.org/10.1111/j.1728-4465.2005.00056.x

Hallberg, L. (1998). Combating iron deficiency: daily administration of iron is far superior to weekly administration. *The American Journal of Clinical Nutrition*, *68*(2), 213–7. https://doi.org/10.1093/ajcn/68.2.213

Harriet Birungi & W. Onyango. (2006). Acceptability and Sustainability of the WHO Focused Antenatal Care package in Kenya. *Population Council Frontiers in Reproductive Health*, (June), 17.

Hurrell, R. F., Reddy, M., & Cook, J. D. (1999). Inhibition of non-haem iron absorption in man by polyphenolic-containing beverages. *The British Journal of Nutrition*, *81*(4), 289–295. https://doi.org/10.1017/S0007114599000537

Ikeanyi, E. M., & Ibrahim, A. I. (2015). Does antenatal care attendance prevent anemia in pregnancy at term Ikeanyi E M, Ibrahim A I - Niger J Clin Pract, *18*(3), 323–328. https://doi.org/http://dx.doi.org/10.4103/1119-3077.151730

Imdad, A., & Bhutta, Z. A. (2012). Routine Iron/Folate Supplementation during Pregnancy: Effect on Maternal Anaemia and Birth Outcomes. *Paediatric and Perinatal Epidemiology*, *26*, 168–177. https://doi.org/10.1111/j.1365-3016.2012.01312.x

Intiful, F. D., Wiredu, E. K., Asare, G. A., Asante, M., & Adjei, D. N. (2016). Anaemia in pregnant adolescent girls with malaria and practicing pica, *8688*, 1–8. https://doi.org/10.11604/pamj.2016.24.96.9282

Jabareen, Y. (2009). Building a Conceptual Framework: Philosophy, Definitions, and Procedure. *International Journal of Qualitative Methods*, *8*(4), 49–62. https://doi.org/10.1177/160940690900800406

JACKSON, R. T., & JACKSON, L. C. (1987). Biological and Behavioral Contributors to Anemia during Pregnancy in Liberia, West Africa. *Human Biology*, *59*, 585–597. https://doi.org/10.2307/41463914

Kahanya, K. W. (2016). Dietary Diversity, Nutrient Intake and Nutritional Status Among Pregnant Women in Laikipia County, Kenya.

Kalaivani, K. (2009). Prevalence & consequences of anaemia in pregnancy. *Indian Journal of Medical Research*, *130*(5), 627–633. https://doi.org/10.1542/peds.2005-1156

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

Kassebaum, N. J., Jasrasaria, R., Naghavi, M., Wulf, S. K., Johns, N., Lozano, R., … Murray, C. J. L. (2014). A systematic analysis of global anemia burden from 1990 to 2010. *Blood*, *123*(5), 615–24. https://doi.org/10.1182/blood-2013-06-508325

Keshav, S., & Stevens, R. (2017). New concepts in iron deficiency anaemia. *British Journal of General Practice*, *67*(654), 10–11. https://doi.org/10.3399/bjgp17X688465

Lam, W. Y., & Fresco, P. (2015). Medication Adherence Measures: An Overview. *BioMed Research International*, *2015*, 217047. https://doi.org/10.1155/2015/217047

Lincetto, O., Mothebesoane-anoh, S., Gomez, P., & Munjanja, S. (2013). Antenatal Care: Opprotunities for Africa's Newborns. *International Journal of Scientific &*

Technology Research, *2*(2), 51–62.

Lokare, P., Gattani, P., Karanjekar, V., & Kulkarni, A. (2012). A study of prevalence of anemia and sociodemographic factors associated with anemia among pregnant women in Aurangabad city, India. *Annals of Nigerian Medicine*, *6*(1), 30. https://doi.org/10.4103/0331-3131.100213

Lynch, S. (2007). Assessing the iron status of populations: ANNEX 1: Indicators of the iron status of populations: red blood cell parameters. *World Health Organization*, 655–666. https://doi.org/10.1007/s00277-011-1164-9

Macdonald, C., Specialist, S. S., Canada, W. V., Mildon, A., Canada, W. V., Neequaye, M., … Yiannakis, M. (2010). Anemia - can its widespread prevalence among women in developing countries be impacted ? 1 . 0 Anemia in Women : A Global Health Priority, (October 2002), 1–42.

Mackerras, D., & Singh, G. (2007). The prevalence of anaemia depends on the definition: an example from the Aboriginal Birth Cohort Study. *European Journal of Clinical Nutrition*, *61*(1), 135–139. https://doi.org/10.1038/sj.ejcn.1602483

Marchant, T., Armstrong Schellenberg, J. R. M., Edgar, T., Ronsmans, C., Nathan, R., Abdulla, S., … Lengeler, C. (2002). Anaemia during pregnancy in southern Tanzania. *Annals of Tropical Medicine & Parasitology*, *96*(5), 477–487. https://doi.org/10.1179/000349802125001221

McClure, E. M., Goldenberg, R. L., Dent, A. E., & Meshnick, S. R. (2013). A systematic review of the impact of malaria prevention in pregnancy on low birth weight and maternal anemia. *International Journal of Gynecology & Obstetrics*, *121*(2), 103–109. https://doi.org/10.1016/j.ijgo.2012.12.014

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

Meda, N., Mandelbrot, L., Cartoux, M., Dao, B., Ouangré, A., & Dabis, F. (1999). Anaemia during pregnancy in Burkina Faso, west Africa, 1995-96: prevalence and associated factors. DITRAME Study Group. *Bulletin of the World Health Organization*, *77*(11), 916–922.

Menaca, A., Pell, C., Manda-taylor, L., Chatio, S., Afrah, N. A., Were, F., … Pool, R. (2013). Local illness concepts and their relevance for the prevention and control of malaria during pregnancy in Ghana , Kenya and Malawi : findings from a comparative qualitative study, 1–15.

Mengist, H. M., Zewdie, O., & Belew, A. (2017). Intestinal helminthic infection and anemia among pregnant women attending ante-natal care (ANC) in East Wollega, Oromia, Ethiopia. *BMC Research Notes*, *10*(1), 440. https://doi.org/10.1186/s13104-017-2770-y

Messick, J. (2015). Determinants of Compliance To Iron Supplementation During Pregnancy in Rural Bangladesh Secondary Data Analysis of the Minimat Trial.

Milman, N. (2006). Iron and pregnancy—a delicate balance. *Annals of Hematology*, *85*(9), 559–565. https://doi.org/10.1007/s00277-006-0108-2

Mocking, M., Savitri, A. I., Uiterwaal, C. S. P. M., Amelia, D., Antwi, E., Baharuddin, M., … Browne, J. L. (2018). Does body mass index early in pregnancy influence the risk of maternal anaemia ? An observational study in Indonesian and Ghanaian women. *BMC Public Health*, *18*(1), 1–9. https://doi.org/10.1186/s12889-018-5704-2

Morisky, D., Green, L., & Levine, D. (1986). Morisky Medication Adherence Scales: MMAS-4 and MMAS-8 MMAS-8 1), 8. Retrieved from https://www.thenationalcouncil.org/wp-content/uploads/2017/03/5_Morisky_Medication_Adherence-Scale.pdf

Mponda, H., Mukasa, O., Abdulla, S., Nathan, R., Edgar, T., Marchant, T., & Lengeler, C. (2002). Socially marketed insecticide-treated nets improve malaria and anaemia in pregnancy in southern Tanzania. *Tropical Medicine and International Health*, *7*(2), 149–158. https://doi.org/10.1046/j.1365-3156.2002.00840.x

Msuya, S. E., Hussein, T. H., Uriyo, J., Sam, N. E., & Stray-Pedersen, B. (2011). Anaemia among pregnant women in northern Tanzania: prevalence, risk factors and effect on perinatal outcomes. *Tanzania Journal of Health Research*, *13*(1), 33–39. https://doi.org/10.4314/thrb.v13i1.60881

Muhsen, K., & Cohen, D. (2008). *Helicobacter pylori* Infection and Iron Stores: A Systematic Review and Meta-analysis. *Helicobacter*, *13*(5), 323–340. https://doi.org/10.1111/j.1523-5378.2008.00617.x

Munasinghe, S., & Broek, N. Van Den. (2006). Anaemia In Pregnancy In Malawi- A Review, *18*(December), 160–174.

Musaiger, A. O. (2002). Iron Deficiency Anaemia Among Children and Pregnant Women in the Arab Gulf Countries: The Need for Action. *Nutrition and Health*, *16*(3), 161–171. https://doi.org/10.1177/026010600201600302

Nandlal, V., Moodley, D., Grobler, A., Bagratee, J., Maharaj, N. R., & Richardson, P. (2014). Anaemia in pregnancy is associated with advanced HIV disease. *PLoS ONE*, *9*(9). https://doi.org/10.1371/journal.pone.0106103

Nguyen, P. H., Gonzalez-Casanova, I., Nguyen, H., Pham, H., Truong, T. V, Nguyen, S., … Ramakrishnan, U. (2015). Multicausal etiology of anemia among women of reproductive age in Vietnam. *European Journal of Clinical Nutrition*, *69*(1), 107–113. https://doi.org/10.1038/ejcn.2014.181

Nitin, J. (2010). A Review of Clinical Profile in Sickle Cell Traits. *Oman Medical Journal*, *25*(1), 3–8. https://doi.org/10.5001/omj.2010.2

Nwizu, E., Iliyasu, Z., Ibrahim, S., & Galadanci, H. (2011). Women ' s Health and Action

Research Centre (WHARC) Socio-Demographic and Maternal Factors in Anaemia in Pregnancy at Booking in Kano , Northern Nigeria Author (s): EN Nwizu , Z Iliyasu , SA Ibrahim and HS Galadanci Published by : Women ' s Health and.

Okoh, D. A., Iyalla, C., Omunakwe, H., Iwo-Amah, R. S., & Nwabuko, C. (2016). A retrospective study of the prevalence of anaemia in pregnancy at booking in Niger Delta, Nigeria. *Journal of Obstetrics and Gynaecology : The Journal of the Institute of Obstetrics and Gynaecology*, *36*(5), 594–7. https://doi.org/10.3109/01443615.2015.1116500

Okunade, K. ., & Adegbesan-Omilabu, M. . (2014). Anaemia among pregnant women at the booking clinic of a teaching hospital in south-western Nigeria. *International Journal of Medicine and Biomedical Research*, 114–120. https://doi.org/10.14194/ijmbr.3.2.7

Ononge, S., Campbell, O., & Mirembe, F. (2014). Haemoglobin status and predictors of anaemia among pregnant women in Mpigi, Uganda. *BMC Research Notes*, *7*(1), 712. https://doi.org/10.1186/1756-0500-7-712

Onyeneho, N. G., Aronu, N. I., Chukwu, N., Agbawodikeizu, U. P., Chalupowski, M., & Subramanian, S. V. (2016). Factors associated with compliance to recommended micronutrients uptake for prevention of anemia during pregnancy in urban , peri-urban , and rural communities in Southeast Nigeria, 1–18. https://doi.org/10.1186/s41043-016-0068-7

Onyeneho, N. G., & Igweonu, O. U. (2016). Anaemia is typical of pregnancies: capturing community perception and management of anaemia in pregnancy in Anambra State, Nigeria. *Journal of Health, Population, and Nutrition*, *35*(1), 29. https://doi.org/10.1186/s41043-016-0066-9

Oppenheimer, S. J. (2001). Iron and Its Relation to Immunity and Infectious Disease. *The Journal of Nutrition*, *131*(2), 616S–635S. https://doi.org/10.1093/jn/131.2.616S

Owusu, W. B., Akanmori, B. D., & Glover-Amengbor, M. (2005). DETERMINANTS OF ANAEMIA IN PREGNANCY IN SEKYERE WEST DISTRICT , GHANA, *39*(3), 102–107.

Parinitha, S., & Kulkarni, M. (2012). Haematological changes in HIV infection with correlation to CD4 cell count. *The Australasian Medical Journal*, *5*(3), 157. https://doi.org/10.4066/AMJ.20121008

Pasricha, S. R., Drakesmith, H., Black, J., Hipgrave, D., & Biggs, B. A. (2013). Control of iron deficiency anemia in low- and middle-income countries. *Blood*, *121*(14), 2607–2617. https://doi.org/10.1182/blood-2012-09-453522

Pavord, S., Myers, B., Robinson, S., Allard, S., Strong, J., & Oppenheimer, C. (2012). UK guidelines on the management of iron deficiency in pregnancy. *British Journal of Haematology*, *156*(5), 588–600. https://doi.org/10.1111/j.1365-2141.2011.09012.x

Perry, K. G. J., & Morrison, J. C. (2004). Anaemia Associated with Pregnancy. In *Gynaecology and Obstetrics* (2004 Editi). Lippincott Williams & Wilkins.

Peterson, P., Cornacchia, M. F., & General, N. (2017). Anemia : Pathophysiology , Clinical Features , and Laboratory Evaluation, *30*(7).

Räisänen, S., Kancherla, V., Gissler, M., Kramer, M. R., & Heinonen, S. (2014). Adverse perinatal outcomes associated with moderate or severe maternal anaemia based on parity in Finland during 2006-10. *Paediatric and Perinatal Epidemiology*, *28*(5), 372–380. https://doi.org/10.1111/ppe.12134

Ramakrishnan, U. (2017). Nutritional Anaemias. In *Nervenheilkunde* (Vol. 36, pp. 800–805). https://doi.org/10.1007/s13398-014-0173-7.2

Royal College of Obstetricians and Gynaecologists (RCOG). (2011). Management of Sickle Cell Disease in Pregnancy, (61). Retrieved from https://www.rcog.org.uk/globalassets/documents/guidelines/gtg_61.pdf

RTC, S. W. (2014). Anaemia in Pregnancy. *South West RTC Management of Anaemia in Pregnancy*.

Sam-Wobo, S. O., Akinboroye, T., Anosike, J. C., & Adewale, B. (2008). Knowledge and practices on malaria treatment measures among pregnant women in Abeokuta, Nigeria. *Tanzania Journal of Health Research*, *10*(4), 226–31. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19402584

Sanghvi, T. G., Harvey, P. W. J., & Wainwright, E. (2010). Maternal Iron–Folic Acid Supplementation Programs: Evidence of Impact and Implementation. *Food and Nutrition Bulletin*, *31*(2_suppl2), S100–S107. https://doi.org/10.1177/15648265100312S202

Sarin, J., Podder, L., Kumari, R., & Sujata, N. (2008). A study to determine the prevalence of anemia among registered antenatal mothers in MMIMs & R antenatal OPD with a view to develop and evaluate a planned health education programme on prevention and management of anemia in pregnancy in terms of knowledge . *Nursing and Midwifery Research Journal*, *4*(2), 39–50.

Satyam, P., & Khushbu, Y. (2015). Maternal Anemia in Pregnancy : An Overview, (3).

Scholl, T. O. (2005). Iron status during pregnancy: setting the stage for mother and infant. *The American Journal of Clinical Nutrition*, *81*(5), 1218S–1222S. https://doi.org/10.1093/ajcn/81.5.1218

Scholl, T. O. (2011). Maternal iron status: relation to fetal growth, length of gestation, and iron endowment of the neonate. *Nutrition Reviews*, *69*, S23–S29. https://doi.org/10.1111/j.1753-4887.2011.00429.x

Scott, S. P., Chen-Edinboro, L. P., Caulfield, L. E., & Murray-Kolb, L. E. (2014). *The impact of anemia on child mortality: An updated review*. *Nutrients* (Vol. 6). https://doi.org/10.3390/nu6125915

Singh, T., Nagesh, S., & Ray, T. K. (2018). Magnitude and Correlates of Anemia in Elderly Women of a Resettlement Colony of Delhi. *Journal of Mid-Life Health*, *9*(1), 21–25. https://doi.org/10.4103/jmh.JMH_57_17

Smith, J. L., & Brooker, S. (2010). Impact of hookworm infection and deworming on anaemia in non-pregnant populations: a systematic review. *Tropical Medicine & International Health*, *15*(7), 776–795. https://doi.org/10.1111/j.1365-3156.2010.02542.x

Stephansson, O. (2000). Maternal Hemoglobin Concentration During Pregnancy and Risk of Stillbirth. *JAMA*, *284*(20), 2611. https://doi.org/10.1001/jama.284.20.2611

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

Stephens, J. K., Ofori, M. F., Quakyi, I. A. kyinbah, Wilson, M. L., & Akanmori, B. D. (2014). Prevalence of peripheral blood parasitaemia, anaemia and low birthweight among pregnant women in a suburban area in coastal Ghana. *The Pan African Medical Journal*, *17*(Supp 1), 3. https://doi.org/10.11694/pamj.supp.2014.17.1.3541

Stevens, G. A., Finucane, M. M., De-Regil, L. M., Paciorek, C. J., Flaxman, S. R., Branca, F., … Nutrition Impact Model Study Group (Anaemia). (2013). Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995-2011: a systematic analysis of population-representative data. *The Lancet. Global Health*, *1*(1), e16-25. https://doi.org/10.1016/S2214-109X(13)70001-9

Strengthening Partnerships, Results, and I. in N. G. (SPRING), & Service, G. H. (2016). *Ghana: Landscape Analysis of Anemia and Anemia Programming*. Retrieved from https://www.spring-nutrition.org/publications/reports/ghana-landscape-analysis-anemia-and-anemia-programming

Sullivan, K. M., Mei, Z., Grummer-strawn, L., & Parvanta, I. (2008). Haemoglobin adjustments to define anaemia, *13*(10), 1267–1271. https://doi.org/10.1111/j.1365-3156.2008.02143.x

Tsaras, G., Owusu-Ansah, A., Boateng, F. O., & Amoateng-Adjepong, Y. (2009). Complications Associated with Sickle Cell Trait: A Brief Narrative Review. *The American Journal of Medicine*, *122*(6), 507–512. https://doi.org/10.1016/j.amjmed.2008.12.020

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

Uneke, C. J., Duhlinska, D. D., & Igbinedion, E. B. (2007). Prevalence and public-health significance of HIV infection and anaemia among pregnant women attending antenatal clinics in south-eastern Nigeria. *Journal of Health, Population and Nutrition*, *25*(3), 328–335. https://doi.org/10.2307/23499751

Vasilevski, V., & Carolan-Olah, M. (2016). Food taboos and nutrition-related pregnancy concerns among Ethiopian women. *Journal of Clinical Nursing*, *25*(19–20), 3069–3075. https://doi.org/10.1111/jocn.13319

WHO. (2014). Global Nutrition targets 2015 Anaemia Policy Brief. *Global Nutrition Targets 2025*, *2*(WHO/NMH/NHD/14.4), 8. https://doi.org/WHO/NMH/NHD/14.4

WHO. (2016). WHO Recommendation on Antenatal care for positive pregnancy experience. *WHO Recommendation on Antenatal Care for Positive Pregnancy Experience*, 152. https://doi.org/ISBN 978 92 4 154991 2

World Health Organisation. (2002). The Clinical Use of Blood - Handbook, 221. Retrieved from http://www.who.int/bloodsafety/clinical_use/en/

World Health Organisation. (2015). the Global Prevalence of Anaemia in 2011.

World Health Organization. (2014). Global Nutrition targets 2015 Anaemia Policy Brief. *Global Nutrition Targets 2025*, *2*(WHO/NMH/NHD/14.4), 8. https://doi.org/WHO/NMH/NHD/14.4

World Health Organization, Alavi, S., Ph, D., Bugusu, B., Ph, D., Cramer, G., … Paintal, K. (2013). *Prevention of Iron Deficiency Anaemia in Adolescents Role of Weekly Iron Acid Supplementation*. *Pediatrics* (Vol. 138). https://doi.org/10.3390/nu6125915

Appendix A

Sample Participant Information Sheet

Introduction.

I am ……, (Research Assistant), with Mr. Hope Edem Kofi Kordorwu, a Master of Public Health (MPH) student from the School of Public Health, University of Ghana, Legon and staff of Keta Municipal Hospital.

Anaemia in pregnancy is a problem in this municipality and we are collecting information on various factors that are associated with anaemia in pregnancy among women attending antenatal care in this hospital.

I will ask you few questions and retrieve some information from your antenatal booklet. Please be assured that all information collected will be treated strictly confidential, and no one will be able to trace them back to you.

Purpose and Significance of Research.

This research aims to estimate the occurrence of anaemia in pregnant women attending antenatal care in this hospital. It also seeks to identify the various reasons associated with it. The findings from this research will add relevant information to existing knowledge. They will be provided to the relevant authorities for decision making on the care of pregnant women.

Procedure

A screening form will be used to determine if you qualify to be part of this research. A consent form will then be given to you to sign or thumbprint if you willingly agree to partake in this study. Your midwife will attend to you and send you to the laboratory for haemoglobin test. I will interview you within 30 minutes and retrieve some information from your antenatal record book.

Risk and Benefit.

You may experience mild pain when blood sample is taken from your arm for haemoglobin estimation. You will not be charged any fee for providing information to us.

Voluntary Participation / Withdrawal.

Participation in this research is voluntary. You are free to stop participating any time you feel uncomfortable. However, I would greatly appreciate your effort to respond to all questions.

Anonymity and Confidentiality.

I wish to assure you that information provided to us during this study are for academic research purposes and for publication in a scientific journal. No names will be used and your information cannot be traced to you. All information provided to us will be treated with utmost confidentiality. Data obtained during this study will be encrypted and kept safely by the principal investigator.

Thank you for your interest to participate and share your experience in this important research.

Who to Contact for More Information.

Principal Investigator: Hope Edem Kofi Kordorwu, Department of Epidemiology and Disease Control, School of Public Health, College of Health Science, University of Ghana, Legon-Accra. OR Monitoring, Support and Evaluation Office, Keta Municipal Hospital, P. O. Box KW 82, Keta. Mobile Number: 0243877874, Email Address: hearl220@gmail.com

Academic Supervisor: Dr. Sarfo Bismark, Head of Department (Epidemiology and Disease Control), School of Public Health, College of Health Science, University of Ghana, Legon-Accra. Mobile Number: 0269343169, Email: sbismark@yahoo.com

Ethical Review Committee: Ms. Hannah Frimpong, Administrative Secretary, Ghana Health Service Ethical Review Committee. Office Telephone Number: 0302 681109, Mobile Number: 0243235225 or 0507041223 Email: ghserc@gmail.com

Appendix B

Sample Pregnant Women Screening Questions

Research Assistant's Initials		Serial Number	
Client's Folder Number		Date	____ /____ /20___

RA Instruction: *Tick client's response appropriately and write corresponding number in code column (i.e. if "Yes" write 1, if "No" write 0)*

No.	Question	Responses	*Variable*	Code
1	Are you willing to participate in the study?	0.No [ ] 1.Yes [ ] ***If No, RA must end interview and thank client.***	*sq1cgc*	
2	Is today your first antenatal care visit?	0.No [ ] 1.Yes [ ] ***If Yes, RA must end interview and thank client.***	*sq2fanc*	
3	If No, how many times did you attend antenatal care? (Check ANC booklet)	0. Less than 4 visits [ ] 1. Fourth visit and above [ ] ***If less than four visits, RA must end interview and thank client***	*sq3nanc*	
4	Were all the four visits or more within 2 months? *(Check ANC booklet)*	0.No [ ] 1.Yes [ ] ***If Yes, RA must end interview and thank client***	*sq4vmont*	
5	Were you transfused with blood within the last 4 weeks?	0.No [ ] 1.Yes [ ] ***If Yes, RA must end interview and thank client***	*sq5hmt*	

NB:

- Only those who answered "Yes" to Q1, "No" to Q2, "Fourth visit and above" to Q3, "Three months or more" to Q4 and "No" to Q5, should be included in the study (**i.e. Combination of 1, 0, 1, 0, 0 in Code Column)**
- ***Tick (√) appropriate box:*** 0.DISQUALIFIED [ ] 1.QUALIFIED [ ]

- If client qualifies, provide consent form to be signed and interview with questionnaire.
- If client does not qualify, thank client.

Appendix C

Sample Consent Form (Pregnant Women)

Research Assistant's Initials		Serial Number	
Client's Folder Number		Date	____ /____ /20___

Participant Statement and Signature.

I certify that I understand the research. All questions I asked were answered. I also understand that I am free to discontinue participation at any time if I so choose, and it won't affect my care. I voluntarily agree to answer these questions, because the research has been explained to me.

Participant's Name:

_____

Participant's Signature or Thumbprint: _____ Date:

____/_____/20____

Investigator/Research Assistant Statement and Signature.

I certify that the participant was provided adequate information on the research. All questions raised by the participant were addressed.

Name: _____

Signature: _____

Date: ____/_____/20___

Appendix D

Sample Pregnant Women Questionnaire

Research Assistant's Initials		Serial Number	
Client's Folder Number		Date	____ /____ /20___

RA Instruction: Tick client's response appropriately and write corresponding number in code column not shaded (e.g. if "Ewe" write 0, if Akan write 1).

SECTION A: Socio-Demographic Factors

No	Question	Response	Code	Variables
1	What is your age (in years)?	Specify Age:		*q1age*
2	Which ethnic group do you belong?	0.Ewe [ ] 1.Akan [ ] 2.Ga [ ] 3.Others (specify):_____		*q2tribe*
3	What is your religion?	0.Christian [ ] 1.Islam [ ] 2.Traditional [ ] 3.Others (Specify):_____		*q3relgion*
4	Are you married?	0. No [ ] 1.Yes [ ]		*q4marry*
5	Where do you live?	Specify name of town:		*q5reside*
6	What is your educational status?	0. No formal education [ ] 1.Primary [ ] 2. JSS/JHS [ ] 3.SSS/SHS [ ] 4.Tertiary[ ]		*q6meduc*
7	Are you employed?	0.No [ ] 1.Yes [ ] ***If No skip to Q9***		*q7memploy*
8	If yes state occupation:	Specify:		*q8moccup*
9	Is your partner/spouse employed?	0. No [ ] 1.Yes [ ] 2. Don't Know[ ] ***If No skip to Q11***		*q9pemploy*
10	If yes what state occupation?	Specify:		*q10poccup*

SECTION B: Obstetric and Medical Factors

11	How many times have you been pregnant?	Specify number:		*q11gravid*
12	Do you have children?	0.No [ ] 1.Yes [ ] ***If No skip to Q16***		*q12parity*
13	If yes how many children do you have?	Specify:		*q13nparity*
14	How did you deliver your last child?	0.Spontaneous Vaginal Delivery [ ] 1.Assisted Vaginal Delivery [ ] 2.Caesarean Section [ ]		*q14chbirth*
15	What is your last child's birth date?	DD:_____ /MM:_____ / 20_____		*q15ipi*
16	Have you lost any pregnancy before 22 weeks gestation (5 months 2 weeks)?	0.No [ ] 1.Yes [ ] ***If No skip to Q19***		*q16abort*
17	If yes how many times?	Specify Number:		*q17nabort*
18	How did the last one occur?	0.Spontaneous [ ] 1.Induced [ ]		*q18mabort*
19	Are you bleeding?	0.No [ ] 1.Yes [ ]		*q19haemo*

SECTION C: Behavioural and Sociocultural Factors

No	**Question**	**Response**	**Code**	**Variable**
20	Do you drink alcoholic beverage?	0.No [ ] 1.Yes [ ] ***If No skip to Q21***		*q20alchol*
21	If yes, how often within the last 4 weeks?	0. Once/week [ ] 1. Less than 3 times/month [ ] 2.Occasionally [ ] 3. Others (Specify): _____		*q21nalchol*
22	Do you smoke?	0.No [ ] 1.Yes [ ] ***If No skip to Q23***		*q22smoke*
23	If yes what is your smoking status?	0. Former smoker [ ] 1.Current smoker [ ]		*q23smksta*
24	Last night, did you sleep under insecticide treated net?	0.No [ ] 1.Yes [ ]		*q24itnuse*

25	Are you forbidden from eating any food by your culture/religion?	0.No [ ] 1.Yes [ ] ***If No skip to Q26***		*q25taboo*
26	If yes mention such foods.			*q26ntaboo*
27	Do you eat pica (white clay, "callaba", "ayidor", "kpandokor" etc.) during this pregnancy?	0.No [ ] 1.Yes [ ] ***If No skip to Q28***		*q27pica*
28	If yes, what period of pregnancy did you it (pica)?	0.First trimester (1-3 months) [ ] 1.Second trimester (3-6 months) [ ] 2.Third trimester (6-9months) [ ]		*q28ppica*
29	During this pregnancy, did you take herbal/natural medications?	0.No [ ] 1.Yes [ ] ***If No skip to 30***		*q29herbs*
30	If yes state them:	Specify:		*q30nherbs*
31	Are you taking nutritional supplements?	0.No [ ] 1.Yes [ ]		*q31iron*

SECTION D: Adherence Supplement during Pregnancy Using Morisky Medication Adherence Scales (MMAS-8) (Morisky et al., 1986)

No	***RA instruction: Score 1 to No and 0 to Yes except for VIII where A=1 and either B, C, D, or E=0***	**No=1 Yes= 0**
I	Do you sometimes FORGET to take your supplements?	
II	Over the past two weeks, were there ANY DAYS when you did not take your supplements?	
III	Have you ever reduced or stopped taking your supplements without telling your doctor/midwife because you FELT WORSE when you took it?	
IV	When you TRAVEL or leave home, do you sometimes forget to bring along your iron supplements?	
V	Did you take all your supplements YESTERDAY?	
VI	When you feel healthy do you SOMETIMES STOP taking your supplements?	
VII	Do you ever FEEL HASSLED about sticking to taking your supplement?	
VIII	How OFTEN do you have DIFFICULTY REMEMBERING to take all your iron supplement? A. Never/rarely [ ] B. Once in a while [ ] C. Sometimes [ ] D. Usually [ ] E. All the time [ ] ***(Score A=1 and either B,C,D or E=0)***	

	Total Adherence Scores	
32	**Adherence Grading** *(Tick appropriate box using total score and write corresponding code)* ***Variable:*** *q32mmas* 0. Non-adherence = 0-5 [ ] 1. Adherence = 6-8 [ ]	**Code**

SECTION E: Pregnant Women Dietary Diversity

RA Instruction: *Ask respondent to describe everything that she ate or drank yesterday during the DAY OR NIGHT, whether at HOME OR ANYWHERE ELSE.*

As the participant recalls foods and drinks, mark (√) the corresponding food in the "Description" column and score '1' in each response (Consumed) column. If participant does not mention any food in each row (food group), score "0". Provide appropriate scores under 10 MDD-W food groups.

If the food is not listed in any of the rows on the questionnaire, write the food in the bottom row labelled "Other beverages and food" on next page.

Minimum Dietary Diversity for Women (MDD-W) Questionnaire (FAO, 2016) *RA Instruction: Rows A–N (14 rows) must be aggregated into the Ten MDD-W food groups*				**10 MDD-W food groups**
			Consumed	
	Food Categories	**Description**	**Yes= 1 No=0**	**Yes=1 No=0**
A	Foods made from grains	Porridge, bread, rice, maize, "akple", "kenkey" or other food from grains		1.
B	White roots and tubers and plantains	Potatoes, yams, cassava, cocoyam, taro or any other foods made from white-fleshed roots or tubers, or plantains		

C	Pulses (beans, peas and lentils)	Soybeans, Beans, Cowpea (ayi), or peas (fresh or dried seed)		2.
D	Nuts and seeds	Any tree nut, Groundnut/peanut or certain seeds, tiger nuts, palm nut		3.
E	Milk and milk products	Milk, cheese, yoghurt or other milk products but **NOT** including butter, ice cream,		4.
F	Organ meat	Liver, kidney, heart or other organ meats or blood-based foods		5.
G	Meat and poultry	Beef, pork, lamb, goat, rabbit, wild game meat, chicken, duck or other birds		
H	Fish and seafood	Fresh/dried/fired fish, shellfish or seafood , snail, crab, shrimp, lobster, smoked fish, herrings - "adzador", "adzoatoe", "aborbi", salmon		
I	Eggs	Eggs from poultry or any other bird		6.
J	Dark green leafy vegetables	"Kotomere", spinach ("gboma"), ademe" , dandelion, moringa, turkey berry		7.
K	Vitamin A-rich vegetables, roots and tubers	Apricot ("ato"), Pumpkin, carrots, squash or sweet potatoes, , lettuce,		8.
L	Vitamin A-rich fruits	Ripe mango, ripe papaya, water melon ,		
M	Other vegetables	Tomatoes, okro, garden eggs, cabbage		9.
N	Other fruits	Orange, pineapple, ashanti prum ("akukor"), lemon		10.
		Total Dietary Diversity Score		
33.	**MDD - W Grading** *(Tick appropriate box using total score and write corresponding code)*	0. Inadequate = 0 – 4 [ ] 1. Adequate = 5 – 10 [ ]	**Code**	**Variable** *q33mdds*

***RA Instruction**: Complete additional table by asking participant to describe all she ate yesterday during day and night.* *Write the foods that are not in the list in the bottom row labelled "Other beverages and food".*			Yes=1 No=0
P	Red palm oil	Red / palm oil	
Q	Other oils and fats	Cooking oil, margarine,	
T	Sugar-sweetened beverages	Sweetened fruit juices and "juice drinks", soft drinks/fizzy (coca cola, fanta , sprit) drinks,	

		chocolate drinks, malt drinks, yoghurt drinks or sweet tea or coffee with sugar	
U	Condiments and seasonings	Ingredients used in small quantities for flavour, such as chilies, spices, salt, herbs, fish powder, tomato paste, flavour cubes or seeds	
V	Other beverages and foods *(optionally, specify if not listed)*	Tea, coffee, light soup, alcohol Specify:_____	

SECTION F: Data Extraction Tool

RA Instruction: *Retrieve information for* ***Q 34 – 46*** *from participant's antenatal record book after she has been attended to by the midwife. NB: Questionnaire must match with folder number*

No	Variable	Response	Variable
34	Booking gestational age	Age (in weeks):	*q34reggest*
35	Haemoglobin level at registration	Value: g/dl	*q35reghb*
36	Maternal height	Height: (m)	*q36height*
37	Maternal weight at first visit	Weight: (kg)	*q37weight1*
38	Maternal weight at current visit	Weight: (kg)	*q38weight2*
39	HIV Status	0. Negative [ ] 1.Positive [ ] 2. Not done[ ]	*q39pmtctc*
40	Sickling Status	0.Negative [ ] 1.Positive [ ]	*q40scstatus*
41	Gestational age at current visit	Age (in weeks):	*q41curgest*
42	Current haemoglobin level	Value: g/dl	*q42curhb*

RA Instruction: Q 43 and Q 44: Was participant treated for:

No	Questions	Responses	Code	Variable
43	Malaria	0.No [ ] 1.Yes [ ]		*q43malaria*
44	Worm infection	0.No [ ] 1.Yes [ ]		*q44helminth*
45	How many times was participant given Intermittent Preventive Treatment (IPTp) for malaria?	Specify number:		*q45iptp*
46	Was participant given Insecticide Treated Net?	0.No [ ] 1.Yes [ ]		*q46itn*