DETERMINATION OF POSSIBLE CAUSES OF NUTRITIONAL ANAEMIA AMONG PREGNANT WOMEN IN TAMALE METROPOLIS, GHANA

BY

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DECLARATION

This is to certify that this thesis is the result of research undertaken by Charles Benatifam Jaween towards the award of the Master of Science Degree in Dietetics in the Department of Dietetics, School of Allied Health Sciences, College of Health Sciences, and University of Ghana.

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DEDICATION

This work is dedicated to my family, especially my lovely wife, Doris Debri for her moral support and encouragement, whose relentless love and care have brought me this far, in whom I see the challenge to work harder.

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ABSTRACT

Background: Anaemia is an important public health problem worldwide and the most vulnerable group, are pregnant women and children. Anaemia associated with pregnancy is a serious health problem and its control requires the initial identification of the major factors responsible. Determination of the possible causes of nutritional anaemia among pregnant women is important to ensure satisfactory birth outcomes. In Ghana there is little data on the usual dietary intake among pregnant women in the Northern Region of Ghana.

Aim: The aim of this study was to determine the possible causes of nutritional anaemia among pregnant women reporting for antenatal care at the Tamale Teaching Hospital.

Methods: A cross-sectional study was used to survey 175 pregnant women attending antenatal clinic in Tamale Teaching Hospital. A structured questionnaire was used to collect information on their socio-demographic characteristics. Their dietary intakes were assessed using three 24-hour recalls and a validated food frequency questionnaire (FFQ). The questionnaires were administered on Mondays, Wednesdays, and Fridays for the previous day's food eaten. In order to get the true eating pattern of respondents, dietary assessment using 24-hour recall was carried out three times for each respondent, each on a different day of the week for three weeks. To make it easier for the respondents to recall accurately the previous day's food eaten, portion sizes handy measures were used and later converted to grams for the analysis. The most recent results of laboratory tests for Hb level, malaria status and worm infestation were extracted from selected pregnant women hospital records. Their sickling status was also noted.

Results: Except for vitamin C, the majority of the respondents did not meet the mean percentage of the recommended daily allowance (RDA) for energy, protein, fiber,

vitamin B_{12}, folate, vitamin E, calcium, copper, iron and zinc. Forty seven percent (47%) of the respondents were anaemic as judged by their Hb level, with 40% of them having mild anaemia (10-10.9g/dl) and 7% having moderate anaemia (7.9-9.9g/dl). The income, profession, age and spouse profession were significantly associated with prevalence of anaemia.

Conclusion: Dietary intakes of pregnant women in Tamale Metropolis do not meet their RDAs. Nutrition education for pregnant women should be intensified. It is recommended that girl child education should be encouraged, nutrition professionals provided by Ministry of Health to all ante-natal care units and if possible food fortification should be done by the food industries in Ghana. Further research should also be carried out to evaluate various Ghanaian local food sources rich in micronutrients to improve maternal nutrition.

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ABBREVIATIONS

ACC/SCN	Administrative Committee on Co-ordination/Sub-committee on Nutrition
AI	Adequate Intakes
ADA	American Dietetic Association
BMI	Body Mass Index
ANC	Ante-natal Clinic
DH	Department of Health
FAO	Food and Agricultural Organization
FAS	Foetal Alcohol Syndrome
GHS	Ghana Health Service
GSS	Ghana Statistical Service
Hb	Haemoglobin
IOM	Institute of Medicine
MOH	Ministry of Health
RBC	Red Blood Cells
RDA	Recommended Daily Allowance
SAHS	School of Allied Health Sciences
SP	Sulfadoxine Pyremethamine
TTH	Tamale Teaching Hospital
WCBA	Women of Child Bearing Age
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

Anaemia is defined as a reduced amount of haemoglobin (Hb) in the blood. It is a deficiency in the size or number of red blood cells (RBCs) or the amount of Hb they contain (Mahan *et al.*, 2012). Haemoglobin is a substance in the blood that transports oxygen from the lungs to all parts of the body. The most common type of anaemia, iron deficiency anaemia, is usually caused by low iron intake or absorption and/or excessive iron loss (Thomas & Bishop, 2007); iron forms an essential component of the Hb molecule. Nutritional anaemia results from an inadequate intake of iron, protein, vitamin B12, folic acid, pyridoxine, ascorbic acid, and copper (Mahan *et al*., 2012). Anaemia is classified based on Hb content as hypochromic (pale colour from deficiency of Hb) and normochromic (normal colour), and described according to cell size as macrocytic (larger than normal), normocytic (normal), and microcytic (small).

Haemoglobin levels vary with age, sex, pregnancy, altitude and smoking. Different levels of Hb are considered normal for different categories of people, below which an individual can be classified as anaemic. For example, the normal Hb level for pregnant women at sea level is 11g/dl or 110g/L. A pregnant woman with Hb level below 11g/dl or 110g/L, is said to be anaemic (WHO, 2008). A pregnant woman with anaemia will present with any of the following: angular stomatitis, pallor, glossitis spoon shaped nails, dizziness, fatigue and shortness of breath. The burden of anaemia in pregnant women remains serious and unacceptably high (GHS Annual Report, 2004). Reducing this anaemia burden in pregnant women has progressed minimally, especially in African countries and Ghana is no exception.

Anaemia is an important public health problem worldwide and the most vulnerable group, are pregnant women and children. The causes of anaemia include genetic factors, nutritional deficiencies, and infectious agents. Of the nutritional causes of anaemia, iron deficiency is probably the most common and important because the physiological changes associated with pregnancy exert a demand for additional iron needed for transfer to the foetus (Webster-Gandy *et al*, 2012). Infections, including malaria, worm infestations are also involved in the pathogenesis of anaemia in pregnancy (GHS Annual Report, 2004). Pregnant women are particularly susceptible to malaria in endemic populations and often have higher prevalence as well as severity including anaemia (Amenger-Glover *et al.,* 2005). The changes in the immune system associated with pregnancy have been suggested as the reason mentioned above. Worm infestations on the other hand impair micronutrient absorption thus increasing the susceptibility of pregnant women to anaemia. The emergence of HIV is an additional risk factor for anaemia among pregnant women. Most studies aimed at identifying the causes of anaemia in pregnancy have focused on specific categories of factors such as excessive blood loss and excessive breakdown of erythrocytes (Amenger-Glover *et al.*, 2005).

1.2 PROBLEM STATEMENT

Anaemia was the leading cause of maternal mortality in the 2010 annual report of the Tamale Teaching Hospital with the prevalence of 68.2%. Anaemia is very common among pregnant women in Ghana (GHS Annual Report, 2004). In Ghana the prevalence of anaemia among pregnant women is 65% (GDHS Report, 2008). Anaemia is considered to be high in countries with a prevalence of greater than 40% (WHO, 2008). The Ghana Demographic and Health Survey **(**GDHS) Report (2008) has estimated that by the year 2020, about 9000 mothers in Ghana will die of anaemia if its levels during

pregnancy are not improved. In many African countries, chronic protein energy malnutrition, poor weight gain during pregnancy, anaemia, and other hidden hunger deficiencies are common among women (Huffman *et al.,* 2001). Despite this, few studies have assessed the possible causes of anaemia among pregnant women in the Tamale Metropolis. In order to reduce this trend, it is necessary to determine possible causes of anaemia, especially due to nutrition, in the Tamale Metropolis.

1.3 SIGNIFICANCE OF STUDY

Anaemia is reported among the top ten diseases in Ghana (GHS Annual Report, 2004). In the Northern Region it ranked fourth on the admission list in 2010 and 2011 with an increase in the cases of anaemia from 1196 to 1422 respectively in the Tamale Teaching Hospital. Maternal deaths may occur because of under nutrition. In many African countries, chronic energy deficiencies, poor weight gain in pregnancy, anaemia, and other micronutrient deficiencies are common among women (Huffman *et al.,* 2001). This leads to anaemia in pregnancy, premature labour, low birth weight and increased susceptibility to infection after birth.

The burden of anaemia in pregnant women remains serious and unacceptably high. Reducing the anaemia burden in pregnant women has progressed minimally, especially in African countries and Ghana is no exception. A healthy diet ensures that adequate nutrients are supplied to the whole body to help the body withstand diseases. Sub-Saharan Africa leads the world with the highest fertility rates and the highest percentage of adolescent pregnancies, HIV/AIDS infections, and malaria cases (Barker *et al*., 2002). Despite these advantages, the warning signs and symptoms of poor nutrition are often overlooked. In order to reduce the trend of events, it is necessary to determine the possible causes, the prevalence and effects of anaemia among pregnant women in the

Tamale Metropolis. Findings from this study will be useful in providing appropriate preventive measures to reduce the maternal mortality of which anaemia is the leading cause in Ghana (GHS Annual Report, 2004).

1.4 HYPOTHESIS

There is no relationship between dietary intake and anaemia status of pregnant women in the Tamale Metropolis.

1.5 AIM AND SPECIFIC OBJECTIVES

1.5.1 Aim

The aim of study was to determine the causes of nutritional anaemia among pregnant women in the Tamale Metropolis.

1.5.2 Specific Objectives

The specific objectives of the study were:

1 To measure nutrient intakes of pregnant women and compare with the recommended daily intakes as well as dietary pattern.

2 To determine the relationship between dietary iron intake and anaemia in the pregnant women.

3 To assess the prevalence of anaemia among the pregnant women.

4 To determine the effects of confounding factors (parasitic infestation and sickling status) on anaemia in the pregnant women.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 NUTRITIONAL STATUS

Nutritional status and health in pregnancy is very important. A mother's nutritional status is critical three (3) months before conception (preconception) and 2-3 months after conception (peri-conception). Maternal nutrition significantly affects a woman's health growth and development of the foetus (Admad *et al*., 2008). The foetus is most vulnerable to nutritional deficiencies in the first trimester of pregnancy, often before a woman realizes that she is pregnant. There is evidence that poor maternal nutrition has both immediate such as low birth weight and long-term consequences such as stunting. The so-called "foetal origins" or "Baker" hypothesis proposes that foetal growth plays a major role in determining the risk of some dietary related non communicable diseases such as cardiovascular diseases and type II diabetes in adulthood (Webster-Gandy *et al.*, 2012).

Haemoglobin is formed from nutrients that we obtain from our food. The major nutrient needed in the production of haemoglobin is iron. Other nutrients play a minor but important role either in the formation of blood, its transport or utilization. Among these are: protein, folic acid, vitamin B_6, vitamin B_{12}, vitamin A, iodine, calcium, zinc and vitamin C. In 2008, the Ghana Demographic and Health Survey said the prevalence of anaemia among pregnant women was 70%. The marked increase in maternal blood supply during pregnancy greatly increases the demand for iron. The developing foetus draws enough iron from the mother to last it through the first six months of life after birth so a woman has an increased need for iron during pregnancy (Institute of Medicine, Food and Nutrition Board, 2001). Adequate intakes of rich food sources of

vitamin C such as oranges, mangoes, pawpaw etc. are needed to help in iron absorption. Though iron can be found in a variety of foods, what really matters is the amount of iron consumed that is bioavailability to the body cells. A diet of low bioavailability can cause anaemia, and the bioavailability of iron present in the diet can be determined by the type or form of iron present in the diet and other components (GHS Annual Report, 2004). Malaria and worm infestation and nutrient mal-absorption may interfere with iron absorption.

2.2 NUTRITIONAL CONSIDERATIONS DURING PREGNANCY

2.2.1 Energy needs of pregnant women

Additional energy is required during pregnancy to support the metabolic demands of pregnancy and foetal growth. Metabolism increases by 15% in the singleton pregnancy (Mahan *et al.*, 2012). The 2002 daily recommended intakes (DRIs) for energy for the pregnant woman in the first trimester is the same requirements for the non-pregnant woman. However, this should be increased by 340-360 kcal/day during the second trimester and by another 112 kcal/day in the third trimester (Institute of Medicine, Food and Nutrition Board, 2001). If maternal weight gain is within the desirable limits, the range of acceptable energy intakes varies widely, given individual differences in energy output and basal metabolic rate (Mahan *et al.*, 2012). Maternal energy restriction impairs lactation after birth (Dewey *et al*., 2010).

2.2.2 Macronutrients

The foetus is most susceptible to nutritional imbalance during the first trimester of pregnancy (Keen, 2003). The first trimester is the period during which rapid cell differentiation and the establishment of embryonic systems and organs are taking place (Marieb & Hoehn, 2010). The extra nutritional requirements imposed by pregnancy

must be met by dietary intake and body stores (Butte & King, 2005). Foetal growth depends on the health and nutritional status of the mother before conception, degree of energy demand placed on her during pregnancy and the growth, energy and nutrient demands of the products of conception at different stages of gestation (Webster-Gandy *et al.*, 2012). But it is worth remembering that there are a number of ways in which the nutrient supply to foetus may be regulated, such as changes in maternal food choices and dietary intake, maternal metabolic adaptation, altered maternal absorption, maternal loss (foetal uptake) and varying placental transfer (Nyaruchucha, 2009).

Dietary recommendations are the same as for the normal healthy diet, where energy is 25-35kcal/day, folic acid 0.2mg/d, protein 51g, vitamin D 40mg and vitamin A 0.6mg except for additional requirements for six nutrients of protein, energy, folic acid, vitamins A, C and D (Mahan *et al*., 2012). The additional requirements include: energy +0.8MJ/day, folic acid +0.4mg (first trimester) and +0.1 (2^{nd} and 3^{rd} trimesters), protein +6g, vitamin C +10mg (3^{rd} trimester), vitamin D +0.01mg and vitamin A +0.1mg (Mahan *et al*., 2012).

2.2.2.1 Carbohydrates

DRIs for carbohydrates in pregnancy are estimated average requirements (EARs) at 135g/day; the RDA is 175g/day (Institute of Medicine, Food and Nutrition Board, 2001). These requirements (135 to 175/day) are recommended to provide enough calories in the diet to prevent ketosis and maintain appropriate blood glucose during pregnancy. With an average 2000 kcal/day regimen, 175g translates to 700kcal or 35% calories. The amount of carbohydrate may be greater in women consuming more calories, but careful choices are needed to meet all the daily nutrients for pregnancy.

2.2.2.2 Protein

Pregnancy increases protein requirement to support the synthesis of maternal and foetal tissues, but the magnitude of this increase is uncertain (Mahan *et al*., 2012). Protein requirement increases throughout gestation and is maximized during the third trimester. The current RDA of 0.8g/kg/day of protein for pregnant women is the same as that for the non-pregnant women in the first half of pregnancy. Nutritional needs increase in the second half to 71g/day, based on 1.1g/kg/day of pre-pregnant weight (Institute of Medicine, Food and Nutrition Board, 2001). For each additional foetus, another 25g/day of protein is recommended; this may be as much as 175g/day for the normal- weight women carrying a twin gestation that is consuming 3500kcal/day (Goodnight & Newman, 2009). Protein deficiency during pregnancy has adverse consequences. Limited intakes of protein and energy usually occur together, making it difficult to separate the effects of energy deficiency from those of protein deficiency.

2.2.2.4 Lipids

There is no DRI for lipids during pregnancy. The amount of fat in the diet should have effects on energy requirements for proper weight gain. However, there is a recommendation of an adequate intake (AI) of 13g/day for the amount of omega-6 polyunsaturated fatty acids (linoleic acid) and an IA of 1.4g/day for the amount of omega-3 polyunsaturated fatty acids in the diet (Institute of Medicine, Food and Nutrition Board, 2001). The recommendation for docosahexaenoic acids is 300mg/day. Essential fatty acid requirements can usually be met by one to two portions of fish per week (Simpson *et al*., 2010).

2.2.3 Micronutrients

2.2.3.1 Vitamins

All vitamins are needed for optimal pregnancy outcome. In some instances the provision of these specific vitamins may be met through the diet. Some studies have reported that in developing countries micronutrients intake of pregnant women were inadequate as a result of poor quality of diet (Zeng *et al*., 2008). For others supplement is necessary. Peri-conceptional multivitamin supplementation has been documented to reduce the risk of heart defects in infants if started very early in pregnancy (Mahan *et al.*, 2012). Most vitamin and mineral recommendations increase approximately 15% from non-pregnant values.

2.2.3.1.1 Folate

There is now conclusive evidence that folic acid is of crucial importance in early pregnancy to help protect against neural tube defects (NTD) (DH, 2000) and that there is an inverse dose-response relationship between folate status and risk of neural tube defect (Wald, 2004). Women who have not been supplementing their diet with folic acid and become pregnant should immediately start supplementation and continue until the 12th week of pregnancy. To prevent recurrence of NTDs in the offspring of women or men with NTD, women who may become pregnant should take a daily supplement of 5mg of folic acid. Although it has been suggested that periconceptional intake of other vitamins may also be relevant to some types of structural malformations (Czeizel, 1993), at present the evidence is that the influence of folate is of paramount importance. Women are therefore encouraged to take specific folate supplements rather than combinations of multivitamins and folate because some of the latter preparations may not contain sufficient folate to be protective. In addition to the preconceptional need for folic acid supplementation, the requirement for folate is also increased during

pregnancy. In order to prevent megaloblastic anaemia, the dietary reference value for folate during pregnancy is increased from 200mcg/day for non- pregnant women to 600mcg/day for pregnant women (Institute of Medicine, Food and Nutrition Board, 1998). This level of increase can be achieved by advising a well-balanced diet containing folate-rich foods such as green leafy vegetables, granary bread, yeast extract and breakfast cereals which are fortified with folate.

2.2.3.1.2 Vitamin C

Vitamin C aids in the absorption of non-haem sources of iron and the recommended vitamin C intake is increased by 10mg during the third trimester of pregnancy to 85mg/day (Brown *et al.*, 2008). Pregnant women are encouraged to include some source of vitamin C at each meal, particularly from fruit and vegetables. If consumption of these foods tends to be low, fruit juice or vitamin C-enriched fruit squash are encouraged. Vitamin C intakes have been found to be lower amongst women who smoke during pregnancy (Haste *et al.,* 1990) and particular attention should be paid to them to ensure that they achieve an adequate intake.

2.2.3.1.3 Vitamin D

Vitamin D is essential to sustain the heightened calcium absorption and utilization during pregnancy. Normally, the body's requirement for vitamin D is met through exposure to sunlight and to a lesser extent, dietary sources such as vitamin D-enriched margarine, cheese, fatty fish and eggs. The current recommendation is that pregnant women should take a supplement providing 0.01mg/day (FSA, 2005). Supplements are particularly important for at risk individuals, especially Asian women, who are particularly likely to compromised vitamin D status as a result of low sunlight exposure

and reduced metabolic synthesis of the active forms of the vitamin. The recommended daily allowance is 15mcg.

2.2.3.1.4 Vitamin A

A recommendation of 0.1mg/day throughout pregnancy is to enhance maternal stores and allow for rapid foetal growth of late pregnancy (Institute of Medicine, Food and Nutrition Board, 1998). Good sources of vitamin A and beta-carotene include milk and milk products, eggs, green leafy vegetables and carrots. However, due to the known teratogenic effects of high retinol intakes, pregnant women are advised to avoid liver and liver products such as liver paste and liver sausage and not to take supplements containing vitamin A or fish liver oils (FSA, 2005b).

2.2.3.1.5 Vitamin B_1 (Thiamin)

Vitamin B_1 functions as coenzyme in the metabolism of carbohydrates, alcohol, and some amino acids. It is also required for growth and maintenance of nerve and muscle tissues. The recommended daily allowance during pregnancy is 1.4mg. Rich sources include: cereals, paster, bread, liver, pork, milk, cheese, yogurt, dried beans and nuts (Brown *et al*., 2008).

2.2.3.1.6 Vitamin B_2 (Riboflavin)

Vitamin B_2 promotes growth and repair of tissues, serves as coenzyme in cell division and energy metabolism and also promote normal vision. Rich sources include; liver, fish, beef, eggs, grains and cereals. The recommended daily allowance during pregnancy is 1.4mg (Brown *et al*., 2008).

2.2.3.1.7 Vitamin B_3 (Niacin)

Vitamin B_3 primary function is to help normal nervous system functions and also serves as coenzyme for energy metabolism and synthesis of body fat. Rich sources include: meat, grains and cereals, milk, cheese, yogurt and potatoes. The recommended daily allowance during pregnancy is 18mg (Brown *et al*., 2008).

2.2.3.1.8 Vitamin B_6

Vitamin B_6 functions as a cofactor in approximately 50 decarboxylase and transaminase enzymes, especially in amino acid metabolism (Mahan *et al*., 2012). Although this vitamin catalyzes a number of reactions involving neurotransmitter production, it is not known whether this function is involved in the relief of nausea or vomiting. Meat, fish, and poultry are good dietary sources. Deficiency is not common and routine prenatal vitamins are sufficient (Simpson *et al*., 2010). The RDI during pregnancy is 1.9mg.

2.2.3.1.9 Vitamin B_{12}

Cobalamin is a complex molecule that contains cobalt, it occurs naturally in usual forms (Williams & Schlenker, 2003). Cyanocobalamin is the commercially available form, which is converted to the natural forms. It requires salivary haptoccrrin and " intrinsic factor" to be absorbed (Gropper, *et al.*, 2005). "Intrinsic factor" is secreted by the parietal cells of the stomach. Vitamin B_{12} does not occur in plant foods, and therefore vegans and strict vegetarians are at risk of deficiency. The functions of vitamin B_{12} include recycling of folate coenzymes, normal myelination of nerves and synthesis of methionine from homocysteine (Gibney *et al.*, 2006). Few pregnant women exhibit deficiency symptoms as vitamin B_{12} is also manufactured by intestinal bacteria. The most common cause of deficiency is mal-absorption due to atrophy of the gastric mucosa, which leads to inadequate production of "intrinsic factor" or diseases of the

ileum (Mahan, *et al.*, 2012). Deficiency results in pernicious anaemia or neurological problems. The anaemia is morphologically the same as that seen in folate deficiency and biochemical tests are necessary to establish the cause (Holdsworth *et al.*, 2012). The neuropathy is characterized by loss of sensation and motor power in the limbs due to degeneration of myelin. Good sources of vitamin B_{12} include meat and meat products, eggs, milk and dairy products, fish and fish products, yeast products and fortified vegetables extracts and fortified breakfast cereals. The recommended daily allowance intake during pregnancy is 2.6mcg.

2.2.3.1.1.10 Vitamin E

Vitamin E requirements are increased during pregnancy. Deficiency during pregnancy is speculated to cause miscarriage, preterm birth, and intrauterine growth retardation (Gagne *et al.*, 2009). Vitamin E deficiency has not yet been reported in human pregnancy. Vitamin E is an important lipophilic antioxidant. The recommended daily allowance intake during pregnancy is 15mg (Mahan *et al.*, 2012).

2.2.4 Minerals

2.2.4.1 Iron

Pregnancy is a period of a significant increase in iron requirement over and above the non-pregnant state (Zavaleta *et al.*, 2000). Although iron requirements are reduced in the first trimester because of the absence of menstruation, they rise steadily thereafter from approximately 0.8 mg per day in the first month to approximately 10 mg per day during the last 6 weeks of pregnancy (Bothwell, 2000). The increased iron requirement is due to expansion of maternal red blood cell mass for increased oxygen transport, including transfer of iron, to both the growing foetus and the placental structures, and as a needed reserve for blood loss and lochia at parturition (Beaton, 2000). Due to

increased iron requirements, pregnancy is also a period of increased risk for anaemia. Thus, a high proportion of women become anaemic during pregnancy (Mahan *et al.*, 2012). During pregnancy, iron is needed for the manufacture of haemoglobin in both maternal and foetal red blood cells. The foetus accumulates most of its iron during the last trimester and, at term, a normal weight infant has about 246mg of iron in blood and body stores. Maintenance of erythropoiesis is one of the few instances during pregnancy when the foetus acts as true parasite by ensuring its own production of haemoglobin, drawing iron from its mother (Mahan *et al.*, 2012). Maternal iron deficiency, does not usually result in an infant that is anaemic at birth (Brown *et al.*, 2008). The most common cause of iron deficiency anaemia in infants is prematurity, as an infant who has a short gestation simply does not have enough time to accumulate sufficient iron during the last trimester (Holdsworth, *et al.*, 2012). The current recommended reference values (Department of Health, UK, 1991) for iron in adult women is with no recommended increase during pregnancy. In theory, the increased in demand for iron in pregnancy is met through the combined actions of mobilization of maternal iron stores, increased dietary absorption, and savings made in basal iron losses due to cessation of menstruation.

In women who begin pregnancy with adequate iron reserves, these adaptations allow the additional iron requirements to be met without the necessity for an increased dietary iron intake (Department of Health, UK, 1991). The current intake of iron from dietary sources has been found to be below the lower recommended nutrient intake in over 40% of 19-64 year old women (Henderson *et al.*,2003), therefore it is recommend that women planning pregnancy should ensure they achieve adequate iron intake (FSA, 2005). Iron absorption from the gastrointestinal tract is increased during pregnancy. However, the bioavailability of dietary iron is of greater importance than the actual

amount of iron in the diet (Hallberg, 1994). Haem iron from the haemoglobin and myoglobin of animals is absorbed more efficiently than non-haem iron because the entire porphrin ring containing the iron is taken up by the mucosal cells, hence the iron is protected from factors that inhibit its absorption. Non-haem is found in vegetables, cereals, eggs, milk, and its bioavailability is affected by the balance of dietary factors enhancing and inhibiting iron absorption. Vitamin C increases bioavailability and calcium and iron-binding polyphenols such as tannins from tea, phytate from cereals decrease it (Robinson *et al.*, 1998).

2.2.4.2 Calcium

A baby at birth contains 25-30g of calcium, most of which is stored in the last 10 weeks of pregnancy. There is a consensus that the concentration of maternal free (biological active) 1,25-dihydroxy vitamin D_3 is raised during pregnancy (Misra & Anderson, 1990), increasing net calcium absorption (Holdsworth *et al.*, 2012). The recommended Reference Nutrient Intake (RNI) for calcium for adult women of ages between 19-50 years is 700mg/day and 800mg for those aged 15-18 years (Department of Health, UK, 1991). The RNI for calcium for 11-18 year old girls is 100mg more per day than for adult women (Department of Health, UK, 1991). This is to take into account the need for calcium during the increase in bone mass and development which occurs during adolescence. It does not take into account, however, the needs of the foetus in the pregnant adolescent. Although there is some physiological adaptation to allow enhanced absorption of calcium from the gut during pregnancy, the calcium intake of the pregnant teenager needs to be carefully monitored and advice given as to how to increase calcium intake if necessary (Mahan *et al.*, 2012).

2.2.4.3 Zinc

Animal studies have shown that deficiency of zinc is associated with abnormalities in pregnancy, but this has not been clearly demonstrated in humans. There is no evidence that extra zinc is required during pregnancy and the UK RNI for zinc is 7mg/day with no increment during (Department of Health, UK, 1991). Zinc intakes tend to parallel protein intake and rich sources of zinc include meat, fish, pulses and whole grain cereals.

2.2.4.4 Copper

Diets of pregnant women are often marginal in copper. Copper deficiency alters embryo development and induced-copper deficiency has been shown to be tetratogenic. Not only are there genetic mutations, as in Menkes disease, but also secondary deficiency differences from excessive zinc or iron intake, certain drugs, and bariatric surgery (Uria-Adams, 2010). These inadequacies cause decreased activity of cupro-enzymes, increased oxidative stress, altered iron metabolism, abnormal protein cross-linking, decreased angiogenesis and altered cell signalling (Uria-Adams, 2010). Copper is an essential mineral required by the body for bone and connective tissue production. Foods containing copper include liver, oysters, sesame seeds, nuts.

2.2.4.5 Iodine

Iodine is part of the thyroxine molecule, with a critical role in the metabolism of micronutrients. Adequate gestational iodine is associated with a higher intelligence quotient in the child and attention deficit may be associated with milder iodine deficiency (Hoy- Rosas, 2009). In instances where preconception iodine intake cannot be ensured, supplementation before the end of the second trimester protects the foetal brain from effects of deficiency. To ensure adequate iodine, food is often fortified with

iodized salt. If urinary iodine levels are low, supplementation is needed (Simpson *et al.*, 2010). Pregnant women are advised to use iodized table salt when cooking (Glinoer, 2007).

2.2.5 Fibre

Daily consumption of whole-grain breads and cereals, leafy green and yellow vegetables, and fresh and dried fruits should be encouraged to provide additional minerals, vitamins, and fibre. The DRI for fibre during pregnancy is 28g/day (Institute of Medicine, Food and Nutrition Board, 2001) and if met, will help a great deal in managing the constipation that often accompanies pregnancy.

2.3 ALCOHOL INTAKE DURING PREGNANCY

The term foetal alcohol syndrome (FAS) is used to describe the congenital malformations associated with excessive maternal alcohol intake. These include growth retardation, abnormal craniofacial features and developmental problems (Beattie, 1992). FAS is likely to occur in the offspring of mothers regularly drinking more than 80g of pure alcohol per day. Current optimal advice of abstinence in pregnancy, is especially important in the first trimester, however, occasional drinking of small quantities, less than or equal to 1-2 units, once or twice a week but less than or equal to 2 units at any sitting is likely to harm the foetus. Excessive binge drinking is most dangerous and can have teratogenic effects leading to FAS which affects 1-2/1000 births/ year. Risk is elevated in women drinking greater than 8 units /day. Pregnant women are advised not to get drunk (Thomas & Bishop, 2007).

2.4 PICA (NON- FOOD SUBSTANCES INTAKE DURING PREGNANCY)

Pica is persistent craving for non- food substances, ranging from coal, clay, candles, matchboxes, to soil. Pica can be harmful if the item craved and eaten is toxic or eaten in large enough quantities to have an impact on nutritional status. Eating soil could carry the risk of toxoplasmosis. Pica is often associated with iron deficiency but it is uncertain whether iron deficiency causes pica or conversely whether pica causes iron deficiency because of its effects on decrease iron absorption (Holdsworth *et al.*, 2012).

2.5 FOOD AVERSIONS

Aversions are relatively common for tea, coffee, fried foods, and eggs. Food cravings can be strong but depend on the individual. There are no nutritional implications as long as craving does not involve eating a lot of energy-dense foods that result in excessive weight gain (Mahan *et al*., 2012).

2.6 MATERNAL WEIGHT GAIN

Weight gained in pregnancy is a combination of maternal and foetal tissues and fluid, as well as maternal fat stores (Artal, 2010). Rate of weight gain is usually not constant; this is around 2kg in the first trimester and the rest throughout the second and third trimesters at a rate of approximately 0.4kg/week (Webster-Gandy *et al*., 2012). A normal weight gain over the course of pregnancy is around 10-12kg for women who have a healthy pre-conception weight (Begum, 2008).

To account for this increase in energy demands, the Department of Health (DH, England) makes a blanket recommendation for pregnant women to consume an extra 200kcal/day in the last trimester, but the best advice is to encourage pregnant women to

eat well and monitor weight gain within the appropriate ranges. An average weight gain of 10-16kg is recommended for women of normal BMI (18.5-24.9).

Both too little and too much weight gain can adversely affect the foetus. Too much maternal weight gain during pregnancy lead to post-partum maternal obesity, possibility of caesarean, infant macrosomia and increase risk of gestational diabetes. Too little maternal weight gain can lead to low birth weight with subsequent effects on long-term health.

Women who are overweight or obese should not attempt to lose weight during pregnancy. Institute of Medicine, Food and Nutrition Board (USA) recommends that, based on pre-pregnancy and BMI, overweight women should limit weight gain to 5-9kg (Institute of Medicine, Food and Nutrition Board, 2001). Overweight and obese pregnant women need regular monitoring as there is increased risk of pre-eclampsia, gestational diabetes mellitus and hypertension as BMI increases. At birth there is increased likelihood of caesarean section, poor post-operative complications, low Apgar score, excessive birth weight of new born (macrosomia), increase peri-natal mortality by three- fold, and neural tube defects. Women carrying twins or more will gain even more weight than women carrying one foetus. The Institute of Medicine advised that normal weight pregnant women carrying twins should gain 17-25kg, overweight women should gain 14-23kg, and obese women should gain 11-19kg during pregnancy (Institute of Medicine, Food and Nutrition Board, 2001). A healthy weight gain is particularly important in multiple pregnancies as they carry higher risk of premature birth and low birth weight.

2.7 TYPES OF NUTRITIONAL ANAEMIA

2.7.1 Iron Deficiency Anaemia

This is characterized by the production of microcytic erythrocytes and a diminished level of circulating haemoglobin (Mahan *et al.*, 2012). This microcytic anaemia is actually the last stage of iron deficiency, and it represents the end point of iron deprivation (Gibney *et al.*, 2006). The iron deficiency anaemia may be due to inadequate ingestion, inadequate absorption, inadequate utilization, increased requirement, increased blood loss or excretion and increased destruction resulting in decreased release from stores (Thomas & Bishop, 2007).

As iron-deficiency becomes more severe, defects arise in the structure and function of the epithelial tissues, especially of the tongue, nails, mouth, and stomach. The skin may appear pale, and the inside of the lower eyelid may be light pink instead of red (Brown *et al.*, 2008). Mouth changes include atrophy of lingual papillae, burning, redness, and in severe cases a completely smooth, waxy and glistening appearance of the tongue (glossitis). Angular stomatitis may also occur. Gastritis occurs frequently and may result in achlorhydria. Fingernails can become thin and flat, and eventually koilonychias (spoon-shaped nails).

The management of iron deficiency anaemia includes; increase of absorbable iron in the diet, inclusion of vitamin C at every meal, inclusion of meat, fish, or poultry at every meal and decrease of tea and coffee consumption (Mahan *et al.*, 2012).

2.7.2 Folic Acid Deficiency Anaemia

It is associated with tropical sprue, can affect pregnant women, and occurs in infants born to mothers with folic acid deficiency. Folic acid deficiency in early pregnancy can also result in an infant with neural tube defect (Holdsworth *et al.*, 2012). Prolonged inadequate diets, faulty absorption and use of folic acid, and increased requirements resulting from growth are believed to be the most frequent causes (Mahan *et al.*, 2012). Rich sources of folate include: green leafy vegetables, mushrooms, roots, tubers, fruits, liver, kidney, meat, egg yolk, among others (Thomas & Bishop, 2007).

2.7.3 Vitamin B_{12} Deficiency and Pernicious Anaemia

Pernicious anaemia is a megaloblastic, macrocytic anaemia caused by a deficiency of vitamin B_{12}, most commonly from a lack of intrinsic factor (Mahan *et al.*, 2012). It is common among vegetarians (Williams & Schlenker., 2003).

2.7.4 Anaemia of Protein-Energy Malnutrition

Protein is essential for the proper production of haemoglobin and red blood cells (Latham, 1997). Diet lacking in protein is usually deficient in iron, folic acid, and less frequently, vitamin B_{12} (Mahan *et al.*, 2012).

2.7.5 Copper-Deficiency Anaemia

Copper and other heavy metals are essential for the proper formation of haemoglobin. Ceruloplasmin, a copper containing protein, is required for normal mobilization of iron from its storage sites to the plasma. In a copper deficient state, iron cannot be released, this leads to low serum iron and haemoglobin levels, even in the presence of normal iron stores (Mahan *et al.*, 2012). Other consequences of copper deficiency suggest that

copper proteins are needed for use of iron by the developing erythrocyte and for optimal functions of the erythrocyte membrane.

2.7.6 Sideroblastic (Pyridoxine-Responsive) Anaemia

This is characterized by a derangement in the final pathway of heme synthesis, leading to a build-up of iron-containing immature red blood cells (RBCs). The neurologic and cutaneous manifestations of vitamin B_6 deficiency are not observed. The anaemia responds to the administration of pharmacologic doses of pyridoxine and thus distinguishes it from anaemia caused by a dietary vitamin B_6 deficiency (Mahan *et al.*, 2012).

2.7.7 Vitamin E-Response Haemolytic Anaemia

It occurs when defects in RBC membranes lead to oxidative damage and eventually to cell lysis. This anaemia is caused by shortened survival of mature RBCs. Vitamin E, an antioxidant, involved in protecting the membrane against oxidative damage, is one of the few signs noted in vitamin E deficiency is early hemolysis of RBCs (Mahan *et al.*, 2012).

2.8 24-HOUR RECALL OF DIETARY INTAKE ASSESSMENT

The 24-hour recall of dietary intake assessment is a formal method that a trained interviewer uses to assess the subject through their food intake recall over the previous 24-hour. It is a quick retrospective method of dietary assessment, but cannot be used to classify a subject's usual intake as it is not necessarily representative of the subject's normal eating pattern.

To overcome these problems the 24-hour recall was repeated for three days which includes early week day, mid-week day and week end day to estimate nutrient intake .This is considered more representative of the usual intake than estimates from a single day (Margetts & Nelson, 1997).

The limitations of this method include the fact that it is prone to underestimate consumption due to omissions, and a single observation provides a poor measure of the individual intake.

2.9 FOOD FREQUENCY QUESTIONNAIRE (FFQ)

This is a retrospective review of intake frequency. Printed questionnaires are used and interviewees ticks the category that approximates to their usual consumption out of a list of foods, that is never eaten, eaten once a month, eaten once a fortnight and the number of times eaten per week. This is quantified and the intake is estimated.

Food frequency questionnaire can be conducted via post. The number of foods can vary; sometimes only a few are used when assessing a food group or nutrient (Mahan *et al.*, 2012). These are sometimes called screeners. FFQs are often used in large surveys. It is necessary to validate FFQs against a more precise method such as weighed food intake.

There are three main types of FFQ:

1. qualitative: this does not use portion size.
2. semi-quantitative: standard portion size is used.
3. quantitative: interviewers are asked to record data on portion size.

This tool is helpful in relation to particular disease risk or incidence by helping determine the use of specific groups of food over an extended period of time. It is

suitable for large-scale surveys, can be posted and short versions can focus on specific foods, e.g. fruit and vegetables.

The limitations include:

1. requires validation in relation to reference
2. literacy and numeracy skills are required if self-completed

CHAPTER THREE

3.0 METHODS

3.1 STUDY DESIGN

The research design for the study was descriptive cross-sectional. This was chosen because all information except the repeated 24-recall was used to collect data at one point in time.

3.2 STUDY SITE

Data for the survey was collected from the antenatal clinic of Tamale Teaching Hospital in the Tamale Metropolis. Tamale is one of the twenty six districts of the Northern Region, and it is the Regional capital. Tamale Teaching Hospital is located in the Tamale South Constituency and at the north-eastern part of Tamale on the main Tamale-Yendi road, opposite the Kukuo market. The metropolis has a population of 537,986 (Ghana Statistical Service, 2010) of which 10% constitute older adolescent (15-19 years) and women constitute 274,373 with expected pregnancy of 4,292 per year.

The people of Tamale metropolis are indigenous Dagombas and they speak the Dagbani language with other minority tribes like Gonja, Konkomba, Dagaare and Twi. They practice the patrilineal lineage system. Majority of people are Muslims with a few Christians and African traditionalists. Most men are polygamous and in general endogamous marriages are encouraged among the people.

Tamale Teaching Hospital is the only referral centre in the three northern regions of Ghana. The metropolis has one Teaching Hospital, three (3) district hospitals, five (5) health centres and other private clinics. Data for the survey was collected from the

antenatal clinic of Tamale Teaching Hospital in the Tamale Metropolis. The maternity department provides antenatal services, has a labour ward, lying-in ward and postnatal, maternal and child health units. The average daily attendance to the antenatal clinic is 100.

3.3 SAMPLE SIZE CALCULATION

Sample size was selected based on calculation using Cochran's sample size formula.

$n = t^2 \times p(1-p)/m^2$ where

n = required sample

t= (the z-score associated with the confidence level required) = 1.96

p (is occurrence (events) rate within the population) = 0.65

m (margin of error (the required precision) = 0.05

Therefore $n = (1.96)^2 \times 0.65\ (1-0.65)/0.05 = 349.58 = 350$.

However, due to time constraint and financial limitations, 50% of the sample size, 175, was used.

3.4 SAMPLING TECHNIQUE

Convenient sampling procedure was employed. Pregnant women who met the inclusion criteria and agreed to participate were interviewed when they came for their antennal visits. This was done daily over a period of ten days.

3.5 PARTICIPANTS

3.5.1 Inclusion criteria

Pregnant women between the ages of 18-50 years attending antenatal clinic in Tamale Teaching Hospital for routine care were recruited.

3.5.2 Exclusion criteria

Pregnant women with severe nutrition related problems such as *Hyperemesis gravidarium* were excluded.

3.6 DATA COLLECTION

3.6.1 Questionnaire administration

A questionnaire was designed and used for data collection. The questionnaire was made up of six sections: Section A was on food habits of respondents; Section B gathered information on precipitants of anaemia; Section C collected data on socio-demographic characteristics; Section D collected data on food intake by 24-hour recall and food frequency questionnaire; and Section E was an intervention on healthy eating.

The questionnaire was pre-tested at the Tamale Teaching Hospital among ten pregnant women who met the criteria for the main study to determine the validity and clarity, and to also eliminate possible ambiguity. The necessary corrections were effected on the questionnaire for better understanding by the respondents. The questionnaires were administered on Mondays, Wednesdays and Fridays for the previous day's food eaten. In order to get the true eating pattern of a respondent, dietary assessment using 24-hour recall was carried out three times for each respondent, each on a different day of the week for three weeks. To make it easier for the respondents to recall accurately the previous day food eaten, portion sizes handy measures were used and later converted to grams for the analysis.

3.6.2 Laboratory data

The most recent results of laboratory tests for Hb level, malaria status and worm infestation was extracted from respondent's hospital records. Their sickling status was

also extracted. Anaemia was classified as mild (Hb of 10-10.9g/dl), moderately anaemic (Hb of 7.9-9.9g/dl), severely anaemic (Hb of 4-6.9 g/dl) and very severely (Hb of less than 4g/dl) (UNICEF, UNU & WHO, 2001).

3.7 ETHICS

Approval of the study was obtained from the Ethics and Protocol Review Committee, School of Allied Health Sciences. A consent form was attached to the questionnaire to ask for each participant's consent. Data collected during the survey from each study participant and results of laboratory tests were kept confidential.

3. 8 DATA ANALYSIS

Data collected was analysed using statistical programs such as SPSS version 19, Microsoft Excel 2010 and Epi-info 7. Descriptive variables such as mean, mode, and standard deviation were used to analyse demographic data. Point estimation of prevalence, worm infestation and malaria infection and odd ratios with 95% confidence interval was computed to compare each of the two variables using chi- square test. Multi variable logistic regressions were employed for variables, have significant association with disease outcome to determine the main predictors of infection. A *p*-value of less than or equal to 0.05 was considered significant. Esha-F Processing was used to determine the nutrients intake of participants.

CHAPTER FOUR

4.0 RESULTS

4.1 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

A total of 175 pregnant women (respondents) were recruited for the study. Table 1 shows the socio-demographic characteristics of the respondents. The age profile shows that few of the pregnant women (4%) were in the age group of 18-19 years, whereas majority of the pregnant women (68.7%) were in the age range of 20-34.

Over one – quarter (30.9%) of the study population had no formal education, while those with Junior High School, Senior High School, and Tertiary had 27.4%, 10.9%, and 30.9% respectively. The majority (38.3%) of the respondents were professionals while those who were unemployed were the least (2.9%). The majority of the respondents' spouses were also professionals (67.8%). The monthly income levels generally were low; the majority (43%) earned between GHC50 -100 and only 2.9% earned above GHC1000. The majority of the respondents' spouse's (44.4%) had income between GHC50-100 and only 10.5% earned above GHC1000. Forty eight percent (48%) of the respondents were in the third trimester of pregnancy, 47% were in the second trimester, with only 5% in their first trimester. Anaemia was more prevalent in the second and third trimesters of pregnancy.

Table 1: Socio-demographic characteristics of respondents

Variable		N	%	Mean
Age	18-19	7	4.0	29.77
	20-24	31	17.7	
	25-29	47	26.9	
	30-34	44	25.1	
	35 and above	46	26.3	
	Total	**175**	**100.0**	
Educational background	Never attended school	54	30.9	N/A
	Elementary/JHS	48	27.3	
	SHS	19	10.9	
	Tertiary	54	30.9	
	Total	**175**	**100.0**	
Occupation	Professional	67	38.3	N/A
	Trading	65	37.1	
	Vocational	21	12.0	
	Jobless	5	2.9	
	Other	17	9.7	
	Total	**175**	**100.0**	
Spouse's Occupation	Professional	116	67.8	N/A
	Trading	41	24.0	
	Vocational	14	8.2	
	Total	**171**	**100.0**	
Monthly income (GHC)	Less than 50	29	16.9	287.35
	Between 50-100	74	43.0	
	Between 100-300	9	5.2	
	Between 300-500	14	8.2	
	Between 500-1000	41	23.8	
	Above 1000	5	2.9	
	Total	**172**	**100.0**	
Monthly income of spouse (GHC)	Less than 50	12	7.0	361.40
	Between 50-100	76	44.4	
	Between 100-300	11	6.4	
	Between 300-500	14	8.3	
	Between 500-1000	40	23.4	
	Above 1000	18	10.5	
	Total	**171**	**100**.0	
Trimester	First=1-12wks	8	4.6	N/A
	Second=13-24wks	83	47.4	
	Third=25-40wks	84	48.0	
	Total	**175**	**100.0**	

4.2 DIETARY HABITS OF RESPONDENTS

4.2.1 Pica practice

Majority of the respondents (78.9%) practiced some form of pica and the items mostly eaten were chewing stick/wooden sponge (48.6%) and about 46.9% of the respondents started in the second trimester (Table 2). The main reasons for practicing the pica were to prevent nausea (39.7%) and for satisfaction (30.1%).

4.2.2 Food craving

Food craving was a common practice among the respondents (Table 3). Most of them (85.7%) craved for a particular food at a point in time in any of the trimesters. The items mostly craved was fizzy drinks (33.5%) and the least craved for was chocolate (8.2%). The respondents also craved for local foods like banku, pepper, roasted yam, smoked fish and leafy vegetables. Food craving was highest (58.2%) at the second trimester and least at the third trimester (5.7%). The reason for craving by 63.1% of the respondent was for satisfaction while 10% did not know why.

4.2.3 Food aversions

Majority of the respondents (76.7%) reported that they avoided some foods, mostly in second trimesters (72.5%) [Table 4]. Meat or fish was what mostly avoided (48.6%) whilst were fruits the least (1.4%). The highest reason for the avoidance was smell/aroma (48.6%) with other reasons being the least (1.3%).

Table 2: Pica practice among pregnant women in Tamale

Variable		N	%
Do you practice any form of pica?	Yes	138	78.9
	No	37	21.1
	Total	**175**	**100.0**
What respondents eat as a form of pica	Chewing stick/wooden sponge	85	48.6
	Uncooked maize dough/starch	6	3.4
	Chalk	3	1.7
	Clay	66	37.7
	Cola nuts	9	5.1
	Other	6	3.4
	Total	**175**	**100.0**
Stage of pregnancy at which respondent start practicing pica	1-3 months	63	36.0
	4-6 months	82	46.9
	7-9 months	15	8.6
	Not sure	15	8.6
	Total	**175**	**100.0**
Why respondents practice pica	To prevent nausea	54	39.7
	To prevent vomiting	25	18.4
	For satisfaction	41	30.1
	To prevent salivation	14	10.3
	Other	2	1.5
	Total	**136**	**100.0**

Table 3: Food craving among pregnant women in Tamale

Variable		N	%
Do you crave for any food?	Yes	150	85.7
	No	25	14.3
	Total	**175**	**100.0**
What respondents crave for	Chocolate	13	8.2
	Toffees/candies	16	10.1
	Ice cream	37	23.4
	Fizzy beverages	53	33.5
	Other	39	24.7
	Total	**158**	**100.0**
Stage of pregnancy respondents start craving	1-3 months	47	29.7
	4-6 months	92	58.2
	7-9 months	9	5.7
	Not sure	10	6.3
	Total	**158**	**100.0**
Why respondents crave	To prevent nausea/vomiting	43	26.9
	For satisfaction	101	63.1
	Don't know	16	10.0
	Total	**160**	**100.0**

Table 4: Food aversions among pregnant women in Tamale

Variable		N	%
Do you avoid taken any food?	Yes	132	76.7
	No	40	23.3
	Total	**172**	**100.0**
Foods respondents avoid	Meat/Fish	69	48.6
	Eggs	36	25.4
	Milk	11	7.7
	Fruits	2	1.4
	Other	24	16.9
	Total	**142**	**100.0**
Time of pregnancy respondents avoid certain foods	1-2wks	34	23.9
	13-24wks	103	72.5
	25-40wks	5	3.5
	Total	**142**	**100.0**
Why respondents avoid certain foods	Taste of food	5	3.3
	Poor appetite	33	22.0
	Don't know	37	24.7
	Smell/aroma	73	48.7
	Other	2	1.3
	Total	**150**	**100.0**

4.3 SUBSTANCES THAT AFFECT IRON ABSORPTION

Tea/coffee intake was high (92.2%) among the respondents (Table 5a). Over half (63.8%) of the respondents took it once a day. Those who took it once a month were the least (0.7%). Majority of the respondents (81.8%) also took supplements, with multivitamin intake being the highest (35.2%) and herbal preparations the lowest (11.7%) [Table 5b].

4.4 BEHAVIOURS THAT PRECIPITATE OR PREVENT INCIDENCE OF ANAEMIA

Few of the respondents (7.3%) had experienced some form of blood loss mainly due to injuries (58.3%) [Table 6]. Majority of the respondents (98.3%) attended antenatal regularly and monthly attendance was 82.7% while 17.3% either attended once every three months or not at all [Table 6]. The majority of the respondents (95.2%) took their ANC drugs regularly and only 4.8% were not taking their routine drugs regularly. A high percentage (83%) of the respondents took their multivitamins, iron and folic acid supplements and 15% took their SP medication for malaria prevention.

4.5 TRIMESTER OF RESPONDENTS AND MALARIA OCCURRENCE

Twenty eight percent (28%) of the respondents had malaria in any of the trimesters with an increase in the prevalence from the first to third trimester (Fig. 1).

4.6 DE-WORMING FREQUENCY OF RESPONDENTS BEFORE PREGNANCY

The majority of respondents (76.1%) never de-wormed before pregnancy, 5.2% used to de-worm every 3 months and 13.6% used to de-worm every six months before pregnancy (Fig. 2). Ninety percent (90%) of respondents routine stool examination was negative for parasitic worms.

Table 5a: Substances that inhibit iron absorption.

Variable		N	%
Do you take tea or coffee?	Yes	153	92.2
	No	13	7.8
	Total	**166**	**100.0**
How often respondents take tea or coffee	Once a day	97	63.8
	twice a day	45	29.6
	Weekly	6	3.9
	Monthly	1	0.7
	Sometimes	3	2.0
	Total	**152**	**100.0**
Do you take some food supplements or any herbal preparation?	Yes	121	81.8
	No	27	18.2
	Total	**148**	**100.0**

Table 5b: Substances that enhance Hb level

Variable		N	%
Food supplements respondents take	Folic acid	34	23.4
	Iron	43	29.7
	Multivitamin	51	35.2
	Herbal	17	11.7
	Total	**145**	**100.0**

Table 6: Behaviours that precipitate or prevent incidence of anaemia

Variable		N	%
Have you experienced blood loss?	Yes	12	7.3
	No	153	92.7
	Total	**165**	**100.0**
Type of blood loss	Bleeding from injuries	7	58.3
	Coughing out blood	2	16.7
	Other	3	25.0
	Total	**12**	**100.0**
Do you attend ANC regularly	Yes	170	98.3
	No	3	1.7
	Total	**173**	**100.0**
How often respondents attend ANC	Monthly	134	82.7
	Every 3 months	4	2.5
	Other	24	14.8
	Total	**162**	**100.0**
Do you take your routine ANC drugs?	Yes	160	95.2
	No	8	4.8
	Total	**168**	**100.0**
ANC drugs respondents take	Iron supplements	49	30.6
	Folic acid	46	28.8
	Multivitamins	37	23.1
	SP	24	15.0
	Other	4	2.5
	Total	**160**	**100.0**

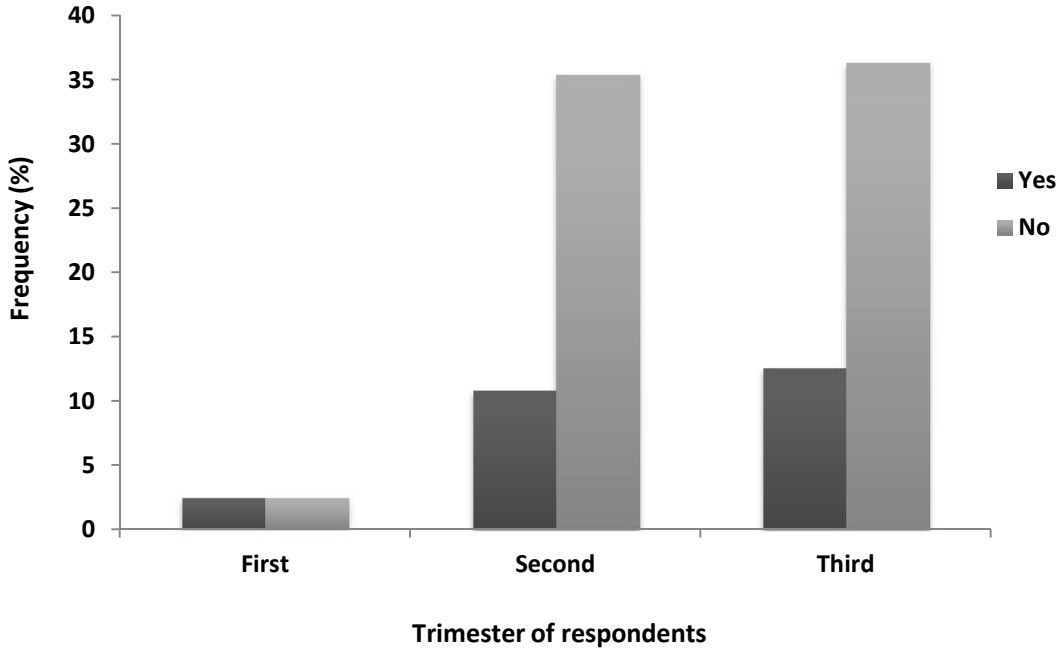

Figure1: Trimester of respondents and malaria occurrence

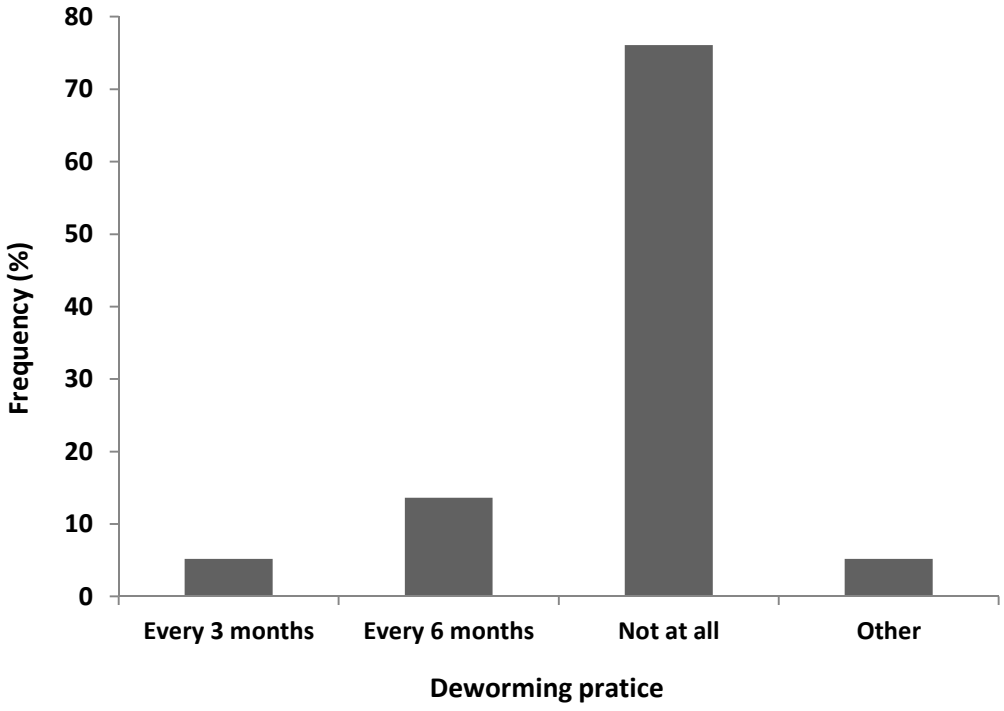

Figure 2: The frequency of respondents de-worming before pregnancy

4.7 SICKLING STATUS OF RESPONDENTS

Ten percent (10%) of the respondents were sickling positive and their Hb-electrophoresis indicated they were all sickle cell disease carriers.

4.8 TRIMESTER OF RESPONDENTS AND THE HB LEVEL ESTIMATION

Forty seven percent (47%) of the respondents were anaemic (Hb less than 11g/dl). The anaemia rate increased as the trimester increased, with 2% in the first trimester and 23% in the third trimester [Fig. 3]. Although close to half of the respondents were anaemic, 40% were mild (Hb of 10-10.9g/dl) and 7% were moderately anaemic (Hb of 7.9-9.9g/dl). None of the respondents was severely anaemic (Hb of 4-6.9 g/dl) and very severely (Hb of less than 4g/dl).

4.9 CHANGES IN THE NUMBER OF TIMES RESPONDENTS ATE IN A DAY BEFORE PREGNANCY EXCLUDING SNACKS

Most of the respondents (78.7%) indicated that the number of times they ate in a day changed [Table 7]. Those who previously ate twice a day (85.5%) were those who reported the greatest change.

4.10 NUTRIENTS ADEQUACY RATIO OF THE RESPONDENTS

Nutrients adequacy ratio of the respondents compared to standards is shown in Table 8a. Only vitamin C had a mean above the RDA. The number of respondents who met and did not meet the RDAs is shown in Fig, 4. More than 60 % of the respondents did not meet the RDAs for the nutrients with exception of vitamin C.

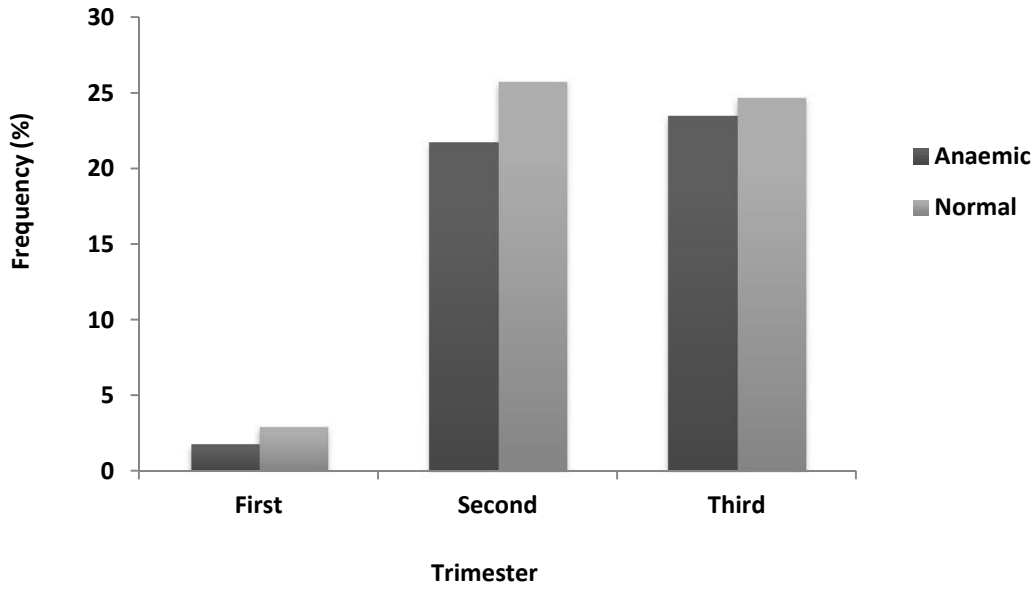

Figure 3: Trimester of respondents and Hb level estimation

Table 7: Number of times respondents ate in a day before pregnancy excluding snacks

Number of times respondents eat in a day before pregnancy excluding snack	Has the number of times you eat in a day changed since you became pregnant?		Total
	Yes (%)	No (%)	
Two times	59 (85.5)	10 (14.5)	69 (100.0)
Three times	70 (78.7)	19 (21.3)	89 (100.0)
Four to Five times	8 (50.0)	8 (50.0)	16 (100.0)
Total	**137 (78.7)**	**37 (21.3)**	**174 (100.0)**

Table 8a: Nutrients adequacy ratio of the respondents (N = 175) compared to standards

Variables	RDA	Minimum	Maximum	Mean	Std. Deviation
Energy (Kcal)	2400	2003.00	2986.00	2284.22	246.52
Protein (g)	71	29.70	143.00	59.22	23.36
Fibre (g)	28	0.39	134.00	25.33	23.42
Vitamin B12 (mcg)	2.6	0.00	4.65	1.16	0.96
Folate (mcg)	600	0.00	628.00	58.99	35.99
Vitamin C (mg)	85	16.70	214.00	98.96	49.53
Vitamin E (mg)	15	0.00	19.90	2.16	0.96
Calcium (mg)	1000	104.00	1411.00	503.71	252.88
Copper (mcg)	800	0.10	3.57	0.99	0.63
Iron (mg)	27	0.00	61.10	25.69	10.30
Zinc (mg)	11	3.68	22.40	9.78	4.18

***Source: Krause's Nutrition Care Process (2012)**

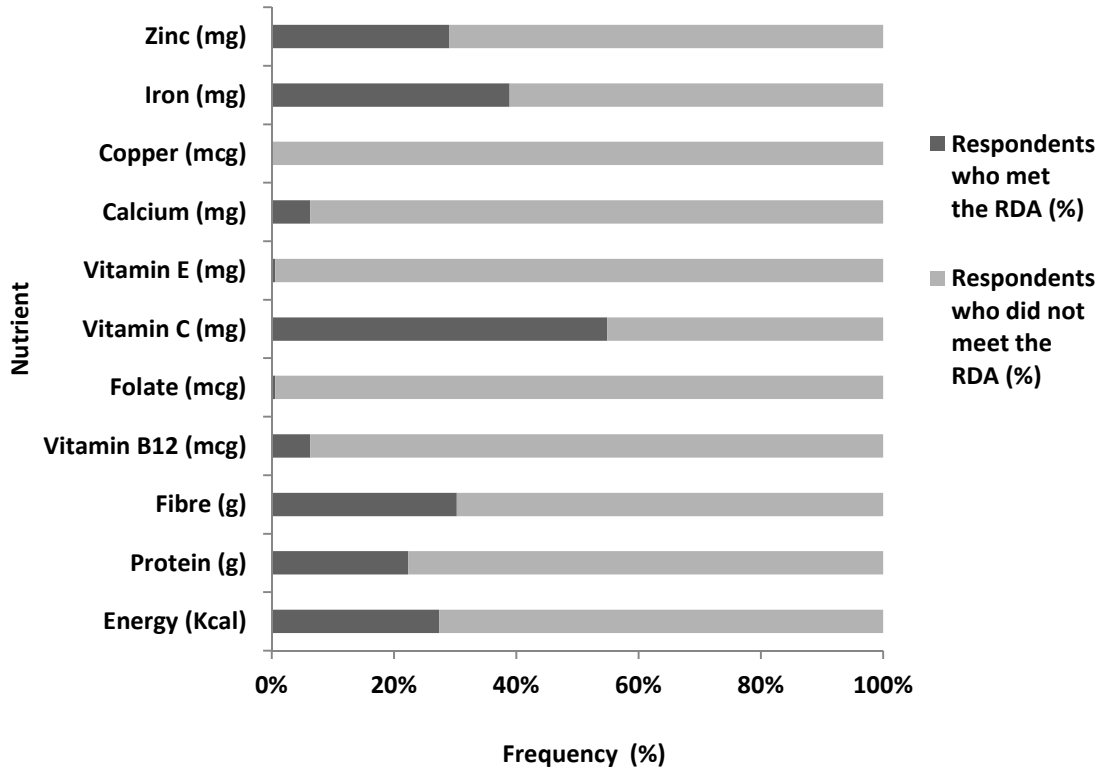

Fig. 4: Number of respondents who met and did not meet the RDAs

4.11 NUTRIENTS REQUIREMENTS AND HB LEVEL ESTIMATION

In all, 95% of respondents who did not meet the RDA were anaemic whilst only 5% who met the RDA were anaemic [Table 9]. For folate, all the respondents who did not meet the requirement were anaemic whereas about 99% of respondents who met their RDA were not anaemic. Forty three percent (43%) of respondents who did not meet their RDA were anaemic, whereas 57% who met their RDA were also anaemic for vitamin C. All the respondents who did not meet the RDA were all anaemic, while 74% of those respondents who met their RDA had their Hb above 11g/dl for vitamin E. For calcium. Ninety-six percent (96%) of respondents who did not meet their RDA were anaemic and only 4% who met their RDA were anaemic.

4.12 FREQUENCY OF CONSUMPTION OF FOODS FROM THE FOOD GROUPS BY RESPONDENTS

Tables 10a and 10b show frequency of consumption of foods from the food groups by respondents. Majority of the respondents consumed maize (77%), rice (70%) and bread (70%) on a daily basis. About half of the respondents consumed fish, meat and milk on a daily basis. For legumes, 46% of respondents consumed groundnut, 40% consumed agushie (melon seed) and 19% consumed beans on a daily basis. Generally, there was low consumption of fruits on a daily basis with the consumption of orange being the highest (27%). Majority of the respondents consumed vegetables: 95% consumed pepper, 93% consumed tomatoes, 83% green leaves and 77% okro.

Table 9: Nutrients requirements and Hb level estimation

Variable	Hb level estimation	Nutrient requirements		Total
		Does not meet RDA (%)	Meets RDA (%)	
Energy	Anaemic (<11g/dl)	67 (75.3)	22 (24.7)	89
	Normal (11+g/dl)	60 (72.0)	26 (28.0)	93
Protein	Anaemic (<11g/dl)	64(78.0)	18(22.0)	82
	Normal (11+g/dl)	21 (22.6)	72 (77.4)	93
Fiber	Anaemic (<11g/dl)	62 (75.6)	20 (24.4)	82
	Normal (+11g/dl)	60 (64.5)	33 (35.5)	93
Vitamin B12	Anaemic (<11g/dl)	78 (95.1)	4(4.9)	82
	Normal (+11g/dl)	7 (7.5)	86 (92.5)	93
Folate	Anaemic (<11g/dl)	82 (100)	0 (0)	82
	Normal (+11g/dl)	1 (1.1)	92 (98.9)	93
Vitamin C	Anaemic (<11g/dl)	35 (42.7)	47 (57.3)	82
	Normal (+11g/dl)	34 (36.6)	59 (63.4)	93
Vitamin E	Anaemic (<11g/dl)	92 (100)	0 (0)	92
	Normal (+11g/dl)	22 (26.5)	61 (73.5)	83
Calcium	Anaemic (<11g/dl)	79 (96.3)	3 (3.7)	82
	Normal (+11g/dl)	8 (8.6)	85 (91.4)	93
Iron	Anaemic (<11g/dl)	56 (68.3)	26 (31.7)	82
	Normal (+11g/dl)	40 (43.0)	53 (57)	93
Zinc	Anaemic (<11g/dl)	65 (79.3)	17 (20.7)	82
	Normal (+11g/dl)	34 (36.6)	59 (63.4)	93

Table 10a: Frequency of consumption of foods from the food groups by respondents

Food Group		Frequency of consumption (%)				
		Not often	**1-2x/ week**	**3-4x/ week**	**5-6x/ week**	**Daily**
Starchy roots and plantains	Cassava	57.7	23.2	6.5	0	12.5
	Cocoyam	88.2	10.2	0	0.6	0.6
	Yam	28	44.0	11.3	2.4	14.3
Cereals and grains	Maize	0	9.9	12.9	0.6	76.6
	Rice0.6	0.6	16.4	12.3	0.6	70.2
	Bread	14.4	12.6	2.4	0.6	70.1
Animal Products	Fish	34.9	10.1	4.1	0	50.9
	Meat	39.9	15.0	3.5	0	41.6
	Poultry	68.9	9.8	2.4	0	18.9
	Egg	53.8	22.0	6.9	0	17.3
	Milk	51.6	6.4	1.3	0	40.8
	Crab	91.3	4.8	1.6	0	2.4
Legumes, nuts and oil seeds	Beans	15.9	50.0	9.4	5.9	18.8
	Groundnut	13.0	28.4	5.9	6.5	46.2
	Bambara beans	51.8 30.4	7.7	1.2	8.9	
	Agushie (melon seed)	34.9	16.4	4.6	4.6	39.5
Fruits	Orange	51.5	14.0	6.4	1.2	26.9
	Mangoes	58.0	23.7	0.6	8.3	9.5
	Pawpaw	64.3	22.0	2.4	0	11.3
	Banana	58.2	18.8	2.4	0.6	20.0
	Watermelon	76.6	14.6	3.2	0	5.7
Vegetables	Tomatoes	1.8	1.2	1.2	2.9	93.0
	Pepper	2.4	1.2	1.8	0	94.7
	Garden eggs	13.5	5.9	1.2	2.4	77.1
	Okro	4.7	12.9	2.9	2.3	77.2
	Green leaves	1.2	9.4	6.4	0.6	82.5
Fat and oils	Palm oil	10.3	66.7	5.7	1.1	16.1
	Refined vegetable oil eg coconut oil	10.4	67.6	1.7	3.5	16.8
	Margarine	28.3	61.8	2.9	1.2	5.8

Table 10b: Frequency of consumption of foods from the food groups by respondents

Food Groups		Frequency of consumption (%)					
		Not often	1-2x/ week	3-4x/ week	5-6x/ week	Daily	Not Applicable
Food high in refined sugar	Coca cola	2.3	47.4	2.9	0	2.3	45.1
	Biscuits	2.9	33.3	24.7	0	14.4	24.7
	Cakes	4.6	38.7	21.4	1.2	4.0	30.1
	Sprite	5.2	48.0	3.5	3.5	0	39.9
	Fanta	4.6	52.6	10.4	0	3.5	28.9
	Sugar	0	4.8	6.0	2.4	73.5	13.3
	Don Simon/ Minute Maid etc.	7.2	24.0	6.6	0	5.4	56.9
	Malt	4.6	45.7	17.3	0	5.8	26.6
	Other soft drinks	0	0	8.0	0	12.0	80.0
Alcoholic beverages	Beer	0	8.7	0	0	0	91.3
	Guinness	0	8.0	0	0	0	92.0
	Spirit	0	0	0	0	0.6	99.4
	Wine	0	0.6	0	0	0.6	98.9
	Punch	0	0	0	0	0.6	99.4
	Others	0	0	0	0	0.7	99.3

Generally, alcohol consumption was low because majority of the respondents were Muslims (Table 10b). But for foods high in refined sugar, 74% of respondents consumed sugar, 14% consumed biscuits, and 12% consumed other soft drinks respectively on a daily basis.

4.13 ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC FACTORS, SELECTED NUTRIENTS AND ANAEMIA

Anaemia was significantly associated with a respondents' profession (p=0.031), spouses' profession (p=0.000), income levels of GHC300 and above (p=0.020) and ages between 20-24 years (p=0.001) [Table 11]. With the exception of vitamin C, all the other nutrient were significantly associated (all p –values <0.05) with anaemia (Table 11).

Table 11: Association between socio-demographic factors, selected nutrients and anaemia

Parameter		*p* –value*
Educational level	Never attended school	0.811
	Elementary/JHS	0.590
	Senior High School	0.098
	Tertiary	
Occupation of respondent	Professional	0.031*
	Trading	0.870
	Vocational	0.364
	Jobless	0.739
	Other	
Occupation of spouse	Professional	0.000*
	Trading	0.000*
	Jobless	
Monthly income of respondent	Less than GHC50	0.765
	GHC50-GHC100	0.909
	GHC100-GHC300	0.784
	GHC300-GHC500	0.020*
	GHC500-1000	0.011*
Monthly income of spouse	Less than GHC50	0.657
	GHC50-GHC100	0.324
	GHC100-GHC300	0.999
	GHC300-GHC500	0.288
	GHC500-1000	0.068
Number of times respondents eat in a day	Two times	0.424
	Three times	0.300
	Four to Five times	
Age categories	18-19	0.915
	20-24	0.001*
	25-29	0.168
	30-34	0.424
	35 and above	
Selected Nutrients	Energy	0.030*
	Protein	0.000*
	Vitamin B12	0.007*
	Vitamin C	1.391
	Iron	0.000*
	Zinc	0.050*

* Significant at ($p < 0.05$)

CHAPTER FIVE

5.0 DISCUSSION AND CONCLUSION

5.1 DISCUSSION

A mother's nutritional status is critical three months before conception and 2-3 months after conception. The foetus is most vulnerable to nutritional deficiencies in the first trimester of pregnancy, often before a woman realizes that she is pregnant (Webster-Gandy *et al., 2012*). Maternal nutrition is an important factor affecting pregnancy outcome. During this period extra energy and nutrients are required for the growth of a developing foetus, expanding maternal blood supply and preparation for lactation (Aboagyeh-Aggrey, 2011). This study was conducted to find out the dietary habits, nutrients intake, prevalence of anaemia and causes and effects of anaemia among 175 pregnant women in Tamale, the Northern Regional Capital of Ghana. The effects of dietary intakes on nutritional status were also examined.

Majority (70%) of the women were within the age range of 20-34 which agrees with the active reproductive age in Ghana which is between 20-35 years (GDHS Report, 2008). It was observed that 31% of respondents had no formal education, thus it was most likely that these women would have had little knowledge about their health and nutritional needs. The fact that majority of the respondents' spouses (68%) were professionals was encouraging as it indicates that most of the respondents will have responsible partners who will be ready to support financially. Income levels generally were low among the pregnant women: the highest range (43%) was between GHC 500-1000 per month. With such low incomes it is likely that many of the subjects lacked the financial resources to purchase adequate amounts of nutritious food. Forty eight percent (48%) of respondents were in the third trimester of pregnancy, while 47% of

respondents were in the second trimester, with only 5% in the first trimester. It was not surprising to find most of the pregnant women in the third trimester because of weekly attendance.

Generally, majority of the pregnant women perceived pregnancy as a period for dietary change. Seventy nine percent (79%) of the respondents practiced pica eaten and majority (83%) started either in the second and third trimesters of pregnancy. Simpson *et al.* (2011) reported that 38% of American pregnant women who practiced pica daily were significantly more likely to have lower prenatal haematocrit than women who did not.

Food craving was a common practice among the respondents with 80% craving for a particular food at one point in time in any of the trimesters. They craved for food items like ice cream (23%), fizzy drinks (34%), toffees (10%) and chocolate (8%). The respondents also craved for local Ghanaian foods like pepper, banku, kenkey, roasted yam, peanut, smoked fish and leafy vegetables. The reason for craving, 63% of respondents said, was for satisfaction, while 27% said it was to prevent nausea and vomiting. Food cravings may have a positive or negative influence on nutritional status depending on the nutritional quality of the foods (Belzer *et al.*, 2010). Majority of the respondents (90%) reported they avoided some nutritious foods, such as meat, fish, eggs, milk and fruit, which are essential in blood production. Some of the reasons for the avoidance, for example due to aroma (48.6%) and poor appetite (22%), were all due to certain physiological changes taking place due to hormonal imbalances in the respondents. Ninety two percent (92%) of respondents said they took diets containing substances called inhibitors such as phytates and polyphenols that bind the iron and prevent easy absorption. A good number of respondents (94%) either took these

substances that contain the inhibitors either once a day or twice a day and this might have contributed to the Hb levels of the respondents.

From the findings of the study, the pregnant women were consuming mostly foods rich in non-haem iron. Absorption of non-haem iron obtained from plant sources like millet, maize, beans, groundnuts, may be as low as 5% (Mahan *et al*., 2012). A plant-based diet which has little animal foods is said to be of low bioavailability (GHS Report, 2004). The cultural and dietary practices of the pregnant women were apparently in favour of the consumption of foods rich in non-haem iron. Clearly a close link may be said to exist between prevalence of anaemia among the pregnant women and their dietary characteristics. The pregnant women were not obtaining enough iron and other essential nutrients through their food intake to meet their increased demand in physiological requirements hence leading to the anaemia prevalence 47% among them.

Blood loss as a precipitant of anaemia was insignificant in the present study as only 7 of the respondents had some form of injuries resulting in heavy bleeding. Majority of the respondents (98%) attended their antenatal clinic regular and 95% took their routine drugs daily as prescribed by the health care professionals.

Twenty eight percent (28%) of the respondents had malaria in any of the trimesters. This was not surprising because the respondents live in a malaria endemic area. In addition, most of the pregnant women (75%) did not take their SP medication.

All the respondents with worm infestation were anaemic. It is likely they had hookworms. According to Latham (1997), one of the most prevalent and important causes of blood loss is hookworm which can be present in very large numbers. The

worms suck blood and also damage the intestinal walls, causing blood leakage. Ten percent (10%) of the respondents were sickling positive but this was insignificant, and therefore could not be attributed to be the underlying factor for the anaemia status of the respondents.

The anaemia rate increased as the trimester increased. This could be because nutritional requirements increase as the pregnancy progresses from the first trimester to the third trimester. Due dietary problems like heartburn and bloating, which is common among 30-50% of pregnant women, they might have intentionally restricted or reduced their food intake especially in the third trimester when most nutrients requirements are needed in the highest amounts for the growing foetus (Webster-Gandy *et al.*, 2012).

Seventy five percent (75%) of respondents did not meet their energy requirement. It is therefore most likely that the energy needed for free iron to be converted to ferritin was not available and hence this might have led to the low Hb level in the respondents (Mahan *et al*., 2012). Additional energy is required during pregnancy to support the metabolic demands of pregnancy and foetal growth. Metabolism increases by 15% in the singleton pregnancy (Institute of Medicine, Food and Nutrition Board, 2001).

Protein is necessary for the conversion of free iron into ferritin, which is required for red blood cells production (Mahan *et al*, 2012). Findings from the study indicated that majority of respondents did not meet their RDA which could have therefore led to 78% of the subjects being anaemic. Protein is essential for the proper production of Hb and red blood cell production (Latham, 1997). A diet lacking in protein is usually deficient in iron, folic acid and less frequently vitamin B_{12} (Mahan *et al,* 2012). There is an additional protein requirement for pregnancy to support the synthesis of maternal and

foetal tissues, but the magnitude of this increase is uncertain. Protein requirement increases throughout gestation and is maximized during the third trimester (Goodnight & Newman, 2009).

The majority (81.7%) of the pregnant women avoided animal protein sources of food, which are of high biological value for pregnant women to support the synthesis of maternal and foetal tissues. This finding agrees with Andersen *et al*. (2008) which concluded that the diet of women before pregnancy was different from that during pregnancy in terms of quality, quantity and the frequency of consuming food groups. Protein deficiency during pregnancy has adverse consequences. Limited intakes of protein and energy usually occur together, making it difficult to separate the effects of energy deficiency from protein deficiency (Mahan *et al.*, 2012). The RDA for most nutrients was not met by the respondents. The high intakes of vitamin C was encouraging. Since the majority of the respondents' staple foods were cereals, which contain non-haem iron, it will help make the iron bioavailable for absorption. There is the need to educate all pregnant women planning to get pregnant to start folic acid supplementation two (2) months prior to pregnancy to prevent neural tube defects (GHS, 2004).

Foods consumed by the respondents were based on the locally available staple food groups such as starchy roots and plantain, cereals and grains, animal products, legumes, nuts and oil seeds, fruits and vegetables, and finally fats and oils. The common daily consumed foods by respondents from this group were yam (14%), cassava (13%) and cocoyam (1%). These food items were cooked and eaten with stew or were eaten in the form of "fufu" (a popular Ghanaian dish) prepared by pounding cooked cassava, cocoyam or yam. This was eaten with soup, depending on the individual's choice.

These foods produced energy needed for the increased basal metabolic rate, for the greater energy cost of physical activity and for the normal accumulation of fat as energy reserve during pregnancy.

Majority of the respondents main staples were locally available staple food groups. The daily consumption were maize (77%), rice (70%) and bread (70%). The maize was usually fermented and milled into or dough which was used to prepare any of the local Ghanaian dishes, e.g. “tuoozaafi, kokoo, banku, akpele and kenkey”. The fermentation of the maize was a good practice because researches have shown that the fermentation helps make certain micronutrients such as non-haem iron in the cereals bioavailable to the body. Rice was either cooked and eaten with stew or moulded into rice balls and eaten with groundnut or palm nut soup, which was also a good practice for the pregnant women. According to GHS (2004), that the absorption of certain micronutrients such as iron may be affected by inhibitors like phytate and polyphenols which are mostly found in cereals and grains. The polyphenols and the phytate can be reduced depending on the preparation of the food, and the micronutrients absorption can also be enhanced depending on the combination of the diet eaten, e.g. with a vitamin C source food.

Over half (51%) of the respondents consumed fish daily which was good for the pregnant women because fish contains omega-3-fatty acids which are good for the development of brain cells of the foetus (Mahan *et al.*, 2012). This consumption pattern agrees with the locally available foods within the area. The frequent consumption of fish was encouraging.

Majority (46%) of the respondents consumed groundnuts on daily basis. This was either in the form of soup, stew or roasted in combination with a cereal or starchy root food

item, e.g. plantain. This was a good practice because it was a cheaper source of protein and other micronutrients in that part of Ghana. While agushie (melon seed) 40% and beans (28%) were also consumed daily which was also encouraging, there needs to be improved. There is thus the need for health professionals to educate the pregnant women on the need to plan meals that will be adequate and well balanced to meet their nutritional needs.

Fruits were consumed occasionally: orange (27%), banana (20%), pawpaw (11%), mango (10%) and watermelon (6%). It was surprising to realize that only a relatively few number of respondents were consuming watermelon because it was the most commonly grown fruit in the area. The other fruits were mostly transported from other parts of Ghana to the area, and this might have possibly led them having being more expensive thereby making it impossible for the respondents to purchase and consume them on a daily basis. The low level of consumption of foods from this group with high consumption of plant sources of iron might have been the reason why majority of the respondents had their Hb lower than 11g/dl according to GHS report (2004). This is because nutrients needed to increase the absorption of non-haem iron were not usually consumed on a daily basis. Low fruits and vegetables intake have been reported to be the main contributor to micronutrient deficiencies in the developing world, especially in populations with low intakes of nutrient dense animal source foods such as meat and meat products (FAO, WHO, 2004).

Majority of the respondents consumed vegetables like pepper (95%), tomatoes (93%), green leaves (83%) and okro /garden eggs (77%) on a daily basis, which was a good practice. This was expected since these are basic ingredients in most Ghanaian soups, stews and sauces. Most of the vegetables consumed were a good source of folate,

vitamin A, vitamin C, and iron, which are needed for tissue growth, prevent anaemia, and also prevent neural tube defects.

Fats and oils such as coconut oil (17%), palm oil (16%) and margarine (6%) were consumed by the pregnant women. The low fat and oils intake was not a problem if the energy requirements can be obtained from other macronutrients. The essential fatty acids can usually be met by one to two portions of fish per week (Simpson *et al.*, 2010). With over 50% of the respondents consuming fish on a daily basis, there was a high possibility of a majority of respondents meeting their recommended daily allowances.

Majority (74%) of the respondents consumed sugar on a daily basis. The high sugar consumption may be due to majority of the respondents eaten a locally prepared fermented cooked maize porridge (koko) as their breakfast. Sugar was mostly added to improve upon the taste to enable them consume it. The study area is dominated by Islamic practice therefore majority (99%) of the respondent did not consume any form of alcoholic beverage. This is something that they needed to be recommended for to keep since in order to promote a good healthy lifestyle.

The study confirmed that respondents who did not meet the essential nutrients intake, zinc (79%), iron (68%), folate (99%), vitamin B_{12} (95%), and protein (78%), were at a higher risk of becoming anaemic than those who met their RDA of these nutrients.

A nominal logistic regression analysis showed insignificant effects of educational level, monthly income of less than GHC300, monthly income of spouse, number of times respondents eat and ages below twenty (20) and above twenty five (25) years of respondents on anaemia. However, it showed significant association (p=0.031) of

respondents professional with anaemia. It has also indicated that respondents spouse professional had significant association (p=0.000) with anaemia. The study also a significant association of income levels of GHC300 and above (p=0.020) and ages between 20-24 years (p=0.001) of respondents with anaemia.

In conducting the study the following challenges were encounted:

i. Esha F-pro software used could not analyse certain local foods, hence similar foods were chosen to replace these food items.
ii. Due to limited finances a larger sample size could not be used and moreover some respondents expected a reward after an interview was granted.
iii. Under estimation and overestimation of meals might have occurred in the 24-hour food recall.

5.2 CONCLUSIONS

Forty seven percent (47%) of the respondents were anaemic (Hb less than 11g/dl). The anaemia rate increased as the trimester increased. With the exception of vitamin C, the majority of the respondents did not meet the mean percentage of the RDA for energy, protein, fibre, vitamin B_{12}, folate, vitamin E, calcium, copper, iron and zinc. In all, 95% of respondents who did not meet the RDA were anaemic whilst only 5% who met the RDA were anaemic. Thus the pregnant women were not able to obtain essential nutrients through their food intake to meet the increased demand in the physiological requirements, hence the high prevalence of anaemia among them.

There was a significant association between anaemia and a respondents' profession (p=0.031), spouses' profession (p=0.000), income levels of GHC300 and above (p=0.020) and ages between 20-24 years (p=0.001).

Based on the findings, the following recommendations have been made:

1. Girl-child education should be encouraged and promoted by the Ministry of Education and non-governmental organizations (NGOs), since an educated professional woman is in a better position to understand and take responsibility of her nutrition and health status.
2. The Ministry of Health and Ghana Health Service should make nutrition health professionals available to every health facility in Ghana so that nutritional education for pregnant women will be intensified especially at the ante-natal clinics.
3. The possibility of food fortifications by food industries should be encouraged by the Government of Ghana and food based strategies for reducing anaemia should be explored and developed by Ministry of Health and Ministry of Food and Agriculture.
4. Further researches should be done by NGOs and food research institutions in Ghana to evaluate the various Ghanaian local food sources rich in micronutrients to improve maternal nutrition. It is also important for similar studies be carried out across the entire country to confirm the present study.

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APPENDIXES

Appendix I

CONSENT FORM

This study is investigating possible causes of nutritional anaemia among pregnant women. If I volunteer to take part in this study, I will be asked to answer questions about my dietary practices, how often I de-worm before pregnancy and I will also be asked to provide some personal information.

"POSSIBLE CAUSES OF NUTRITIONAL ANAEMIA AMONG PREGNANT WOMEN IN TAMALE, GHANA"

I, ……., agree to participate in this study being conducted by CHARLES JAWEEN from the Dietetics Department, of School of Allied Health Sciences, College of Health Sciences, University of Ghana under the supervision of Dr. Charles Brown and Dr. Matilda Asante of Ghana, Legon- Accra. I understand that my participation is voluntary.

The main focus of this proposed study is to assess the possible causes of nutritional anaemia among pregnant women in Tamale Metropolis, Ghana. If I volunteer to take part in this study, I will be asked to answer questions about my food intake, dietary practices and also provide some information about myself. All these will be kept confidential.

I will also be asked to provide 3ml of blood sample (half teaspoonful) for some laboratory tests. A qualified health professional will take the blood sample. There is a

small risk of minor discomfort resulting from the blood being taken from a vein on my arm. All medical and personal information will not be disclosed to any individual or organization without my consent. Blood samples will be coded and only investigators will hold the key to linking addresses of participants. The principal investigator will be available to answer any further questions about the research, now or during the course of the project.

I agree that the research project named above has been explained to my satisfaction and I agree to take part in the study. I understand that I am agreeing by my signature /thumbprint on this form to take part in this research project and understand that I will receive a signed copy of this consent form for my records.

Name of Investigator: CHARLES JAWEEN…….Signature

Tel No 0233668841

Date…….....

Name of participant……

Signature/Thumbprint…….....

Date…….....

Mobile No…….....

Appendix II

QUESTIONNAIRE

UNIVERSITY OF GHANA SCHOOL OF ALLIED HEALTH SCIENCES

QUESTIONNAIRE

POSSIBLE CAUSES OF NUTRITONAL ANAEMIA AMONG PREGNANT WOMEN IN TAMALE METROPOLIS, GHANA

Date_____/ _____ /2013 Location: _____No__

Trimester of respondent [1] First =1-12wks [2] Second =13-24wks [3] Third=25-40wks

SECTION A: FOOD HABITS

1. Do you practice any form of pica? [1] Yes [2] No
2. If yes, what do you eat?

   [1] Chewing stick/wooden sponge [3] chalk [5] cola nuts

   [2] Uncooked maize dough/starch [4] clay] [6] others
3. What stage of your pregnancy did you start this practice?

   [1] 1-3 months [2] 4-6 months [3] 7-9 months [4] not sure
4. Why do you practice pica?

   [1] To prevent nausea [2] to prevent vomiting [3] for satisfaction

   [4] To prevent salivation [5] others, specify ----------
5. Do you crave for any food? [1] Yes [2] No
6. If yes, what do you crave for?

   [1] chocolate [2] toffees/ candies [3] ice cream [4] fizzy beverages

   [5] alcoholic beverages [6] others ----------
7. What stage of your pregnancy did you start craving?

[1] 1-3 months [2] 4-6 months [3] 7-9 months [4] not sure

8. Why do you crave?

[1] to prevent nausea/vomiting [2] for satisfaction [3] Don't know why

[4] others ----------

9. Do you avoid taken any food? [1] Yes [2] No

10. If yes, what food do you avoid?

[1] meat/fish [2] eggs [3] milk [4] fruits [5] others ----------

11. At what time of the pregnancy did you avoid these foods?

[1] 1-2wks [2] 13-24wks [3] 25-40 wks

12. Why do you avoid these foods?

[1] taste of food [2]poor appetite [3] Don't know why [4] smell/aroma others----------

13. Please do you take any alcoholic beverage? [1] Yes [2] No

14. When did you start it? [1] before pregnancy [2] during pregnancy

15. What type of alcoholic beverage do you take?

[1] pito [2] beer/guiness [3] locally distilled alcohol [4] others……

16. How often do you take? [1] once a day [2] twice a day [3] weekly

[4] monthly [5] others…….

17. Quantity

[1] 300ml beer bottle or tumble [2] large beer bottle……. [3] one calabash [4] a tot others.....

18. Do you take tea and coffee? [1] Yes [2] No

19. If yes, how often do you take it? [1] once a day [2] twice a day [3] weekly

[4] monthly [5] sometimes [6] not at all

20. Do you take some food supplements or any herbal preparation [1] Yes [2] No

21.If yes which of these [1] folic acid [2] iron [3] multivitamin [4] herbal..

SECTION B: PRECIPITANTS OF ANAEMIA

22. Have you experienced blood loss from the body in the past 2 months ? [1] Yes [2] No

23. If yes, which of these [1] injuries that result in heavy bleeding [2] blood loss in urine [3] blood loss in stool [4] coughing out blood [5] vomiting out blood [6] others (specify)…….

24. Do you attend ANC regularly? [1] Yes [2] No

25. If yes how often? [1] monthly [2] every 3 months [3] not at all

[ ] others (specify) ……..

26. Do you take your routine ANC drugs? [1] Yes [2] No

27. If yes indicate [1] iron supplements [2] folic acid [3] multivitamins [4] SP [5] others (specify}…….

You may choose more than one.

28. Have you had malaria recently? Yes [ ] no [ ]

If yes how often do you get malaria

[1] once a month [2] twice a month [3] thrice a month [4] not at all

28. How often were you de-worming before pregnancy ? [1] every 3 months

[2] every 6 months [3] not at all [4] others (specify)…….

29. Results of laboratory investigations of the client?

[1] Hb level…….. [2] sickling test…… [3] BF for MPs [4] urine RE……[5] stool RE……

30. If sickling positive then, Hb – electrophoresis……

SECTION C: Socio-Demographic characteristics

31. Age……(Yrs}

32. Educational background

[1] Never attended school [2] Elementary/ Junior High School

[3] Senior High School [4] Tertiary [5] others (specify)

33. Occupation of client: [1] professional [2] trading [3] vocational

[4] jobless [5] others (specify).....s

34.Position.....

35. Spouse occupation: [1] professional [2] trading [3] vocational [4] jobless

36. Position.....

37. Monthly income of participant (GH CEDI)

[1] Less than 50 [2] between 50-100 [3] between 100-300

[4] between 300- 500 [5] between 500-1000 [6] above 1000

38. Monthly income of spouse (GH CEDI)

[1] Less than 50 [2] between 50-100 [3] between 100-300

[4] between 300-500 [5] between 500- 1000 [6] above 1000.

SECTION C: FOOD INTAKE (THREE 24-HOUR RECALL)

39. Please how many times do you eat in a day before pregnancy excluding snack?

[1] Two times [2] Three times [3] Four to five [4] More than five times

40. Has it changed since you became pregnant? [Yes] [2] No

41. If Yes How many times now?

[1] Two time [2] three times [3] Four to five times [4] More than five times

[5] Find it difficult eating

Appendix III

24 –HOUR RECALL

WEEK DAY 1

Menu	Food	Handy Measure	Weight (g)
BREAKFAST	1. 2. 3. 4.		
SNACK	1. 2. 3.		
LUNCH	1. 2. 3. 4.		
SNACK	1. 2. 3.		
SUPPER	1. 2. 3. 4.		
SNACK	1. 2. 3.		

Appendix IV
FOOD FREQUENCY QUESTIONNAIRE (FFQ) WEEKLY CONSUMPTION

Food Groups	Not often	1-2x	3-4x	5-6x	Daily
Starchy roots and plantains					
Cassava					
Cocoyam					
Yam					
Cereals and grains					
Maize					
Rice					
Bread					
Animal Products					
Fish					
Meat					
Poultry					
Egg					
Milk					
Crab					
Legumes, nuts and oilseeds					
Beans					
Groundnut					
Bambara					
Agushie (melon seed)					
Fruits					
Orange					
Mangoes					
Pawpaw					
Banana					
Watermelon					
Vegetables					
Tomatoes					
Pepper					
Garden eggs					
Okro					
Green leaves					
Fat and oils					
Palm oil					
Refined vegetable oil eg coconut oil					
Margarine					

FOOD HIGH IN REFINED SUGAR	**Number of times per week**	**Not applicable**
Coca cola		
Biscuits		
Cakes		
Sprite		
Fanta		
Sugar		
Don simon/ ceres/ minute maid etc		
Malt		
Others		
ALCOHOLIC BEVERAGES		
Beer		
Guinness		
Spirit		
Wine		
Punch		
Others		

INTERVENTIONS GIVEN

1	Daily calorie	
2	Type of diet given	
3	Advice on alcohol	
4	Advice on smoking	
5	Advice on physical activity	
6	Advice on fruits and vegetables	
7	Advice on timing of meals a. Morning b. Afternoon c. Evening d. Snack 1 e. Snack 2 f. Others	
	Total number of meals in a day	
8	Total number of snacks in a day	
9		

Health Education for pregnant women:

- Some fruits inhibit the absorption of iron although they are rich in ascorbic acid because of their high phenol content e.g strawberry , banana and melon.

- Food fermentation aids iron absorption by reducing the phytate content of diet
- Foods containing ascorbic acid like citrus fruits, broccoli & other dark green vegetables enhances iron absorption because ascorbic acid reduces iron from ferric to ferrous forms, which increases its absorption.
- Foods containing muscle protein enhance iron absorption due to the effect of cysteine containing peptides released from partially digested meat, which reduces ferric to ferrous salts and form soluble iron complexes.
- Food with polyphenol compounds which may inhibit iron absorption include:

  Cereals like sorghum & oats

  Vegetables such as spinach and spices

  Beverages like tea, coffee, cocoa and wine.

  A single cup of tea taken with meal reduces iron absorption by up to 11%.

  Food containing phytic acid i.e. Bran, cereals like wheat, rice, maize & barely.

  Legumes like soya beans, black beans & peas.

  Cow's milk due to its high calcium & casein contents.

  The dietary phenols & phytic acids are: compounds which bind to iron decreasing free iron in the gut & forming complexes that are not absorbed. Cereal milling to remove bran reduces its phytic acid content by 50%.

APPENDIX V:

ETHICAL CLEARANCE

SCHOOL OF ALLIED HEALTH SCIENCES
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA
ACADEMIC AFFAIRS

Phone: +233-0302-687974/5
Fax: +233-0302-688291

My Ref. No. SAHS/ 10231377
Your Ref. No.

P. O .Box KB 143
Korle Bu
Accra
Ghana

4th June, 2013.

Mr. Charles Jaween,
Dept. of Dietetics,
SAHS,
Korle Bu.

Dear Mr. Jaween,

ETHICS CLEARANCE

Ethics Identification Number: SAHS – ET. /10364080/AA/3A/2012-2013.

Following a meeting of the Ethics and Protocol Review Committee of the School of Allied Health Sciences held on Friday 1st February, 2013, I write on behalf of the Committee to approve your research proposal as follows:

TITLE OF RESEARCH PROPOSAL: **"Determination of the Possible Causes of Nutritional Anaemia among Pregnant Women Attending Temale Teaching Hospital"**

This approval requires that you submit six-monthly review reports of the protocol to the Committee and a final full review to the Committee on completion of the research. The Committee may observe the procedures and records of the research during and after implementation.

Please note that any significant modification of the research must be submitted to the Committee for review and approval before its implementation.

You are required to report all serious adverse events related to this research to the Committee within seven (7) days verbally and fourteen (14) days in writing.

As part of the review process, it is the Committee's duty to review the ethical aspects of any manuscript that may be produced from this research. You will therefore, be required to furnish the Committee with any manuscript for publication.

Please always quote the ethical identification number in all future correspondence in relation to this protocol.

Thank you.

Yours sincerely,

Dr. (Maj. Rtd.) George Asare
(Chairman, Ethics and Protocol Review Committee)

cc Dean
Co-ordinator, Dept. of Dietetics
Senior Assistant Registrar