

UNIVERSITY OF GHANA

COLLEGE OF BASIC AND APPLIED SCIENCES

**EFFICACY OF NUTRITION EDUCATION WITH AN EMPHASIS ON
CONSUMPTION OF IRON-RICH FOODS ON HAEMOGLOBIN LEVELS OF
PREGNANT WOMEN: A RANDOMIZED TRIAL IN GOMOA EAST DISTRICT OF
THE CENTRAL REGION OF GHANA**

BY

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**THIS THESIS IS SUBMITTED TO THE DEPARTMENT OF NUTRITION AND FOOD
SCIENCE, UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE AWARD OF M.PHIL NUTRITION DEGREE**

JULY, 2015

DECLARATION

I, Yakubu Adam hereby declare that this thesis is as a result of my own research work except references to other works which have been duly acknowledged. And that this thesis has not been presented wholly or partly to this institution or any other elsewhere for any kind of degree.

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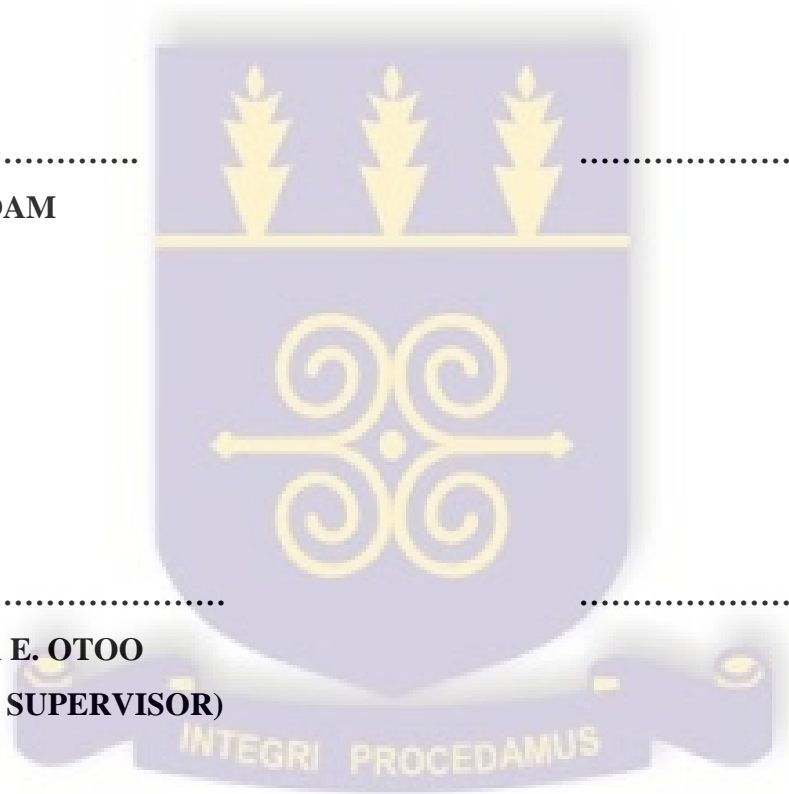
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ABSTRACT

Anaemia in pregnancy continues to be a huge public health problem worldwide with multiple adverse outcomes on both mother and child especially in developing countries. The causes of anaemia among pregnant women (PW) are multifactorial and may be associated with inadequate dietary intake of iron-rich foods. The aim of the study was to evaluate the impact of a nutrition education (NE) intervention on haemoglobin (Hb) levels, knowledge and dietary intake of anaemic PW in Gomoa East (GE) district of the Central region of Ghana. A total of 130 anaemic PW (Hb level 7-11 g/dl) in second trimester who were attending antenatal care (ANC) in four health centres (Buduatta, Ojobi, Okyereko and Nyanyano) were recruited and randomly assigned to an intervention group, IG (n=65) to receive specific NE on anaemia and iron-rich foods in addition to general NE; or control group, CG (n=65) to receive general NE. The education sessions were on individual, face to face basis done through biweekly home visits and biweekly phone calls. Semi-structured questionnaires were used to collect data on background socio-demographic characteristics, morbidity, Hb measurements, and anthropometric measurements at baseline and after 10 weeks of intervention. A total of 119 PW completed the study. Data were analysed using SPSS (version 16). Means and standard deviations were calculated for all continuous variables and frequencies for all categorical variables. All probability values less than 0.05 ($p < 0.05$) were considered statistically significant. At the end of the intervention, PW in the IG had significantly higher weight gain (2.50 ± 1.07) than the CG (1.09 ± 1.46), $p < 0.05$. Most of the PW in the IG (89.8%) attained good nutritional knowledge on anaemia and iron-rich foods at the end of the NE intervention while none in the CG had good knowledge on anaemia and iron-rich foods. Haemoglobin concentration increased significantly in the IG over the 10 weeks and the absolute change in Hb concentration was significantly higher in the IG (0.1 ± 1.3) than in the CG (-0.6 ± 1.3),

$p < 0.05$. The intakes of red meat, legumes, vitamin C-rich foods, grains, roots and tubers became significantly higher for PW in the IG than the CG at the end of intervention period ($p < 0.05$). The NE intervention emphasizing the consumption of iron-rich foods showed positive effects on Hb, weight gain, nutrition knowledge and dietary intake of iron rich foods and could be a practical and effective strategy for improving dietary practices, Hb level as well as adequate weight gain during pregnancy.



DEDICATION

This work is dedicated to my sister, Abuyama.



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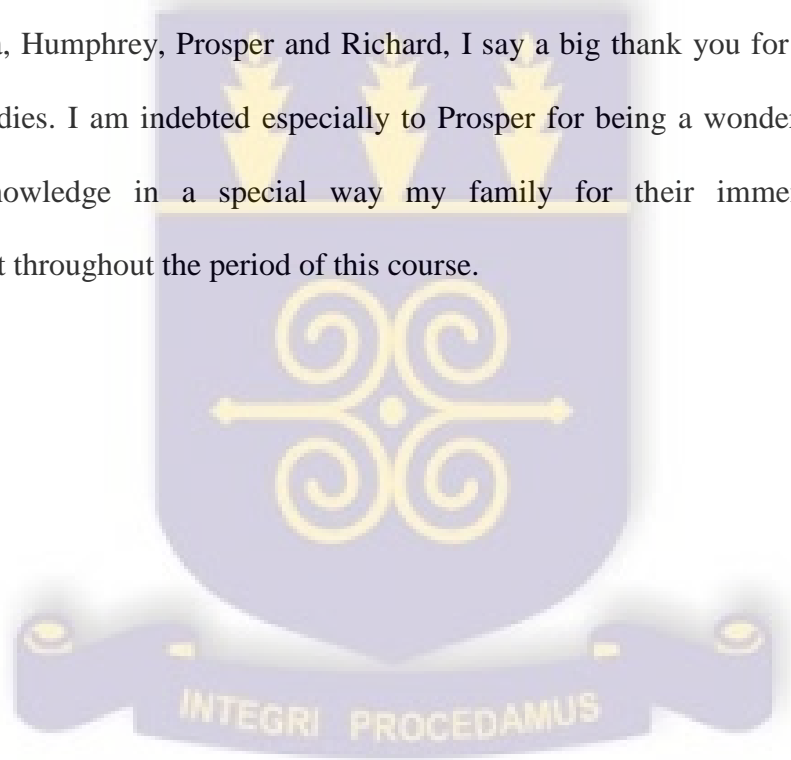


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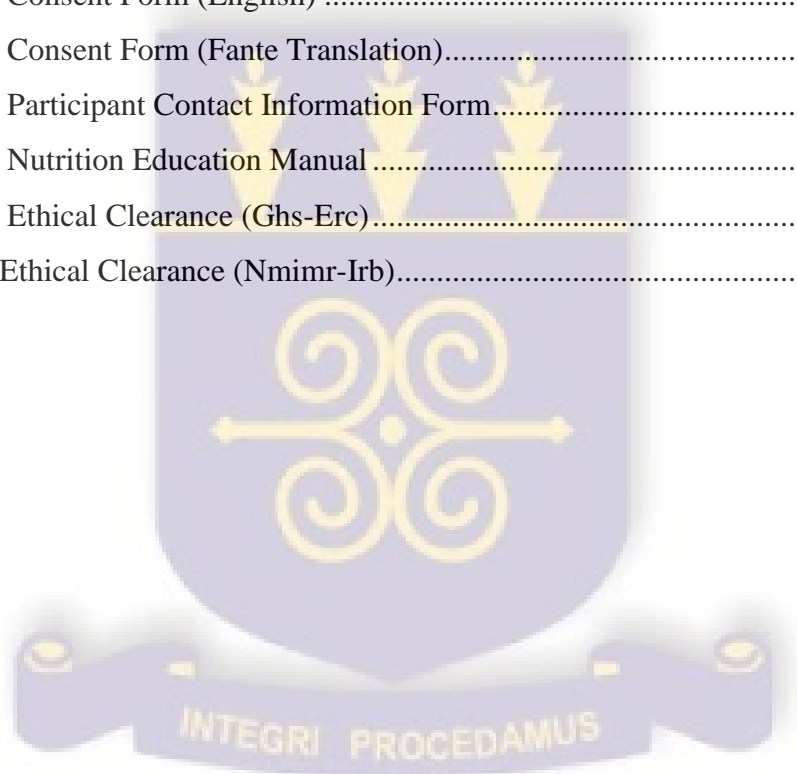
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ACRONYMS AND ABBRVIATIONS

ANC	Antenatal Care
ASF	Animal Source Foods
BMI	Body Mass Index
CG	Control Group
CHPS	Community-based Health Planning and Services
DHMT	District Health Management Team
ERCRIHS	Ethical Review Committee on Research Involving Human Subjects
GDHS	Ghana Demographic and Health Survey
GE	Gomoa East
GHS	Ghana Health Service
GSS	Ghana Statistical Service
Hb	Haemoglobin
ICSH	International Council for Standardization in Haematology
IDA	Iron Deficiency Anaemia
IEC	Information, Education and Communication
IG	Intervention Group
IOM	Institute of Medicine
IRB	Institutional Review Board
LGA	Large for Gestational Age
MDG	Millennium Development Goals

MUAC	Mid-Upper Arm Circumference
N-CRS	Nutrition Collaborative Research Support Programme
NE	Nutrition Education
NEC	Nutrition, Education and Counselling
NMIMR	Noguchi Memorial Institute for Medical Research
PHC	Population and Housing Census
PW	Pregnant Women
SPSS	Statistical Package for the Social Sciences
UNICEF	United Nations Children Fund
UNU	United Nations University
USDA	United States Department of Agriculture
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Anaemia continues to be a serious public health problem affecting both rich and poor countries (Gautam *et al.*, 2008) though developing countries have the highest prevalence (MacDonald *et al.*, 2007). The worst affected groups by anaemia and its devastating consequences are infants and young children, and pregnant women (PW). During pregnancy, haemoglobin (Hb) concentration $< 11\text{g/dl}$ is used to define anaemia (WHO/UNICEF/UNU, 2001). Anaemia during pregnancy is associated with multiple adverse outcomes for both mother and infant, including an increased risk of haemorrhage, maternal mortality, pre- and peri-natal mortality and delivering a low birth weight baby (WHO, 2001). Studies show that an estimated 69% of PW are affected by anaemia globally (Benoist *et al.*, 2008). This prevalence is above the 40% threshold defined by World Health Organization (WHO) as representing a severe public health problem among the population (WHO, 2001).

The causes of anaemia during pregnancy are multifactorial and includes nutritional deficiencies of iron, folate and vitamin B₁₂ as well as parasitic diseases such as malaria, hookworm and other helminthic infections. However, iron deficiency, which is often reported as the most common nutritional deficiency globally, is the major cause of anaemia. It is estimated that iron deficiency is responsible for about 50% of all cases of anaemia (WHO/UNICEF/UNU, 2001).

Countries have employed various strategies to combat the menace of anaemia particularly among vulnerable groups such as pregnant women. Iron supplementation may improve Hb

and iron status during pregnancy (Beard, 2000). However, iron supplementation is often limited by poor compliance resulting from programmatic constraints, lack of available supplements, lack of information, education and communication (I.E.C.) campaigns and poor counselling by health care providers.

During periods of increased physiological requirement, dietary intake of iron should increase. The best sources of iron in the non-vegetarian diet are red meat, fish, liver and egg yolk. However, the intake of these iron-rich foods by pregnant women may be influenced by the lack of adequate maternal nutritional knowledge and dietary taboos related to pregnancy (Ladipo, 2000). Fallah *et al.*, (2013) have shown that nutrition education (NE) has a positive effect on nutritional awareness of pregnant women. Other studies suggest that NE is a promising and sustainable strategy for preventing iron deficiency anaemia (IDA) in the general population (Tontisirin *et al.*, 2002).

1.2 Problem Statement

The contributors to the prevalence of anaemia in pregnancy are varied, thus it remains an intractable public health problem for many countries. In order to effectively manage anaemia there is the need for an analysis of the major contributors to the problem so the appropriate intervention package can be used to address them. There is inadequate information on the level of nutritional awareness of pregnant women especially on anaemia and iron-rich foods. The 2008 Ghana Demographic and Health Survey (GDHS) shows that although 96% of pregnant women in Ghana receive antenatal care (ANC), about half of all the pregnant women report for ANC after the first trimester (GSS, 2009). In the Gomoa East (GE) district of the Central region of Ghana, the patient-nurse ratio is high. This situation does not allow

sufficient time for nurses to render all essential components of the ANC programme particularly, NE. Much of the health counselling given during ANC tends to be general and is often delivered to the group of PW who are attending on a particular day. There is the need to equip every PW with the relevant nutritional knowledge that is likely to culminate in the adoption of the appropriate dietary behaviours and consumption of iron rich foods.

1.3 Rationale

The GDHS (2008) has reported one of the highest prevalence of anaemia among women for the Central region (63.7%) but there is no such documentation specific for the GE district. The addition of animal source foods (ASF) such as meat and fish to the meal will not only provide the more absorbable haem iron, but will also enhance the absorption of non-haem iron in the diet of PW. Moreover, the intake of meat and other iron-rich foods has the propensity of providing multiple micronutrients in the diet. However, no work has been done on the level of iron-rich foods consumption in the GE district of the Central region of Ghana. Furthermore, the efficacy of NE focussing on improving iron-rich foods consumption and consequently increasing Hb levels among PW has not been explored.

In light of this, a NE package emphasizing consumption of iron-rich foods like red meat and fish as well as fruits and vegetables were developed targeting PW. This randomized controlled trial seeks to test the efficacy of NE as a strategy to improve nutritional knowledge, intake of iron-rich foods as well as fruits and vegetables intake, and ultimately, Hb status of PW. The study is expected to bring out current data on the anaemia prevalence among PW in relation to their dietary practices in the study area which will help to prompt the needed action

by all stakeholders. Moreover, the true impact of NE intervention on the iron status of PW, if ascertained, will stimulate efforts in this regard.

1.4 Objectives of the Study

The main objective of the study was to determine the efficacy of NE with an emphasis on iron-rich foods consumption on Hb levels of PW in GE district.

Specifically, the study sought to:

1. To determine the prevalence of anaemia among PW in GE district
2. To assess the effect of NE intervention on nutritional knowledge of PW in GE district
3. To assess the effect of NE intervention on the level of consumption of iron-rich foods such as ASF as well as fruits and vegetables by PW in GE district
4. To measure the efficacy of NE intervention on Hb levels among PW in GE district
5. To assess the nutritional status of PW in GE district.

1.5 Hypothesis Statement

Null hypotheses

1. There is no difference in Hb levels of PW who received NE intervention on anaemia and iron-rich-foods and those who did not.
2. There is no difference in nutritional knowledge about iron-foods between PW who received NE intervention on anaemia and iron-foods and those who did not.
3. There is no difference between dietary intakes of PW who had NE about anaemia and iron-foods and those who had not.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Prevalence and Trends of Anaemia Among Pregnant Women

During pregnancy, Hb level less than 11 g/dl signifies anaemia (WHO/UNICEF/UNU, 2001). According to the World Health Organization(WHO) (2002), anaemia is one of the most important contributing factors to global disease burden occurring at all stages of the life cycle but more prevalent in PW and young children. An estimated 69% of PW are affected by anaemia globally (Benoist *et al.*, 2008). Anaemia has been noted among the most intractable public health problems in developing countries as well as the commonest complication in pregnancy in sub-Saharan Africa (Buseri *er al.*, 2008). The 2008 GDHS report showed a soaring in the level of anaemia among PW from 65% to 70% between 2003 and 2008 (GSS, 2009).

2.2 Aetiology of Anaemia in Pregnancy

Anaemia may result from a wide variety of causes which often coexist. In literature, the major direct causes of anaemia have been presented under the following categories:

2.2.1 Compromised red blood cell (RBC) production

Blood Hb production may be decreased due to: poor, insufficient, or abnormal red blood cell (RBC) production. This may result from poor dietary intake and/or absorption of iron and other micronutrients including vitamins A and B₁₂, folate, riboflavin and copper. Other factors leading to decreased RBC production include infectious diseases and increased requirements due to disease and growth (van den Broek & Letsky, 2000).

2.2.2 Excessive RBC destruction

Acute and chronic infections including malaria, cancer, tuberculosis and human immunodeficiency virus (HIV) can also lower blood Hb concentrations. Malaria is a major cause of anaemia in endemic areas especially during seasons of high transmission (Glover-Amengor *et al.*, 2005).

2.2.3 Excessive RBC loss

Anaemia may also be caused by heavy blood loss due to parasite infections such as hookworm, ascaris and schistosomiasis; bacterial or viral infections; reproductive-related losses as a result of menstruation (Galloway, 2013; MacDonald *et al.*, 2007)

The most significant contributor to anaemia worldwide is iron deficiency. So anaemia and IDA are often used synonymously. This also accounts for the reason that prevalence of anaemia has often been used as a proxy for IDA. In general, half of all cases of anaemia are assumed to be due to iron deficiency (WHO, 2008). The major risk factors for IDA include low intake of iron, poor absorption of iron from diets high in phytates or phenolic compounds. Increased iron requirements during certain periods of life especially, growth and pregnancy have also been shown to play a role as a risk factor in pregnancy anaemia (WHO, 2008). Alene and Dohe (2014) conducted a community based cross-sectional study on the prevalence of anaemia and associated factors among PW in Eastern Ethiopia. The study revealed that trimester of current pregnancy, wealth quintile, gravidity, iron supplementation and mid-upper arm circumference (MUAC) were significantly associated with anaemia. In a full spectrum assessment of nutritional and non-nutritional factors associated with pregnancy anaemia, the

role of chronic inflammation as a possible contributing factor has been implicated (van den Broek and Letsky, 2000). Glover-Amengor *et al.* (2005) have shown that among the important determinants of anaemia in pregnancy in Sekyere West district of the Ashanti region of Ghana include low parity, young age, rural dwelling, and parasitic infections such as hookworms.

2.3 Consequences of Anaemia in Pregnancy

Anaemia is linked to poor health and poor nutrition. A WHO (2001) report showed that during pregnancy, iron deficiency was associated with multiple adverse outcomes for both mother and infant including an increased risk of haemorrhage, sepsis, maternal mortality, perinatal mortality, decreased work productivity, impaired cognitive development of children and low birth weight.

2.3.1 Maternal anaemia, birth weight and infant health

Maternal iron deficiency anaemia in pregnancy has been shown to be associated with increased risk of preterm delivery and invariably low birth weight (Allen, 2000). Low birth weight is in turn an important risk factor for neonatal mortality and morbidity. It has also been well documented that a surviving low birth weight infant is more likely to suffer various deficits in health, development and cognitive growth (MacDonald *et al.*, 2007). In rural Indonesia, data from Nutrition and Health Surveillance System was analysed for haemoglobin of 3-5 months old infants and related factors. It was revealed that infants born to anaemic mothers enter into the first year of life with reduced iron stores. Such infants thus have greater susceptibility to iron deficiency and anaemia leading to impaired cognitive development in early childhood, even if iron deficiency is corrected (De Pee *et al.*, 2002).

2.3.2 Effects of anaemia on maternal mortality and morbidity

Severe anaemia (Hb <7g/dL) is directly linked to maternal death. Der *et al.* (2013), conducted a five-year retrospective study using autopsy results to assess maternal mortality causes in southern Ghana. The study revealed that 12.5% of all deaths among women aged 15-49 years were pregnancy-related while haemorrhage was first among the top 5 causes of maternal death. It has been well reported that the most dramatic health effects of anaemia in PW are increased risk of maternal and child mortality (Benoist *et al.*, 2008). According to Brabin *et al.*, (2001), PW with Hb<7 g/dL have 1.35 times greater risk of 'dying from obstetric complications' while in those with Hb<5 g/dL, the risk is 3.5 times greater compared with non-anaemic women. Although a causal link has not yet been found between moderate anaemia and maternal mortality, it is important to include the management of mild and moderate anaemia as an integral part of the prevention of the onset of severe anaemia. It has been suggested that about 10% of maternal deaths could be prevented through the implementation of full coverage treatment for both IDA and malaria globally (Wagstaff and Claeson, 2004).

2.3.3 Reduced work productivity

Haemoglobin is the iron-containing oxygen-transport metalloprotein in the RBC. Haemoglobin in the blood carries oxygen from the lungs to body tissues where it releases the oxygen to enable aerobic respiration to provide energy for metabolism. Low Hb will therefore result in lack of adequate oxygen for physical activity which consequently leads to fatigue. This translates into reduced productivity and incomes for the world's many anaemic women. Many studies have examined the relationship between anaemia and reduced productivity.

Haas and Brownlie IV (2001) in a review of 29 research reports demonstrated a strong causal effect of severe and moderate IDA on aerobic capacity which translates into reduced physical activity and ultimately productivity. It is presumed that the mechanism for this effect is the reduced oxygen supply due to anaemia. In a study to determine the association between anaemia and reduced productivity of women workers even in less physically-strenuous task, a significant correlation was found between Hb and work output. On average anaemic women produced 5.3% less in the factory and 6.5 hours less house work per week (Scholz *et al.*, 1997) These results are linked to the clinical impression that people with anaemia suffer from fatigue and body weakness. The clear association between anaemia and reduced work capacity and productivity justifies value in interventions to improve iron status as a way of enhancing human capital and health.

2.4 Maternal Iron Nutrition

2.4.1 Maternal iron requirement

During pregnancy, iron requirements go up considerably. Iron is an essential element for making Hb, the protein that is in RBC that carries oxygen to other cells. Studies show that, the amount of blood increases during pregnancy up to about 50% more than usual indicating haemodilution (Benoist *et al*, 2008). Therefore, more iron is needed to make more Hb for the additional blood. Extra iron is also required for the growing baby and placenta, especially in the second and third trimesters. It has also been demonstrated that many women need more iron because they start their pregnancy with inadequate stores of iron (Goonewardene *et al.*, 2011). According to Picciano (2003), the total iron cost of pregnancy is about 1,040 mg. The woman retains 200 mg after delivery as blood volume decreases while 840 mg is lost permanently. In order to preserve maternal stores and also prevent iron deficiency, it has been

recommended that iron intake during pregnancy is increased by 9 to 27 mg/day (IOM, 2001). It is envisaged that this level of intake will be achieved through prudent food choices alongside supplementation.

2.4.2 Iron bioavailability

Iron bioavailability is defined as ‘the extent to which iron is absorbed from the diet and used for normal body functions’ (Hurrell and Egli, 2010). There is extensive documentation describing the various factors that influence iron bioavailability. The metabolism of iron is unusually different from that of other metals as there is no physiologic mechanism for iron excretion (Hurrell and Egli, 2010). Iron losses may occur in all population groups through obligatory losses (skin, intestines, urinary tract and airways) and in women of child bearing age through menstrual blood losses. In order to maintain iron balance, ‘the sum of these losses plus the iron required for growth in infants, children, and adolescents, and during pregnancy must be provided by the diet’ (Hurrell and Egli, 2010).

Dietary iron is divided into 2 types: haem iron which is most readily absorbed comes from Hb and myoglobin in animal tissue foods; and less bioavailable non-haem iron which comes from both plant and animal food sources (Rideout, 2009). In a review, Hurrell and Egli (2010) described the dietary and host factors reported to influence iron bioavailability. The absorption of non-haem iron depends on the balance between the absorption inhibitors and enhancers as well as the iron status of the person.

2.4.2.1 Enhancers of iron absorption

It has been documented that ascorbic acid is the most efficient enhancer of non-haem iron absorption by virtue of its reducing and chelating properties (Teucher *et al.*, 2004). However, its stability in the food vehicle must be ensured as instability of ascorbic acid may occur during food processing, storage and cooking. The consumption of natural sources of vitamin C (fruits and vegetables) with foods could be an important recommendation as part of interventions to improve iron nutrition in pregnancy.

The addition of beef, chicken or fish to a carbohydrate-rich food such as maize meal consistently increased the absorption of non-haem iron 2-3 folds (Hurrell and Egli, 2010). According to Miret *et al.* (2003), iron status and iron absorption are inversely related. Also, the effect of iron status on iron absorption is more on haem iron than non-haem iron.

2.4.2.2 Inhibitors of iron absorption

According to Hurrell and Egli (2010), the main inhibitor of iron absorption in plant based diets is phytates. Food processing methods such as milling, heat treatment, soaking, germination and fermentation have been shown to remove or degrade phytates to various degrees (Hurrell, 2004). Polyphenols which occur in various amounts in plant foods and beverages including fruits, vegetables, some cereals and legumes, tea, coffee and wine have been documented as having inhibiting effect on iron absorption (Reddy, 1999). Unlike other inhibitors of iron absorption which affect only non-haem iron absorption, calcium has been shown to have negative effect on the absorption of both haem and non-haem iron (Hallberg *et al.*, 1993). Although animal tissues are known to enhance non-haem iron absorption, animal proteins like

milk proteins, egg proteins and albumin have been found to inhibit iron absorption. Protein from soybean also decreases iron absorption.

In order to ensure optimal bioavailability of iron in the diet of PW, it may be prudent to separate tea or milk drinking from meal time, one or two hours later. As part of nutritional counselling for PW, fruit juices or other foods rich in ascorbic acid should be included in the meal (Camara-Martos and Amaro-Lopez, 2002).

2.5 Factors Affecting Maternal Iron Intake

2.5.1 Maternal knowledge and dietary practices

The adoption of appropriate dietary practices during pregnancy is an important prerequisite in ensuring desirable pregnancy outcomes. The maternal diet must meet the mother's usual requirements as well as those of the growing foetus while maintaining adequate stores of nutrients required for foetal and infant health, and future breastfeeding (Chandyo *et al.*, 2015). An important determinant of the dietary practices of PW is their level of nutritional knowledge. Knowledge and behaviour cannot be said to be the same but knowledge can be a determining factor of dietary behaviour (Haslam *et al.*, 2000). In a study of the knowledge, attitude and behaviour of pregnant women, Fallah *et al.* (2013) have identified lack of knowledge, attitudes and false beliefs as the main barriers of behaviour change. For pregnancy nutrition and food practices, most women draw on multiple sources of knowledge including health systems educational settings, the mass media and most importantly, their own pregnancy experiences (de Graft Aikens, 2014). Efficacy studies on interventions targeting improvement in maternal nutritional knowledge in Ghana are lacking.

2.5.2 Household food security and maternal consumption of animal source foods

Several studies including the Nutrition Collaborative Research Support Programme (N-CRS) have provided evidence of a strong positive association between ASF intake and micronutrient status (Neumann *et al*, 2003). According to Yeudall *et al* (2007), household food security has a strong positive correlation with percent ASF consumption among children of urban Uganda. In their study, Yeudall *et al* (2007) further demonstrated that consumption of ASF was significantly negatively associated with C-reactive protein level, which in turn had a negative association with Hb level. Data on household food security situation in the GE district are limiting. Such data may be useful in predicting the level of consumption of ASF by PW in the area.

2.6 Maternal Morbidity and Nutritional Status

The target set under Millennium Development Goal (MDG) 5 is a 75% reduction in maternal mortality between 1990 and 2015. Although the maternal mortality ratio is one of the main indicators of a country's status in maternal health, the burden of maternal deaths is only the tip of the iceberg in relation to maternal morbidity (Tabassum *et al.*, 2013). 'For every woman who dies of pregnancy related causes, 20 or 30 others experience acute or chronic morbidity' which often result in some permanent malfunctioning (Reichenheim, 2009). Storeng *et al.* (2010) have estimated the burden of maternal morbidity just as maternal mortality to be highest in low- and middle-income countries particularly, among the PW. However, the true burden of maternal morbidity is difficult to measure due to lack of common definitions and standard identification criteria, coupled with inaccurate records and inadequate information systems (Tabassum *et al.*, 2013).

2.6.1 Interventions to improve iron status among pregnant women

The WHO (2008) has reiterated that reducing the burden of anaemia will greatly contribute to achieving several United Nations MDG. Anaemia in pregnancy has been well recognized as a widespread public health problem with major implications on human health as well as social and economic development (McLean *et al*, 2009). Inadequate dietary intake of bioavailable iron coupled with the high iron requirement of PW is a major factor in the aetiology of iron deficiency. Combating such deficiency requires large-scale interventions as such various countries have employed a number of strategies to combat anaemia in pregnancy.

2.6.2 Iron supplementation

WHO guidelines provides global evidence-informed recommendations on daily iron and folic acid supplementation in PW as a public health intervention for the purpose of improving pregnancy outcomes and reducing maternal anaemia in pregnancy. WHO recommends universal iron supplementation to PW with 60 mg iron daily, in a pill that also contains 400 µg folic acid (WHO, 2012). Beard (2000) asserts that the use of iron supplementation mostly around the world as a therapeutic approach rather than public health-based approach is challenged with compliance which may be real or perceived. Much of the success achieved through iron supplementation is reported in the developed world particularly in the United States and Europe (Roodenburg, 1995). A study on an iron supplementation programme among PW in Indonesia found a low compliance (Schultink, 1993). A major contributory factor to this was noted to be the low level of awareness of PW, hence the authors recommended NE for PW and health service staff.

2.6.3 Fortification

A wide range of fortifying agents and food carriers have been developed to date. In many countries, nutrients are added to a wide variety of food carriers such as flour, bread, milk, orange juice, salt, sugar and beverages (UNU, 1996). According to Mannar (2001), food fortification is the strategy with the greatest potential to improve iron status of the largest number of people. Fortification of foods with iron has yielded improvements in iron status in many countries. In an efficacy trial in Ghana (Lartey *et al.*, 1999), iron and other micronutrients were added to weanimix, which is a cereal-legume blend being promoted by the government and UNICEF. Infants 6 to 12 months almost all of whom were partially breastfed were given the food. The food was supplied weekly free of charge and feeding 3 times per day was encouraged. Unfortified weanimix was used as a control. In the unfortified group, the prevalence of low ferritin concentrations increased from 19% at 6 months to 55% at 12 months but decreased from 18% to 11% during the same period for those who received fortified weanimix. In a six-month controlled trial, it was confirmed that NaFeEDTA-fortified fish sauce was efficacious in improving iron status of anaemic Vietnamese women (Thuy *et al.*, 2003). It is assumed that compliance with food fortification programmes can be considerably better than with food supplementation since less active involvement of the consumer is required (Davidsson and Nestel, 2004). Unfortunately, efforts in iron fortification are thwarted by constraints that usually characterize fortification including need for Central processing and lack of useful iron fortificants.

2.6.4 Dietary diversification

‘Targeting animal products to those with highest iron requirements’ as well as promoting the production of small animals and fish, would result in increased intake of absorbable iron and

other micronutrients (ACC/SCN, 2001). In Islamabad, Pakistan, an assessment of dietary diversity and nutritional status of PW in their second and third trimesters revealed that dietary diversity is a good proxy indicator for micronutrient adequacy in PW (Ali *et al.*, 2014).

2.7 Nutrition Education and Control of Anaemia

‘Nutrition education is defined as a series of activities that facilitate adoption of eating and other related behaviours conducive to health’ (Smith & Smitasiri, 1997). It has been suggested that NE is a promising and sustainable strategy for preventing IDA in the general population (Tontisirin *et al.*, 2002). A review by Girard and Olude (2012) observed that nutrition education and counselling (NEC) is a widely used strategy for improving nutritional status of women during pregnancy. According to Gaetke *et al.* (2006) attendance at even one nutrition counselling session is associated with improved short-term clinical outcomes. These studies presents clear evidence in favour of the effectiveness of NE on the nutritional status of PW. To this end it is expected that focussed NE which emphasizes the consumption of iron-rich foods will result in improved Hb levels among PW.

2.7.1 Theories of nutrition education interventions

The theoretical basis for planning interventions aimed at changing health behaviours counts on models of behaviour (Caitlin, 2012). Some frequently used theoretical approaches in NE include: social learning theory; stages of change/translocation theory; health believe model; and social action theory.

Social Learning Theory: Behaviour change results from cognitive processes, that is, thinking, perceiving and believing. Attitudes and beliefs about a behaviour change most easily by

actual performance or observed performance of the behaviour. It involves interaction and influence of components in the social environment as they reflect and modify behaviour. The components of influence include the environment, offering incentives and disincentives, situations which provide consequences, self-efficacy (Bandura, 1986).

Stages of Change/Translocation Theory: This theory focuses on the construction of different messages to people who are at different stages of readiness to change certain behaviour. The stages of behaviour include pre-contemplation through contemplation and eventual action. The theory emphasizes attitudes and attitudinal assessment of target audience (Prochaska, 1990).

The Health Belief Model: This model stipulates that individuals who believe they are healthy will pursue behaviours to prevent disease or to detect a disease. The desire to avoid disease or get well is important (Orji *et al*, 2012). Some components of the Health Belief Model include: perceived severity; perceived risk; perceived benefits; and perceived barriers. The Health Belief Model can be applied to enable individuals to change dietary behaviours and also serve as a guide for counsellors to assist their clients (Strychar, 2007).

Social Action Theory: It is assumed that based on the information processing theory, people will select options which gives them the most 'good' outcomes and the fewest 'undesirable' outcomes. The theory examines peoples' intentions to behave a certain way and assigns a probability of certain actions based on intentions and influence of others (Fishbein & Ajzen, 2010).

The Food and Agriculture Organization (FAO) Expert Consultation has concurred that the practical application of these theories is difficult since no single model of behaviour change

available today fits all situations (Hosmer *et al.*, 1995). Glanz and Rudd (1993) conducted a survey of two groups of professionals thus, NE and consumer behaviour. Both were into the field of providing information to influence food choices. They were to give their opinions on which theories and models were most familiar and useful. The professionals in both fields chose a few familiar and current theories but respondents agreed that theories were not all that important since gaps often exist between research and practice. Although theories make efforts to identify all factors which may predict the outcome behaviour, they may not be a true reflection of the reality. One theory may also be more successfully applied in one situation than another. This therefore poses a challenge in using one theory for the whole intervention process. However, according to Caitlin *et al.* (2012), theory-based NE efforts and the use of theoretical models are useful as they enable the educator to incorporate the influence of motivators, barriers and other important factors in the planning and implementation of NE initiatives. It may be more appropriate to use eclectic models.

2.7.2 Nutrition Education Approaches

Stuart (1991) views NE and nutrition communication as integral components of other nutrition intervention approaches like food production, food assistance, food fortification, supplementary feeding, promotion of breastfeeding and nutrition-related health services. There has been an evolution in NE and communication programmes from a conventional one-way flow of communication, that is, a mere transfer of information to change food beliefs, attitudes and habits in target groups. A review of NE programmes in developing countries (Cerqueira, 1990) showed that this conventional method mainly consists of health talks at health centres. The method is found to be largely ineffective and yielded few changes in

nutrition-related behaviours or nutritional status. The programme failure, to a large extent, may be attributed to the ineffective communication methods used coupled with inappropriate content of the messages. A two-way process of sharing which permits free exchange of knowledge, values and practices on nutrition is more desirable (Stuart and Achterberg, 1997). This approach to nutrition intervention is advantageous in that it provides a platform for interaction and ensures active participation of those who are required to make decisions. The current approach also leads to the adoption of improved practices and produces lasting effects or changes. Various strategies to NE have been developed and effectively applied over the years including, social marketing, social mobilization and development-support communication (Parlato *et al.*, 1992).

2.7.3 Framework of nutrition education programmes

The framework for planning and implementing NE programmes adapted in this review is as described in the FAO Expert Consultation discussion papers (Smith and Smitasiri, 1997). In the framework, there are four interactive components which are fundamental to planning NE programmes. These components are underpinned by the nature of food supply. The framework proposes to broaden the role of NE programmes beyond addressing existing problems to include those aimed at promoting and enhancing nutritional status. Moreover, it proposes to include as a role of NE, a range of programme strategies, as well as communication and education activities. Many countries in the world are experiencing rapid social and economic changes which mostly have negative impacts on nutritional health of population subgroups. Nutrition education can no longer only serve as a remedy for

malnutrition but a means of promoting and enhancing nutritional health in the wake of these changes.

Molina-Lopez *et al.* (2013) have suggested that the problem with NE was more how the initiatives could be implemented effectively. The good strategies are in fact said to be available. What is needed is the support for nutrition practitioners to effectively implement the interventions. A generic framework has been proposed by Smith & Smitasiri (1997) for the implementation of national NE programmes. The framework suggests a conceptual process involving three major components namely, Decision, Development and Dissemination which are noted to be crucial for programme effectiveness. It is believed that the Decision-Development-Dissemination Approach is a holistic and systematic framework for implementing an action-oriented programme. The decision process is necessary to lead the work in the right direction. The process of programme development and dissemination will ensure maximum nutritional change and increased programme sustainability.

2.7.4 The Role of Nutrition Education to Improve Maternal Iron Nutrition

Prenatal NE and counselling intervention in PW has been shown to positively impact nutrition knowledge and diet quality. In Western Iran, Fallah *et al.* (2013) conducted a study to determine the effects of NE on level of nutritional awareness of PW. A random sample of 100 PW attending prenatal urban health centres were taken through NE lessons in groups of between six to ten women. The nutritional education programme contained two to four lessons. Assessment of nutritional knowledge of the PW was done before intervention (pre-test) followed by two post-tests with three weeks interval. The study found a significant

increase in the awareness level of PW from 3% before intervention to 31% after the nutritional education intervention. Elsewhere, a systematic review of the effects of NEC provided during pregnancy on maternal, neonatal and child health outcomes revealed a 30% reduction in the risk of anaemia in late pregnancy (Girard and Olude, 2012). However, the need for additional well designed research to enhance the confidence in the effect of NEC was indicated. More so, in some developing countries such as Ghana, there is no routine collection of data on whether women receive NEC during routine ANC or how it is delivered.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Area

The study was conducted in the GE district of the Central region of Ghana. The administrative capital of GE district is Afransi. The district is a relatively new one which was inaugurated on February 29, 2008. The district shares boundaries with Gomoa West district to the south, Agona West Municipal to the north, Asikuma-Odoben-Brakwa district to the west and Ewutu-Senya East district to the east (Figure 3.1). Gomoa East district is made up of 86 settlements covering an estimated 44,467.9 hectares and an area of 449.63 square kilometres.

The 2010 Population and Housing Census reported the population of GE district as 207,071 comprising 47% males and 53% females (GSS, 2012). The predominant occupation of the inhabitants is agriculture.

The district has no hospital but has five health centres at Ojobi, Nyanyano, Obuasi, Buduatta and Okyereko; five Community-based Health Planning and Services (CHPS) zones; two private midwife/maternity homes; and two private orthodox clinics (Ghana Health Service, 2012). The study participants included PW who were attending ANC at four health centres namely Buduatta, Ojobi, Okyereko and Nyanyano. These health centres provide sub-district level health care services to people in communities under their respective catchment areas. General treatment, preventive health, reproductive and child health services are provided at each facility by various categories of health workers who include medical assistants, midwives, nurses and technical officers. Referrals are made to the nearby hospitals at Agona-Swedru and Apam. There is high patient-doctor and patient-nurse ratio in the district making health care delivery in the district a big challenge.

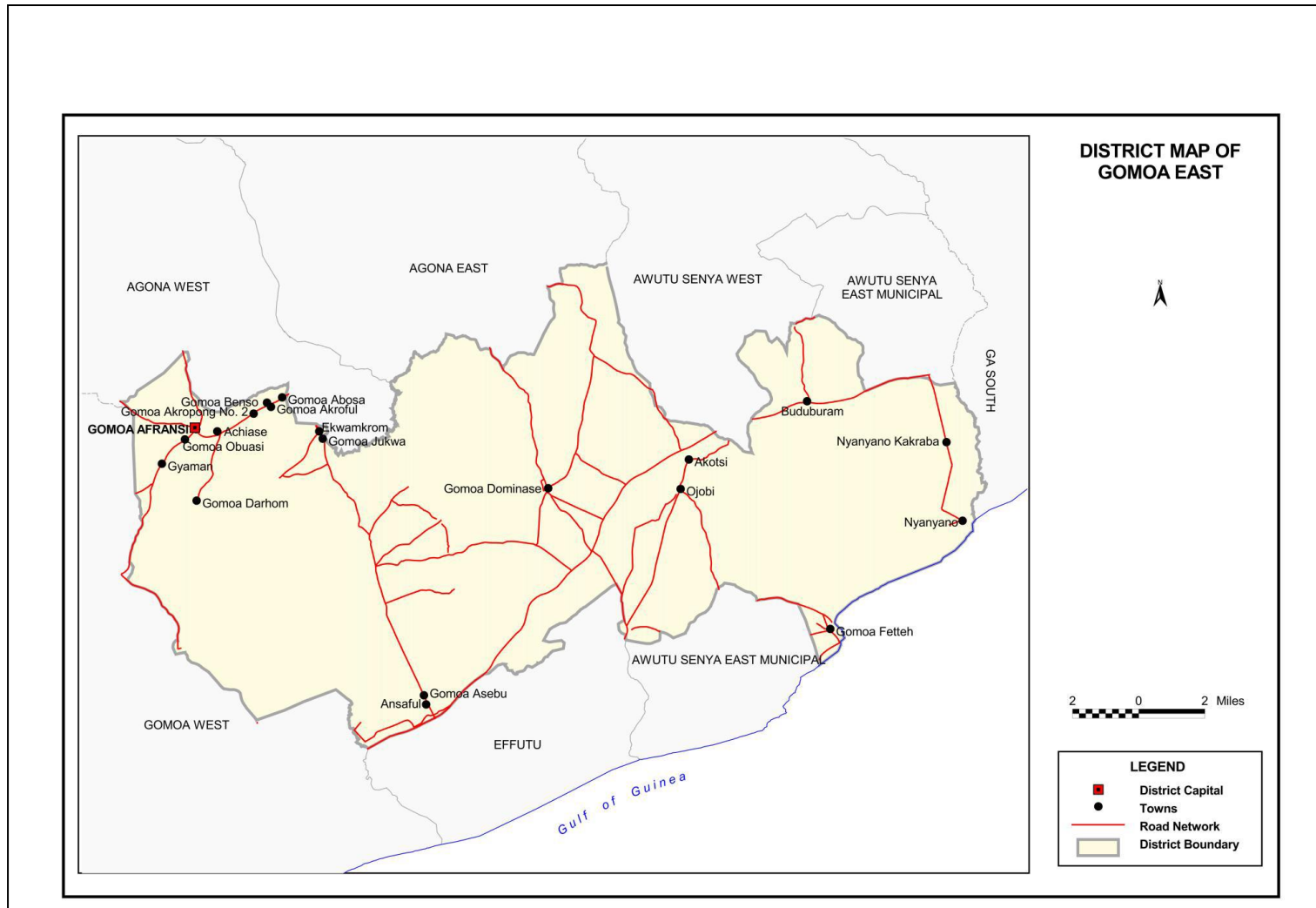


Figure 3. 1: Map of Gomoa East District

3.2 Study Design

The study was a randomized control trial. The study involved a NE intervention conducted on PW attending ANC in four health centres in GE district namely, Buduatta, Ojobi, Okyereko and Nyanyano health centres. The study was carried out between March 2015 and May 2015.

3.2.1 Sample Size Calculation

The sample size for both intervention and control groups was calculated using the following formula with 95% significance level ($Z_{\alpha/2}=1.96$) and 80% power ($Z_{\beta} = 0.840$). The sample size was calculated using an estimated prevalence rate of anaemia among PW in Central region (63.7%) as reported by the 2008 GDHS.

$$n = \frac{2(\bar{p})(1 - \bar{p})(Z_{\beta} + Z_{\alpha/2})^2}{(p_1 - p_2)^2}$$

Where:

n = the required minimum sample size per comparison group

p_1 = the estimated level of an indicator measured as a proportion for the first comparison group

p_2 = the expected level of the indicator for the second comparison group, such that the quantity (p_1-p_2) is the size of the magnitude of change it is desired to be able to detect. This is estimated at 25% (Abd El Hameed *et al.*, 2012; Girard & Olude, 2012).

$Z_{\alpha/2}$ = the Z-score corresponding to the degree of confidence with which it is desired to be able to conclude that an observed change of size $(P_2 - P_1)$ would not have occurred by chance (α - the level of statistical significance)

Z_{β} = the z-score corresponding to the degree of confidence with which it is desired to be certain of detecting a change of size ($P_2 - P_1$) if one actually occurred (statistical power).

P = the proportion or estimated prevalence of anaemia among PW

To allow for an estimated 10% attrition rate, 65 pregnant women were randomly assigned to each group.

3.2.2 Inclusion and Exclusion Criteria of Participants

Pregnant women who were within the second trimester (gestational age from 13 to 26 weeks), willing to participate by signing an informed consent form and with baseline Hb between 7 g/dl and 11 g/dl and were included in the study. All eligible participants were also reachable on phone. Each participant provided her contact number or that of her next of kin which was used to call her.

Severely anaemic participants, that is, Hb levels < 7 g/dl by WHO definition, were excluded from further participation in the study and referred for treatment. Also to be excluded were PW who abstained from the consumption of meat because the NE emphasizes on consumption of meat. A participant was also to be excluded based on health reasons as may have been advised by a health professional.

3.2.3 Selection of Study Participants

Four health centres were selected using random sampling technique out of the five health centres in G.E. district. Pregnant women aged 15-49 years who were attending ANC in the four selected health centres were approached during their antenatal care (ANC) visits and informed about the

study. In cases where subjects were less than 18 years, legal guardians were also required to sign the informed consent form. The prospective study participants who gave consent were screened for anaemia and consecutively recruited if eligible. Enrolment into the study was done subsequent to signing of informed consent by the PW.

3.2.4 Sampling Framework and Randomization

Participants were assigned to either the control or intervention group by simple random sampling. Random assignment of participants was done by writing “1” on 65 pieces of paper and “2” on the other 65 pieces. All 130 pieces of paper were folded and thoroughly mixed in a box. Each participant who was successfully recruited was asked to pick a piece of paper from the box without replacement. If a participant picked a “1” then she was assigned to the intervention group. Those who picked “2” were assigned to the control group.

3.3 Development and Delivery of Nutrition Education Package

The intervention strategy was NE targeted at PW. A nutritional educational guideline on anaemia and iron-rich foods was developed and used for each pregnant woman (Appendix 5). The educational programme consisted of five face-to-face sessions with individual PW. The counselling sessions were held every two weeks through home visits with prior notification of participants. Each session lasted about 20 minutes. Participants in both groups were given individual counselling with the aid of written guidelines. Two research assistants who were carefully trained by researcher delivered the education messages in the dialect of the participant. Five minutes of follow up phone calls were made to the participants in the intervening weeks to reemphasize the key messages. In all, the intervention lasted for ten weeks.

3.3.1 Key messages of nutrition education intervention

The control group received general NE on: 1) Hygiene, 2) Family planning, 3) Rest and exercise, 4) Danger signs in pregnancy and 5) Breastfeeding. In addition to the general NE, participants in the intervention group received key messages on NE:

1. Prevalence, trends and effects of pregnancy anaemia
2. Causes of Anaemia
3. Anaemia in pregnancy and birth outcomes
4. Iron-rich foods and enhancers of iron absorption
5. Inhibitors of iron absorption

3.4 Data Collection Tools

Data collection was at baseline and at the end of 10 weeks of NE intervention at the homes of participants.

3.4.1 Socio-demographic, Income and Household Characteristics

A pretested semi-structured questionnaire (Appendix 1) was administered face-to-face to solicit information on socio-demographic characteristics such as age, educational level, occupation, ethnicity, religion and marital status of PW at baseline. Participants were also interviewed on their income and housing characteristics.

3.4.2 Household Food Security Status

Household food security level was assessed using a standard 6-item module for assessing household food security developed by the United States Department of Agriculture (USDA).

3.4.3 Maternal Nutritional Knowledge

Maternal nutritional knowledge was assessed before intervention (baseline) and after intervention (end line) using a semi-structured questionnaire (Appendix 1). Participants were scored on the proportion of correct responses to questions on anaemia and iron-rich foods. The minimum and maximum scores were 0 and 24 respectively. Scores from 0 to 7, 8 to 16 and 17 to 24 were considered as poor, average and good knowledge respectively.

3.4.4 Dietary Intake Assessment

The food frequency questionnaire and 24-hour recall approaches were used to assess dietary intake of all study participants at baseline and end line. The intake of foods recommended in the intervention package (meat, fish, liver, fruits and vegetables) were recorded using a food frequency questionnaire (Appendix 1). The frequency and number of portions of each food consumed for the past 7 days was recorded.

A single 24 hour recall was used to assess dietary intake from the different food groups within the 24 hour period prior to the interview. The PW were asked to recall all the foods and drinks they consumed over the past 24 hour period. The weights or quantities of the foods consumed by the participants were estimated using household measures and in instances where they were unable to estimate the quantity of the food consumed with a household measure, it was estimated

in cost or amounts and the same foods were purchased from food vendors and then weighed using an Ohaus CS 2000 compact scale.

3.4.5 Anthropometric Measurements

3.4.5.1 Weight

Weighing was done using the seca digital weighing scale. Standard protocol of measuring weight according to the WHO was followed. Weight was recorded to the nearest 0.1 kg. Measurements were taken twice and the average of the two readings calculated. The difference between the two readings did not exceed 0.1 kg.

3.4.5.2 Height

Height was measured to the nearest 0.1 cm using a stadiometer in accordance with the standard protocol for measuring height by the WHO. Measurements were done twice and the two readings averaged. The difference between the two readings did not exceed 0.5 cm.

3.4.6 Biochemical assessment

Measurement of Hb levels of pregnant women was done at baseline and end line by examination of a capillary blood sample (finger prick) using a battery-operated URIT-12 Hb Meter. The estimation of Hb concentration using the URIT-12 Hb Meter is by spectrophotometry that is based on light intensity principle. URIT-12 analyser has high accuracy ($\geq 96\%$) and precision, and is easy to operate, fast-testing and portable. The correlation is very good in the comparison between URIT-12 and International Council for Standardization in Haematology (ICSH) method (Qin *et al.*, 2008). Standard methods of taking blood and measurement were used. The principal

investigator and a research assistant with training and experience in blood taking and measurement did the blood tests.

3.4.7 Maternal Morbidity

Information on participant's morbidity status was sought at baseline and end line by using a questionnaire (Appendix 1). They were asked whether they experienced certain conditions such as diarrhoea, fever, headache or worm infestation during the past two weeks, and the source of treatment for such conditions, if any.

Gestational age was estimated from the date of the last menstrual period and from measurement of the fundal height which were obtained from the ANC attendance records.

3.5 Data Management and Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) (version 16). Socio-demographic data were analysed using descriptive analysis. For univariate analysis, means and standard deviations were calculated for all continuous variables and frequencies for all categorical variables. The mean and standard deviation were calculated for haemoglobin. The independent sample t-test was used to compare the haemoglobin levels between the two randomly assigned groups. The paired t test was used to compare haemoglobin, nutritional knowledge and dietary intake of the treatment groups before and after education intervention. All probability values less than 0.05 ($p < 0.05$) were considered statistically significant.

Table 3. 1: Data analysis plan

Indicator	Variables	Statistical test
Maternal Demographic Characteristics	Age, gravida, parity, gestational age, marital status, educational level, ethnicity, religion, source of drinking water, toilet facility, lighting facility, cooking fuel, mode of transportation	Descriptive statistics (Means and standard deviations for continuous variables; Frequencies for categorical variables); Independent sample t test for comparing between control and intervention groups
Income and household characteristics	Monthly income, ownership of house, building material of house, household size, number of rooms occupied by household, household possessions	Independent sample t test for comparison between control and intervention groups for continuous variables; chi square test for categorical variables
Household food security	Food security score	Descriptive statistics: frequencies
Prevalence of anaemia (Objective 1)	Number of pregnant women screened for anaemia	Proportion of pregnant women with Hb <11 g/dl
Relationship between Nutrition Education and Maternal Nutritional Knowledge (Objective 2)	Maternal nutritional knowledge score	Independent sample t test to compare change in nutritional knowledge between control and intervention groups or paired t test to compare change in nutritional knowledge before and after nutrition education among control and intervention groups.

Table 3.1 : Data analysis plan (Continued)

Indicator	Variables	Statistical test
Frequency of consumption of iron-rich foods (Objective 3)	Consumption of iron-rich foods in last 24 hours; Number of times in last 24 hours; Number of days in last 7 days	Independent sample t test to compare between control and intervention groups. Paired t test to compare change in dietary intake before and after intervention.
Association between Nutrition Education and nutrient intake	Level of consumption of iron rich foods	Chi square test to compare proportion of pregnant women who met and those who have not met the Estimated Average Requirements (EAR) for iron
Impact of Nutrition Education on Hb level (Objective 4)	Hb levels of pregnant women	Independent sample t test to compare change in Hb levels of control and intervention groups or paired t test to compare change in Hb levels before and after nutrition education among control and intervention groups
Nutritional Status (Objective 5)	Body mass index (BMI) for gestational age	Percentage of pregnant women with normal weight, overweight or obesity.

3.5.1 Food Security Status

Responses of “often”, “sometimes”, “yes”, “almost every month” and “some months but not every month” were coded as affirmative (yes). The sum of affirmative responses to the six questions in the module was the household’s raw score on the scale. Food security status was assigned as in Table 3.2 below.

Table 3. 2: Scale for classifying household food security

Raw Score	Food Security Level
0 – 1	Food secure/high or marginal food security
2 – 4	Food insecure without hunger/low food security
5 – 6	Food insecure with hunger/ very low food security

3.5.2 Anthropometry

Body mass index (BMI) was calculated by dividing the participant’s weight in kilograms by the height in meters squared (m^2): $BMI = kg/m^2$. The participants were then grouped into different classifications of BMI based on WHO cut-of points. Weight gain by the PW were calculated by subtracting weight at baseline from weight at end line.

3.6 Data Quality Assurance

The research assistants were carefully trained. The study questionnaire was pretested prior to the data collection. All experimental samples and materials were clearly and accurately labelled. The standard protocols were followed. The project records were safely kept. Instruments for data collection such as the Hb meter and weighing scales were regularly calibrated before use.

Participant particulars were coded and known to only researcher. Data collected were cross-checked by the researcher before being entered for analysis.

3.7 Ethical Consideration

Ethical clearance was obtained from the Ethical Review Committee of Research Involving Human Subjects (ERCRIHS) of the Ghana Health Service (GHS) and the Institutional Review Board (IRB) of the Noguchi Memorial Institute for Medical Research (NMIMR). The study was thoroughly explained to the participants. They were recruited only after they had signed the informed consent form. All protocols were in accordance with the ethical standards of the Ministry of Health. Permission was sought from the GE District Health Management Team (DHMT) and the health centres involved

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

A total of 198 pregnant women who gave consent were screened for anaemia. Out of this number screened, 141 pregnant women were anaemic with 11 being severely anaemic. A total of 130 PW with Hb between 7 g/dl and 11 g/dl were recruited and randomized into intervention and control groups. At the end of the intervention, 11 PW were lost to follow-up: nine were due to migration and two due to miscarriage. 119 PW completed the trial giving a dropout rate of 8%. Data collected during bi-weekly home visits and phone calls showed 92% compliance by each group.

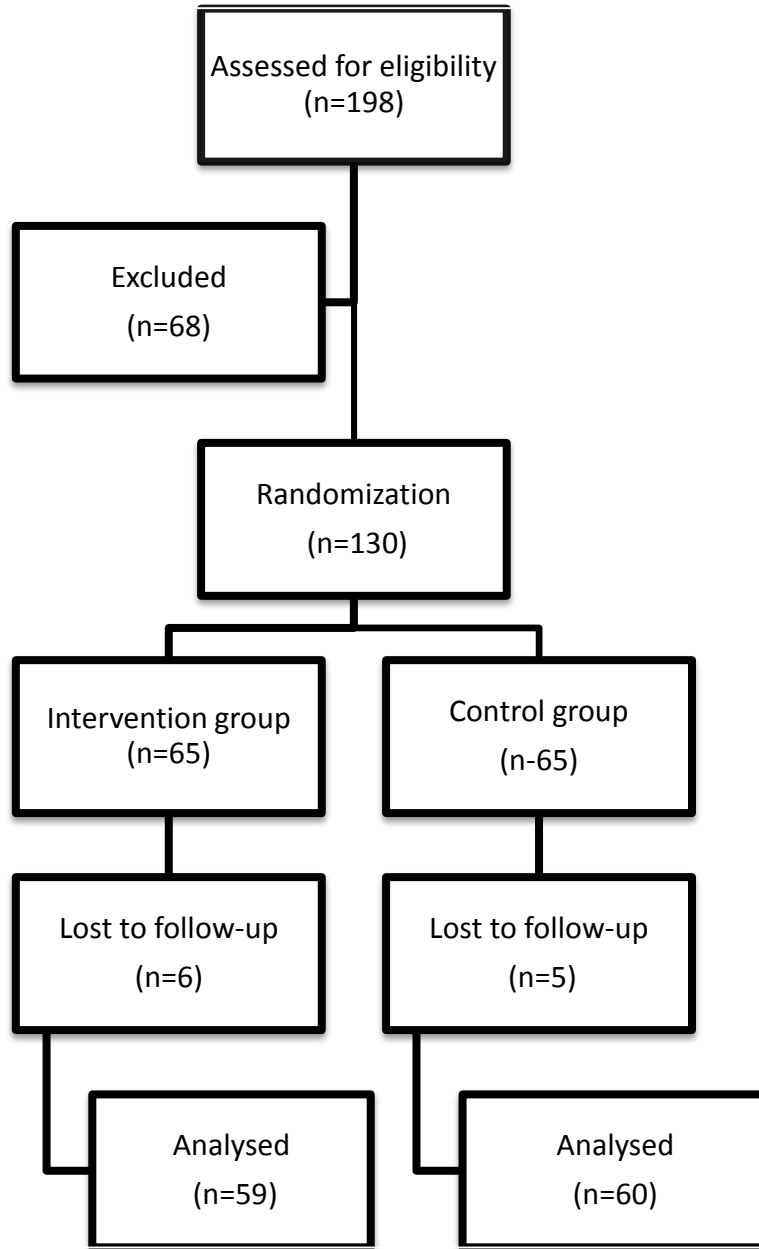


Figure 4. 1: Flow chart of participant progress through the study

4.2 Socio-Demographic Characteristics of Study Pregnant Women

The demographic characteristics of the study participants are presented in Table 4.1. There were no significant differences between the treatment groups with respect to their ages, marital status, parity, religion, occupation, highest level of education and ethnicity. About 82% of the PW were more than 19 years old while 18% were aged 15-19 years with a tendency of women in the IG being older. The majority of the PW were married (68.1%). About a quarter (26%) of the participants were primiparae. Christianity (87.4%) was the dominant religion among the study participants. The study participants were mainly farmers or traders with the majority attaining basic education as the highest educational level. Unemployment rate was 39% among the pregnant women. There was the tendency towards higher unemployment among the control group ($p=0.09$). In all, 82% of the study participants identified themselves as being of Akan ethnicity, with a tendency for more of the intervention group being Akan.

Table 4. 1: Background characteristics of pregnant women by treatment groups

Variables	Total sample (N=119)	Treatment groups		<i>p</i> value ¹
		CG (n=60)	IG (n=59)	
	Mean±SD	Mean±SD	Mean±SD	
Mean Age (years)	24.9±5.8	24.0±5.3	25.9±6.1	0.071
Baseline gestational age, (weeks)	19.2±4.2	19.1±4.4	19.4±4.1	0.682
End line gestational age, (weeks)	29.3±4.2	29.6±4.3	29.1±4.1	0.533
Gravida	2.5±1.5	2.3±1.4	2.7±1.6	0.142
Parity	1.4±1.4	1.1±1.3	1.7±1.4	0.133
	N(%)	n(%)	n(%)	<i>p</i> value²
Age group				
15-19	21(19.3)	10(17.9)	11(20.8)	0.312
20-29	67(61.5)	38(67.9)	29(54.7)	
30-40	21(19.3)	8(14.3)	13(24.5)	
Marital status				
Single	38(31.9)	19(31.7)	19(32.2)	0.952
Married	81(68.1)	41(68.3)	40(67.8)	
Primipae	32(26.9)	16(26.7)	16(26.7)	0.713
Religion				
Christianity	104(87.4)	52(86.7)	52(86.7)	0.911
Islam	15(12.6)	8(13.3)	7(11.9)	
Occupation				
Unemployed	39(32.8)	22(36.7)	17(28.8)	0.092
Farmer/trader	74(62.2)	33(55.0)	41(69.5)	
Others ^a	6(5.0)	5(8.3)	1(1.7)	
Level of Education				
None	16(13.4)	6(10.0)	10(16.9)	0.473
Basic	76(63.9)	41(68.3)	35(59.3)	
Secondary/Tertiary	27(22.7)	13(21.7)	14(23.7)	
Ethnicity				
Akan	87(73.1)	38(63.3)	49(83.1)	0.077
Ewe	21(17.6)	10(16.7)	11(18.4)	
Others ^b	11(9.2)	6(10.0)	5(8.5)	

¹ Independent sample t-test for continuous variables to compare between control and intervention groups.

² Pearson chi square test for categorical variables

^a Others refer to teacher, nurse.

^b Others refers to Ga, Fulani, Bimoba.

CG= Control group

IG= Intervention group

SD= Standard deviation.

4.3 Income and Housing Characteristics

The income and housing characteristics of study pw are shown in Table 4.2. There were no significant differences between the groups. The mean household size was 6.7 ± 4.8 . A household occupied about 5.3 ± 3.5 rooms. More than one half (59%) of the PW earned less than GH¢50 a month. Also, the majority of the study participants ranked low in terms of their possession of household items like television, radio, phone, bicycle, motor bike, vehicle, fan and domestic animals. However, more than half of them were living in their own houses which were mainly constructed with cement blocks. On average, more than 80% of households of participants had access to public pipe-borne water, electricity and toilet facilities. Most of the study participants travel by means of public transport.

Table 4. 2: Income and household characteristics of pregnant women by treatment groups

Variables	Total sample (N=119)	Treatment groups		<i>p</i> value ¹
		CG (n=60)	IG (n=59)	
	Mean±SD	Mean±SD	Mean±SD	
Household size	6.7±4.8	6.7±5.3	6.6±4.3	0.941
Number of rooms	5.3±3.5	6.0±3.8	4.6±2.9	0.0741
	N(%)	n(%)	n(%)	<i>p</i> value²
Monthly income				
Less than GH¢50	70(58.8)	33(55.0)	37(62.7)	0.522
Between GH¢50 and GH¢100	40(33.6)	21(35.0)	19(32.2)	
Above GH¢100	9(7.6)	6(10.0)	3(5.1)	
Household Wealth^b				
High	57(47.9)	28(46.7)	29(49.2)	0.793
Low	62(52.1)	32(53.3)	30(50.8)	
Ownership of house				
Yes	71(59.7)	32(53.3)	39(66.1)	0.161
No	48(40.3)	28(46.7)	20(33.9)	
Type of dwelling				
Cement Blocks	80(67.2)	41(68.3)	39(66.1)	0.672
Mud	15(12.6)	6(10.0)	9(15.3)	
Bricks	24(20.2)	13(21.7)	11(18.6)	
Source of Drinking water				
Own Pipe-borne Water	23(19.3)	9(15.0)	14(23.7)	0.234
Public Pipe-borne Water	96(80.7)	51(85.0)	45(76.3)	
Toilet Facility				
WC	20(16.8)	10(16.7)	10(16.9)	0.672
KVIP	31(26.1)	13(21.7)	18(30.5)	
Pit Latrine	53(44.5)	28(46.7)	25(42.4)	
Bush	15(12.6)	9(15)	6(10.2)	
Lighting Facility				
Electricity	112(94.1)	57(95.0)	55(93.2)	0.683
Others ^a	7(5.9)	3(5.0)	4(6.8)	
Type of Fuel Used for Cooking				
Gas	29(24.4)	15(25.0)	14(23.7)	0.064
Charcoal	57(47.9)	34(56.7)	23(39.0)	
Firewood	33(27.7)	11(18.3)	22(37.3)	
Mode of Transport				
Public	106(89.1)	53(88.3)	53(89.8)	0.802
Private	13(10.9)	7(11.7)	6(10.2)	

¹ Independent sample t-test for continuous variables² Fisher's exact test for categorical variables;^a Others refer to lantern, candle, torch light.^b Household items include: television, radio, phone, bicycle, motor-bike, fan and domestic animals
SD= Standard deviation; WC= Water closet; KVIP= Kumasi Ventilated Improved Pit

4.4 Morbidity among Pregnant Women

The morbidity data (Table 4.3) expressed as the prevalence of malaria, fever and worm infestation during the previous two weeks to the interview as reported by PW showed no group differences. Malaria was the most prevalent illness reported.

Table 4. 3: Prevalence of specified morbidities in study pregnant women during the previous two weeks as reported by participants by treatment groups

Morbidity	Total sample (N=119)	Treatment groups		<i>p</i> value ¹
		CG (n=60)	IG (n=59)	
	N(%)	n(%)	n(%)	
Malaria				
Baseline	40(33.6)	24(40)	16(27.1)	0.137
End	45(37.8)	25(41.7)	20(33.9)	0.382
Fever				
Baseline	26(21.8)	12(20)	14(23.7)	0.623
End	26(21.8)	11(18.3)	15(25.4)	0.350
Worm infestation				
Baseline	12(10.1)	6(10)	6(10.2)	0.976
End	12(10.1)	6(10)	6(10.2)	0.980

¹ There were no significant differences within the groups (Pearson chi square test).

4.5 Household Food Security Situation of Pregnant Women

The household food security situation of study participants is shown in Table 4.4. There was no statistically significant difference in the household food security among the two groups. Overall, 42% of households were classified as food insecure without hunger. Majority of households of participants were however found in both categories of food insecurity (with hunger and without hunger) and only 29.4% were food secure.

Table 4. 4: Household food security situation of study pregnant women

Variables	Total sample (N=119)	Treatment groups		<i>p</i> value ¹
		CG (n=60)	IG (n=59)	
	N(%)	n(%)	n(%)	
Food secure	35(29.4)	22(36.7)	13(22.0)	0.213
Food insecurity without hunger	50(42.0)	22(36.7)	28(47.5)	
Food insecurity with hunger	34(28.6)	16(26.7)	18(30.5)	

¹ Pearson chi square test for categorical variables

4.6 Changes in Anthropometric Indicators

The weights and heights at the baseline and at the end of intervention period, and change in weights of pregnant women are presented in Table 4.5. At baseline and end of intervention, there were no significant differences in mean weights of participants between the groups, and both treatment groups gained weight at the end of the study. The PW in the IG however showed significant weight gain over those in the CG at the end of intervention period ($p=0.032$). The mean heights of participants, measured only at baseline, did not differ significantly between the treatment groups. There was no difference between the groups regarding the various BMI classifications by the WHO (Figure 4.2). None of the PW was underweight during the trial. The

majority of study participants (63.1%) had normal BMI and 31.4% were overweight. Obesity was present in 12.7% of all the study pregnant women at baseline.

Table 4. 5: Anthropometric measurements of pregnant women by treatment groups

Variables	Total sample (N=119)	Treatment groups		<i>p</i> value ¹
		CG (n=60)	IG (n=59)	
	Mean±SD	Mean±SD	Mean±SD	
Weight, kg				
Baseline	63.09±11.15	63.04±10.32	63.14±12.02	0.960
End	65.32±11.39	65.02±10.41	65.63±12.39	0.771
Weight gain	2.14±1.4	1.95±1.46	2.50±1.07	0.126
Height, cm	159.6±5.5	160.0±5.5	159.2±5.4	0.422

¹ Independent sample t-test

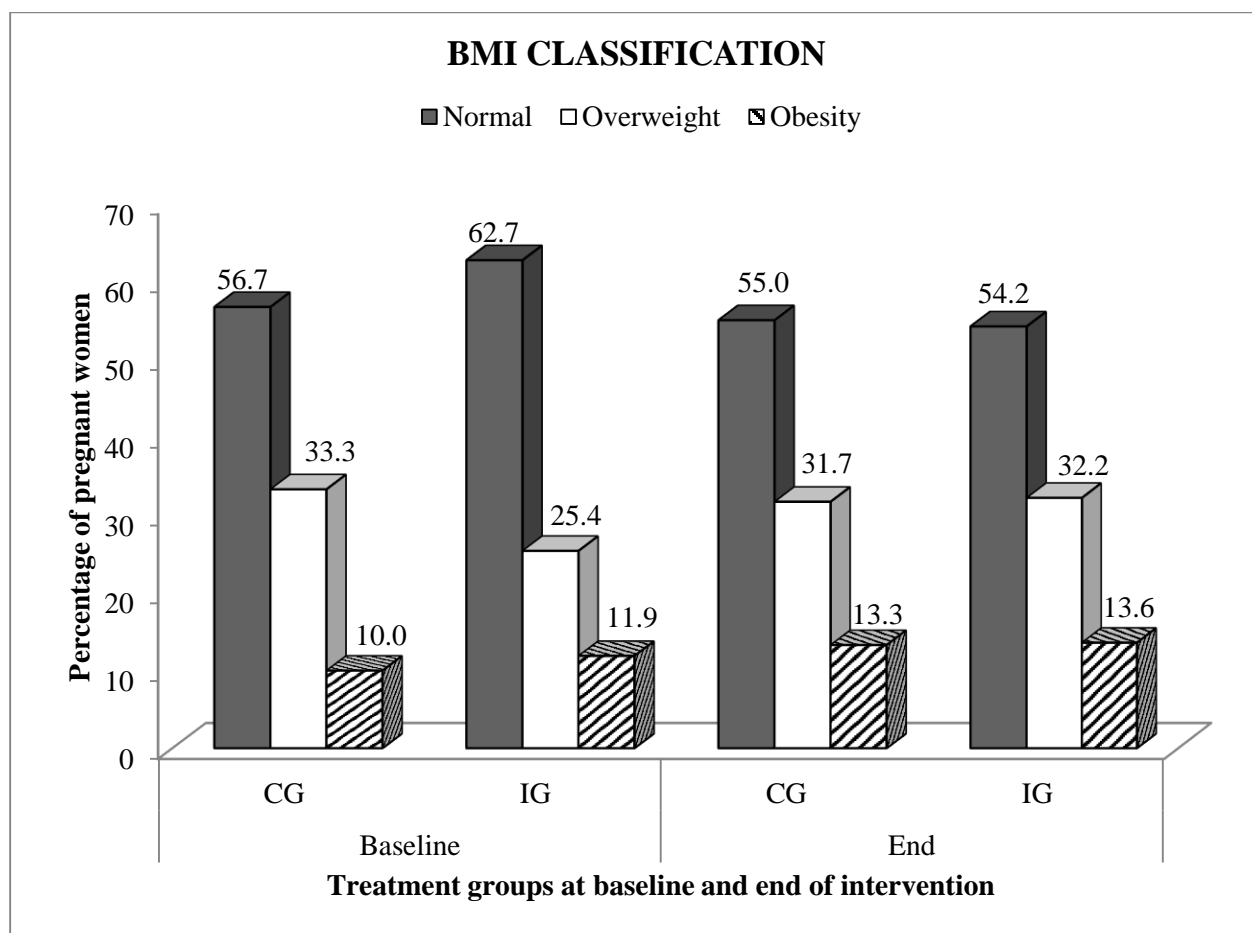


Figure 4. 2: BMI classification of pregnant women at baseline and end of intervention

4.7 Impact of Nutrition Education on Anthropometric and Haematological Indicators

The mean BMI values for both the IG and CG at baseline and end of intervention were not significantly different. The mean change in BMI for the IG was significantly higher than that of the CG from baseline to end line. Hb concentration increased significantly in the IG over the 10 weeks and the absolute change in Hb concentration was significantly higher in the IG (0.1 ± 1.3) than in the CG (-0.6 ± 1.3). Haemoglobin concentration was determined at baseline and end of the intervention period. Anaemia was defined as $Hb < 11$ g/dl and classified as mild (9-10.9 g/dl), moderate (7-8.9 g/dl) and severe (<7 g/dl) (WHO, 2008). The prevalence of anaemia among pregnant women in the study area at baseline was estimated as 71.2%. At the end of the trial period, about 93.3% of the PW in the CG were still anaemic as opposed to 86.4% in the IG (Figure 4.3). Moderate-to-severe anaemia was more prevalent in the CG than in the IG. It was also found that anaemia tended to be mild in the IG as compared to the CG. Also, by the end of the trial, more PW in the IG had normal Hb concentration as compared to the CG.

Table 4. 6: Anthropometric and biochemical indicators of pregnant women by treatment groups

Variables	Total sample (N=119)	Treatment groups		<i>p</i> value ¹
		CG (n=60)	IG (n=59)	
	Mean±SD	Mean±SD	Mean±SD	
Maternal BMI, kg/m²				
Baseline	24.71±3.76	24.55±3.51	24.49±4.00	0.930
End	25.60±3.85	25.41±3.57	25.67±4.23	0.715
Change	0.89±0.52	0.86±0.54	1.18±0.20	<0.001*
Blood Hb level, g/dl				
Baseline	9.4±1.2	9.6±1.2	9.2±1.2	0.110
End	9.2±1.4	9.0±1.4	9.3±1.5	0.166
Change	0.2±1.8	-0.6±1.3	0.1±1.3	0.007*
Maternal Nutritional Knowledge				
Baseline	7.74±3.80	7.87±2.05	7.71±1.80	0.064
End	13.7±7.8	8.4±2.5	21.6±1.3	<0.001*
Change	1.33±3.22	1.01±0.99 ^a	13.27±0.66	<0.001*

¹ Independent sample t-test

* Statistical significance is at p<0.05

BMI= Body mass index (kg/m²)

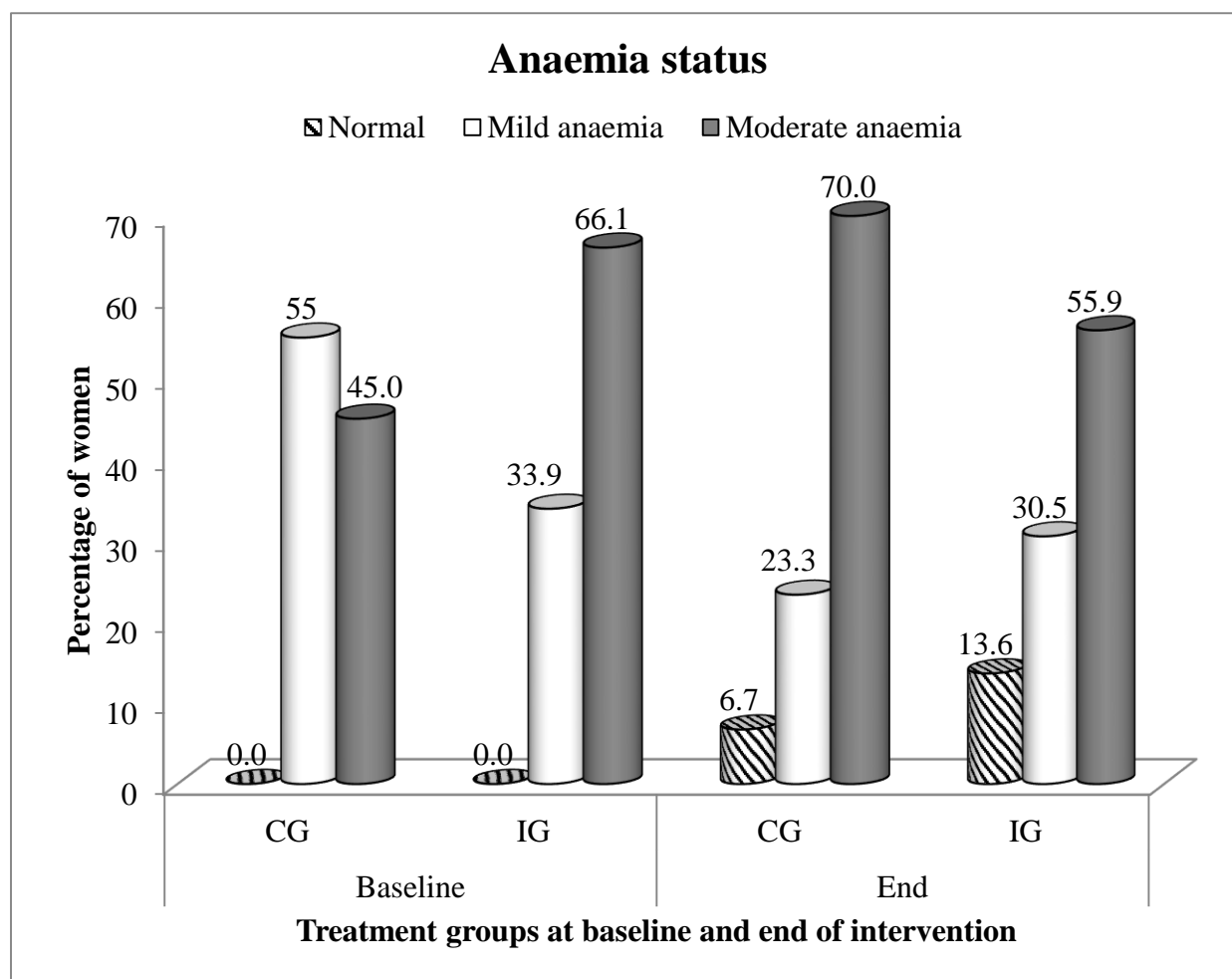


Figure 4. 3: Comparison of anaemia status of pregnant women by treatment group from baseline to end of intervention period

4.8 Nutritional Knowledge on Anaemia and Iron-Foods

The mean change in the nutritional knowledge score of pregnant women in the IG from baseline to end line was significant ($p < 0.001$) (Table 4.6). At baseline, none of the study PW had good knowledge on anaemia and iron-rich foods as seen in Figure 4.4. Most of the PW in the IG (89.8%) attained good nutritional knowledge at the end of the nutritional education intervention with still none in the CG having good nutritional knowledge on anaemia and iron-rich foods. At baseline majority of study participants in both CG and IG, 66.7% and 76.3% respectively had

poor knowledge on anaemia and iron-rich foods. At the end of the intervention, 43.3% of participants in the CG still had poor knowledge while none in the IG had poor knowledge on anaemia and iron-rich foods.

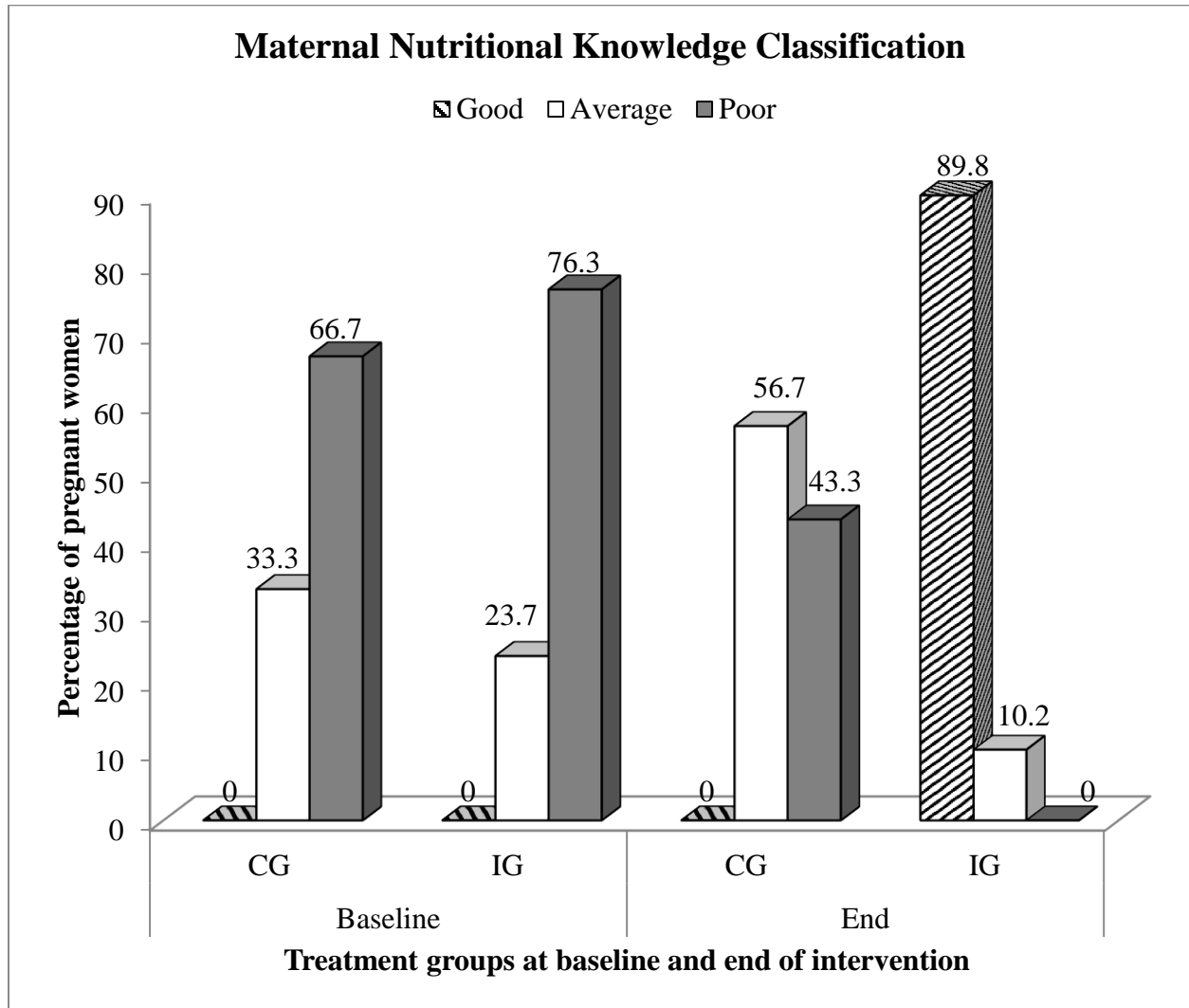


Figure 4.4: Classification of nutritional knowledge of pregnant women at baseline and end of intervention

4.9 Dietary Intakes of Pregnant Women

At baseline the study pregnant women did not differ in their frequency of consumption levels of various selected food items in the previous seven days. The intakes of red meat, legumes, vitamin C-rich fruits, grains, roots and tubers became significantly higher for pregnant women in the IG at the end of intervention period. The pregnant women in the CG were however found to be consuming more poultry at the end of intervention than the IG. There were significant changes in the consumption of red meat ($p=0.002$), legumes ($p=0.012$), vitamin C rich fruits ($p=0.027$), and grains, roots and tubers (0.015) from baseline to end line in the IG (Table 4.8).

Table 4. 7: Comparison of frequency of intake of selected food items during previous seven days by pregnant women and change from baseline

Food item	Total sample (N=119)	Treatment groups		<i>p</i> - value ¹
		CG (n=60)	IG (n=59)	
	Mean±SD	Mean±SD	Mean±SD	
Red meat				
Baseline	1.24±1.71	1.43±1.65	1.03±1.75	0.532
End	1.72±1.51	1.40±1.65	2.05±1.29	0.003*
Change	0.49±1.85	-0.03±0.41	1.02±2.49	0.002*
Fish				
Baseline	6.29±1.61	6.33±1.40	6.24±1.81	0.321
End	6.40±1.34	6.28±1.50	6.53±1.07	0.291
Change	0.12±1.49	-0.05±0.39	0.29±2.08	0.218
Poultry				
Baseline	1.02±1.74	0.78±1.56	1.25±1.88	0.891
End	0.65±1.29	0.80±1.73	0.49±0.50	0.003*
Change	-0.37±1.55	0.17±0.91	-0.76±1.92	0.005*
Vitamin C rich fruits				
Baseline	1.60±1.98	1.87±2.00	1.32±1.93	0.279
End	1.88±1.77	1.78±2.00	1.98±1.50	0.048*
Change	0.29±1.85	-0.09±0.59	0.66±2.51	0.027*
Legumes and nuts				
Baseline	2.18±2.05	2.12±2.11	2.24±2.01	0.321
End	2.76±2.11	1.87±2.00	3.34±1.91	0.008*
Change	0.58±2.26	-0.25±0.07	1.10±3.10	0.012*
Dairy products				
Baseline	1.81±2.33	1.53±2.14	2.08±2.50	0.673
End	2.02±2.00	1.57±2.23	2.47±1.62	0.327
Change	0.21±2.17	0.03±0.61	0.39±3.03	0.373
Grains, roots and tubers				
Baseline	6.52±1.33	6.58±1.24	6.46±1.42	0.818
End	6.77±1.00	6.55±1.38	7.00±0.00	0.005*
Change	0.25±1.30	-0.03±1.12	0.54±1.42	0.015*
Eggs				
Baseline	1.89±2.13	2.25±2.25	1.53±1.94	0.709
End	1.92±1.94	2.27±2.32	1.58±1.39	0.865
Change	0.03±1.62	0.02±0.34	0.05±2.29	0.909
Vitamin A rich fruits				
Baseline	3.10±2.66	2.97±2.44	3.24±2.88	0.713
End	3.18±2.34	3.02±2.53	3.34±2.12	0.826
Change	0.08±2.59	0.05±1.05	0.10±3.54	0.914

¹ Independent sample t-test for continuous variables to compare between control and intervention groups. *

Statistical significance is at $p < 0.05$
deviation

SD= Standard

Nutrient intakes of the study PW were based on a single 24-hour dietary recall. The nutrients intakes were compared with Estimated Average Requirements (EAR) to determine the percentage of women who met the requirements. Tables 4.9 and 4.10 show PW aged ≤ 18 y and ≥ 19 y respectively who met EAR. Except for vitamin C, there was no significant difference in the percentage of PW aged ≤ 18 years in the treatment groups who met their EAR for any nutrient.

Table 4. 8:Percent of study pregnant women aged 18 years and below who met their EAR for selected nutrients at baseline and end of intervention

Nutrient	Mean \pm SD	EAR	% women who met EAR		p-value ¹
			CG(n=9)	IG(n=6)	
Iron, mg/d			n(%)	n(%)	
Baseline	17.94 \pm 5.03	23	2(22.2)	1(16.7)	0.486
End	18.54 \pm 5.31		2(22.2)	2(33.3)	1.000
Vitamin A, μg/d					
Baseline	325.32 \pm 268.66	530	0(0)	0(0)	0.229
End	325.56 \pm 267.72		3(33.3)	3(50)	0.229
Vitamin C, mg/d					
Baseline	33.12 \pm 18.58	66	0(0)	1(16.7)	0.400
Endline	38.39 \pm 22.79		0(0)	3(50)	0.044*
Vitamin B₁₂, μg/d					
Baseline	1.22 \pm 0.55	2.2	1(11.1)	0(0)	1.000
End	1.55 \pm 0.49		1(11.1)	2(33.3)	0.525

¹ Fisher's exact test

Estimated Average Requirement. An EAR is the average daily nutrient intake level estimated to meet the requirements of half of the healthy individuals in a group

Statistical significance is at $p < 0.05$ a g/kg/day

EAR=

*

Generally, there were more PW who did not meet their EAR for all nutrients as compared to those who met them.

Among study pregnant women aged ≥ 19 years, the percentage of women in IG who met their EAR for iron and vitamin C were significantly higher than those in the CG. The percentage of PW aged ≥ 19 years who met their EAR for vitamin A, vitamin B₁₂, folate and protein was not significant for any treatment group. For each nutrient, the number of PW who did not meet the EAR was more than those who met them.

Table 4. 9: Number and percent of study pregnant women aged 19 through 50 years who met their EAR for selected nutrients at baseline and end of intervention

Nutrient	Mean \pm SD	EAR	% women who met EAR		p-value
			CG(n=51)	IG(n=53)	
Iron, mg/d			n(%)	n(%)	
Baseline	17.55 \pm 5.26	22	8(15.7)	11(20.8)	0.503
End	18.93 \pm 5.46		11(21.6)	22(41.5)	0.036*
Vitamin A, μg/d					
Baseline	340.55 \pm 273.49	550	9(17.6)	12(22.6)	0.628
End	340.61 \pm 273.30		9(17.6)	12(22.6)	0.628
Vitamin C, mg/d					
Baseline	28.94 \pm 14.93	70	1(2)	0(0)	0.490
Endline	31.45 \pm 17.39		1(2)	4(7.5)	0.363
Vitamin B₁₂, μg/d					
Baseline	1.28 \pm 0.71	2.2	5(9.8)	6(11.3)	1.000
End	1.48 \pm 0.80		5(9.8)	17(32.1)	0.008*
Folate, μg/d					
Baseline	34.69 \pm 46.93	520	0(0)	0(0)	1.00
End	34.65 \pm 46.95		0(0)	0(0)	
Protein, g					
Baseline	42.71 \pm 19.06	0.88	14(27.5)	11(20.8)	0.495
End	49.35 \pm 22.66		17(33.3)	19(35.8)	0.839

¹ Fisher's exact test

EAR= Estimated Average Requirement. An EAR is the average daily nutrient intake level estimated to meet the requirements of half of the healthy individuals in a group

* Statistical significance is at $p < 0.05$ ^a g/kg/day

CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

Anaemia in PW is a real concern all over the world particularly in developing countries. The current study was aimed at testing the efficacy of a nutritional educational intervention programme with an emphasis on the consumption of iron-rich foods on Hb levels, knowledge and dietary intakes of PW with anaemia. The intervention used in this trial was designed to provide clear, simple and practical advice on individual basis for PW living in the GE district of the Central region of Ghana. The key messages emphasized during the home visits and phone calls to the target PW in the IG included: iron-rich foods; enhancers and inhibitors of iron absorption; prevalence, trends and causes of anaemia in pregnancy. General nutrition education on hygiene, rest and exercise, breast feeding, danger signs in pregnancy and family planning were delivered to PW in both IG and CG.

5.2 Anaemia in Pregnancy in Gomoa East District

The present study shows that the prevalence of anaemia among PW in the GE district is 71.2%. As expected, this prevalence is similar to the findings of the 2008 GDHS which reported the national prevalence of anaemia among PW in Ghana as 70% (GSS, 2009). A study conducted by Glover-Amengor *et al.* (2005) on anaemia in pregnancy in Sekyere West district of the Ashanti region of Ghana reported a 57.1% prevalence of anaemia among pregnant women. It is worth noting that the prevalence of anaemia has generally witnessed a soaring trend over the years. The reason for this trend could include the multifactorial aetiology of anaemia, underfunding and poor programme implementation. The WHO considers this prevalence of anaemia observed as a

major problem of public health concern. In accordance with WHO classification, anaemia prevalence of over 40% in a population is a major health problem, 20-40 per cent is a medium level public health problem, and 5-19.9 per cent is a mild public health problem (WHO, 2001).

5.3 Nutritional Knowledge of Pregnant Women

The NE intervention was positively associated with the level of nutritional knowledge on anaemia and iron-rich foods among the study PW. This was evident from the highly significant increase in knowledge exhibited by the intervention group at the end of the intervention period. A study on the effects of NE on the levels of nutritional awareness of PW in Western Iran also led to significant increase in the awareness level after the intervention (Fallah *et al.*, 2013). Verbeke (2007) has also shown similar effects of NE in the general population. The present study also found that nearly all the studied PW had poor nutritional knowledge at baseline of the study. This finding agrees with a report by Johnson (2000). According to Perez-Escamilla *et al.* (2008), the purpose of health education is basically to eliminate undesirable behaviours and replace them by appropriate and productive behaviours which lead to healthy life. Nutritional education during pregnancy can play a very important role in equipping PW with the right nutritional knowledge which can lead to appropriate food choices and consequently improved nutritional status.

5.4 Consumption Levels of Iron-Rich Foods

Micronutrient deficiencies such as iron, vitamin A and folate can lead to poor maternal health outcomes and pregnancy complications which put the mother and baby at risk (Stolzfus 2004; Christian 2010). The 24-hour recall was used in this study to obtain detailed information of the

types of foods consumed and their amounts in order to measure the level of nutrients ingested by the PW. Additionally, food frequency questionnaire was concomitantly employed to determine the frequency of intake of iron-rich foods. The results revealed that PW who received NE had a significant increase in the consumption level of red meat, legumes, vitamin C-rich fruits as well as grains, roots and tubers over those who did not receive NE. Nutrition education and counselling has been found in other studies to improve maternal diets including dietary practices and consumption of specific macro and micronutrients (Puri *et al.* (1996); Olds *et al.*, 1986; Sultenmeier 1988). Recently, Gilma *et al.* (2013) showed efficacy of new complementary feeding guidelines on improved consumption of red meat, fruits and vegetables. The results of the present study are also consistent with the conclusion by Kafatos *et al.* (1989) in Greece that nutrition counselling was associated with improved dietary intake. It is worth noting from our study that foods from grains, roots and tubers as well as fish were the most frequently consumed on daily basis by all the study participants. This finding confirms the results of a review which observed that dietary patterns are usually heavily cereal-based across regions (Lee *et al.*, 2013). Most of the diets are accompanied with either soup or stew which are commonly prepared with fish which is readily available in the area. The intervention has possibly led to the substitution of meat for fish in some of the diets of PW in the IG.

With regards to the percentage of the PW who met the Estimated Average Requirements (EAR) for selected nutrients, our findings varied according to age categories of the participants. Our results indicate that the intervention resulted in a significantly greater percentage of PW aged ≥ 19 meeting the EAR for iron and vitamin B₁₂. This is possibly a reflection of the increased consumption of red meat observed in the IG. Red meat and other animal source foods are also the best sources of vitamin B₁₂ (Dieticians of Canada, 2014). A review elsewhere examined the

impact of recent efforts to improve iron status by increasing the intake of animal products (Ruel & Levin, 2000). The review observed that in Viet Nam, promotion of fish ponds and animal production led to increased iron intake but iron status was not evaluated.

All study participants ≤ 18 did not meet the EAR for most nutrients. It is possible that as adolescents, they are still dependent upon their parents and financially not capable to afford iron-rich foods such as animal source foods which are relatively more expensive.

5.5 Haemoglobin Levels of Pregnant Women

Haemoglobin concentration is the most reliable indicator of anaemia at the population level, as opposed to clinical measures which are subjective and therefore more prone to error (WHO, 2008). The intervention led to significant improvement in the Hb concentration of PW in the IG which confirms the impact of NE and counselling on reduced risk of anaemia in late pregnancy shown by various randomized controlled trials in low-and middle-income countries (Abel *et al.*, 2000; Adhikari *et al.*, 2009; Gadallah *et al.*, 2002; Garg & Kashyap, 2008). A review of previous studies observed substantial and significant effects when NEC was provided nutritional supplementation, mostly by way of micronutrients. Less strong effect and borderline significance were rather realized when NEC was provided alone (Girard & Olude, 2012). At the end of the intervention, most of the PW in the CG were found to be in the category of moderate to severe anaemia thus positioning them in a more precarious situation. On the other hand there was significant reduction in the level of moderate anaemia in favour of the mild to normal condition in the IG. These further corroborate the positive impact of the intervention. According to Kalaivani (2009), the consequences of moderate anaemia in women include substantial reduction in work capacity, increased maternal morbidity rates, high susceptibility to infection, more

common premature births, delivering low birth weight infants and high perinatal mortality of these babies and increased maternal deaths. With severe anaemia maternal mortality is said to show a steep increase.

There was no significant difference in the mean Hb levels of study participants in both treatment groups at baseline and end of intervention. At baseline the total mean Hb concentration was 9.4 g/dl which was the same value reported by Gloveer-Amengor et al. (2005). However, it is important to highlight that whereas the change in Hb concentration from baseline to end of intervention in the IG was positive and significant, the CG had a negative change in Hb concentration from baseline to end of intervention.

5.6 Impact of Nutrition Education on Nutritional Status of Pregnant Women

Low BMI puts a woman at risk of delivering an infant too small for gestational age, especially when total maternal gestational weight gain is less than 10 kg (Ota et al., 2011). A Swedish population-based cohort study has linked obesity to pregnancy-related complications. When morbidly obese (BMI>40) mothers were compared with normal weight mothers, there was an increased risk for adverse pregnancy outcomes including pre-eclampsia, still birth, early neonatal death and large for gestational age (LGA) infants (Cedergren, 2004). The overall mean weight gain was significantly higher in the intervention group compared with the control group ($p<0.05$). Our findings are consistent with earlier studies conducted in developing countries (Briley *et al.*, 2002; Aaltonen *et al.*, 2008). The significant difference between intervention and control groups in those studies was observed where the NE was provided with nutrition support. Our observation was expected since the consumption level of the IG was significantly greater than that of the CG with regards to carbohydrates and protein. In Greece, a study on the effect of

an educational intervention programme during pregnancy was conducted in which trained nurses undertook home visits every two weeks to instruct the women on basic nutrition. Findings from the Greek study revealed a significantly greater weight gain for the intervention group as compared to the control group thus identifying with our findings (Kafatos *et al.*, 1989). However there were no significant differences in the BMI between the groups. Underweight was generally absent. The majority of all study PW had normal weight. This could possibly be attributed to the predominant rural lifestyle of the area where most women engage in active physical activity such as farming and household domestic chores.

5.7 Maternal Morbidity

In the present study, data on maternal morbidity was basically obtained from reports given by the PW on their health status during the two weeks prior to the interview. There was no significant effect of the intervention that could be identified from the results. The most commonly reported illness among all the PW was malaria obviously because the rains had set in leading to breeding of mosquitoes at that time. A total of 33.6% and 37.8% of the PW reported at baseline and end of the intervention period respectively of having suffered from the malaria during the period. In their study, Glover-Amengor *et al.* (2005) did a parasitological examination of blood smears of PW and found malaria parasitaemia in 35.1% of the PW which confirms the level of morbidity due to malaria that we observed. According to the GDHS (2008), malaria is hyper-endemic in Ghana and constitutes one of the leading causes of morbidity and mortality, especially among PW and children under the age of five. The presence of malaria parasitaemia during pregnancy could be a major risk factor for maternal anaemia (Glover-Amengor *et al.*, 2005). About 21.8% of the respondents also reported having had fever which correlates with the national average of 20% (GSS, 2009). Fever may be a symptom of malaria or other infections. A few cases of worm

infestation were also reported. Several species of worms contribute to anaemia in developing countries with hookworm and schistosomes being the most common. Both cause significant blood loss in the host which leads to iron deficiency and anaemia (MacDonald *et al.*, 2007). A study in rural Nepal identified hookworm infection as the strongest predictor of iron status in PW (Dreyfuss *et al.*, 2000).

5.8 Household Food Security

More than two-thirds of all households of study participants were food insecure, either without hunger (42%) or with hunger (28.6%). In the event of many households being affected by household food insecurity, the pregnant woman stands to suffer even more due to unfavourable intra-household food distribution. To illustrate this, respondents were asked who they will give more share of meat in the household. About 70% indicated that they will give more meat to the husband. This could have negative implication on the nutritional status of the pregnant woman especially as far IDA are concerned.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This NE intervention programme emphasizing iron-rich foods consumption was found to be positively associated with improved haemoglobin levels, nutritional knowledge, maternal weight gain as well as dietary intake of pregnant women and could be a practical and effective strategy for improving dietary practices and maternal iron status as well as adequate maternal weight gain. The intervention was demonstrated to be highly effective in improving nutritional knowledge of pregnant women in the study area. Such an intervention may also have an impact on reducing the severity of anaemia. In particular, countries such as Ghana where other strategies have been tried without the desired success could adopt this simple but effective approach to control anaemia and improve maternal health outcomes.

6.2 Recommendations

- Nutrition education programmes should be integrated with other relevant aspects of health care with significant community involvement.
- Data collection, management and analysis should be enforced and applied to facilitate regular surveillance of issues concerning pregnant women and outcomes of pregnancy in the district and the entire country.

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APPENDICES

Appendix 1: Main Study Questionnaire

Participant ID Number: ___ ___ ___ ___ **Date of interview (DD/MM/YY):** ___ ___ / ___ ___ / ___ ___

Sub-district code: ___ **Community code:** ___ ___ **Interviewer Code:** ___ ___

**DEPARTMENT OF NUTRITION AND FOOD SCIENCE
UNIVERSITY OF GHANA, LEGON**

TITLE OF PROJECT: Efficacy of Nutrition Education with an Emphasis on Consumption of Iron Rich Foods on Haemoglobin Levels of Pregnant Women: A Randomized Trial in Gomoa East District of the Central Region of Ghana

STUDY QUESTIONNAIRE –Baseline/Endline

Section 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PREGNANT WOMAN

(Write the responses in the given spaces for questions 1-4)

1. How old are you? _____(years)
2. How many times have you become pregnant? _____
3. How many live deliveries have you had? _____
4. Gestational age _____ weeks (*copy from ANC attendance book*)

(Indicate in the brackets the code that bears the response)

5. What is your marital status? []
1 = single 2 = married 3 = widowed 4 = divorced 5 = separated
6. What is your highest level of education? []
1 = None 2 = Basic 3 = Secondary 4 = Tertiary
7. What is your nationality? []
1 = Ghanaian 2 = Other (specify)
8. What is your ethnicity? []
1 = Fante 2 = Akan 3 = Ga 4 = Other (specify).....
9. What is your religious affiliation? []
1 = Christianity 2 = Islam 3 = Traditional 4 = Other (specify).....
10. What is the main source of drinking water for your household? []
1 = own pipe borne water 2 = public pipe borne 3 = own well/borehole 4 = public well/borehole 5 = river/stream
11. Have you had water from this source in the past two weeks? [] 1 = Yes 2 = No

12. What type of toilet facility is available to you? []
 1 = WC 2 = KVIP 3 = Pit latrine 4 = Bush 5 = Others (specify)
13. What type of lighting facility does your household use? []
 1 = Electricity 2 = Lantern 3 = Candle 4 = Other (specify).....
14. What is the main kind of fuel used for cooking by your household? []
 1 = Gas 2 = Charcoal 3 = Firewood 4 = Kerosene 5 = Electricity 6 = Other (specify).....
15. What is your mode of transport? []
 1 = Public 2 = Private

Section 2: INCOME AND HOUSING CHARACTERISTICS

(Indicate in the spaces provided the responses or codes that bear given responses)

16. What is your occupation? []
 1 = House wife 2 = Farmer 3 = Employee 4 = Trader 5 = Unemployed
17. How much is your monthly income? []
 1 = less than GH¢50 2 = between GH¢50 and GH¢100 3 = between GH¢100 and GH¢200
 4 = between GH¢200 and GH¢400 5 = above GH¢400
18. Do you and your household own the house you live in? []
 1 = Yes 2 = No
19. What type of building materials is your dwelling made of? []
 1 = cement blocks 2 = mud 3 = wood 4 = bricks
20. How many people are in your household?(persons)
21. How many rooms does your household occupy? (rooms)

22. Do you have any of the following items in your home? (*Write 1 = Yes or 2 = No*)

Item	1= Yes 2 = No
Telephone/ mobile phone	
Refrigerator	
Radio	
Television	
Video deck	
Bicycle	
Motor cycle	
Vehicle	
Fan	

23. Does your household own any of the following domestic animals? (*Write 1 = Yes or 2 = No*)

Domestic animal	1 = Yes 2 = No
Poultry	
Goats	
Sheep	
Pigs	
Cattle	

Section 3: HOUSEHOLD FOOD SECURITY – Baseline [] End line [] (*tick the given response in the appropriate brackets*)

Now I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months, that is, since last (*name of current month*).

1. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?
 - Often true
 - Sometimes true
 - Never true
 - Don't know or Refused

2. "(I/we) couldn't afford to eat the right amounts of a variety of different types of foods (balanced diet)." Was that often, sometimes, or never true for (you/your household) in the last 12 months?
 - Often true
 - Sometimes true
 - Never true
 - Don't know or Refused

3. In the last 12 months, since last (*name of current month*), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?
 - Yes
 - No (Skip 4)
 - Don't know (Skip 4)

4. (*If yes above, Ask*) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
 - Almost every month
 - Some months but not every month
 - Only 1 or 2 months
 - Don't know

5. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?
 - Yes
 - No
 - Don't know

6. In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?
 - Yes
 - No
 - Don't know

Section 4: MATERNAL NUTRITIONAL KNOWLEDGE – Baseline [] Endline []

1. Have you heard of anaemia? []
1 = Yes 2 = No
2. What are the symptoms of anaemia? (*Do not prompt. Allow her to mention and circle the options mentioned*).
0 = I don't know 1 = palour 2 = tiredness 3 = body weakness 4 = dizziness 5 = headache 6 = breathlessness 7 = rapid heartbeat 8 = others (specify) _____
3. What causes anaemia? (*Do not prompt. Circle options mentioned by respondent*).
0 = I don't know 1 = low iron (blood-giving) diets 2 = parasites 3 = heavy menstrual periods 4 = others (specify) _____
4. Could you mention the foods that give blood (iron-rich foods)? _____

5. I am going to mention to you a list of foods. Please tell from the list those which enhance iron absorption and those which inhibit iron absorption?

Food item	1 = enhances iron absorption 2 = inhibits iron absorption 3 = I don't know
Tea	
Red meat	
Orange	
Coffee	
Cocoa	
Fish	
Organ meat	
Grain Cereals	
Milk (calcium)	
Green leafy vegetables	

6. When sharing food at home, who do you think should be served more meat and other animal source foods? []
0 = I don't know 1 = Father 2 = Mother 3 = Pregnant woman 4 = child 5 = Other (specify) _____
7. Do you have any food beliefs/taboo related to pregnancy? []
1 = Yes 2 = No
8. If yes, mention them.

.....
.....

Section 5a: 24-HOUR DIETARY ASSESSMENT – Baseline [] Endline []

Kindly tell me all the foods and drinks you ate from the past 24- hours up to now.

Time	Details of food and drink	Quantity eaten

Section 5b: FOOD FREQUENCY QUESTIONNAIRE– Baseline [] Endline []

(Ask): Did you eat each item at least once in the last 24 hours or 7 days?

FOOD GROUP	Have you eaten this in the last 24 hours 1 = Yes 2= No	If yes, how many times in the last 24 hours did you eat it? 1, 2 or 3, etc.	Have you eaten this in the last seven days? 1 = Yes 2 = No	How many days in the last 7 did you eat it? 1,2,3,4,5,6 or 7
Red meat				
Fish				
Poultry				
Vitamin C rich foods (orange)				
Legumes and Nuts (beans, groundnuts, peanut, soybeans etc)				
Dairy Products (milk, butter, yoghurt and cheese)				
Grains, roots and tubers (rice, bread, maize, cassava, yam, plantain, etc).				
Eggs				
Vitamin A rich fruits (mangoes, carrot, sweet potatoes, dark green leafy vegetables etc)				

Section 6: MATERNAL MORBIDIY – Baseline [] Endline []

Morbidity condition	Sick 1 =yes 2 = no	Treatment 1 = yes 2 = no	Source of treatment (<i>tick</i>)			
			No treatment	Health facility	Self-medication	Herbalist
Malaria						
Fever						
Worm infestation						
Other (specify).....						

Section 7: ANTHROPOMETRY

Measurement	1 ST	2 ND
Weight (kg)		
Height (cm)		

Section 8: Biochemical measurement –Baseline [1st] End line [2nd]

Measurement	1 ST (g/dl)	2 ND (g/dl)
Haemoglobin level		

Appendix 2: Consent Form (English)

Participant ID Number: ___ ___ ___ ___ **Date of interview (DD/MM/YY):** ___ ___ / ___ ___ / ___ ___

Sub-district code: ___ **Community code:** ___ ___ **Interviewer Code:** ___ ___

A. INFORMED CONSENT FORM

TITLE: EFFICACY OF NUTRITION EDUCATION WITH AN EMPHASIS ON CONSUMPTION OF IRON RICH FOODS ON HAEMOGLOBIN LEVELS OF PREGNANT WOMEN: A RANDOMIZED TRIAL IN GOMOA EAST DISTRICT OF THE CENTRAL REGION OF GHANA.

Principal Investigator: Yakubu Adam

Address: Department of Nutrition and Food Science; University of Ghana; P.O. Box LG134, Legon, Accra

General Information about Research

We are conducting a research study, the purpose of which is to assess whether educating pregnant women about how to eat well during pregnancy will improve their blood levels. You are being asked to participate in this study because you are a pregnant woman in Gomoa East district. Your participation in this study will last about 10 weeks. If you decide to take part in the study, your blood level will be measured by a prick on your finger at the start and end of the study. You will be asked to provide information about yourself, your household, the food items that you normally eat and your health condition; in addition your height and weight will be measured. This will take about 1 hour and will be repeated at the end of the study. After asking you these questions, we will be visiting you at home, for about 20 minutes, every two weeks to talk to you about your health as a pregnant woman. You will also receive follow-up calls (about 5 minutes) to give you more information or remind you about your eating and health. As such you will be asked to give a telephone number that we can use to contact you. You are strongly advised to continue taking the oral iron supplements and other medications given to you at antenatal clinic.

Possible Risks and Discomforts

There is no risk involved in taking part in this study. You may feel a little discomfort from the finger prick like that of the bite of a mosquito. Our visits to your home and the phone calls may also be a source of discomfort to you but the time spent will be as minimal as possible.

Possible Benefits

It is expected that you will learn about how to eat well for you and your baby to be healthy. Our findings are also expected to inform others who want to help pregnant women to be healthy and deliver healthy babies to also take the same action.

Confidentiality

Information about you will be kept confidential and protected to the best of our ability. You will not be named in any report. Only investigators involved in this study may sometimes look at your research records. The record of the study will be kept at the University of Ghana.

Compensation

At the end of the study, 2 bars of 150g SABA multipurpose soap will be given to you in appreciation for your participation.

Voluntary Participation and Right to Leave the Research

Your participation in this study is voluntary. You may withdraw from the study at any time without penalty.

Contacts for Additional Information

You are encouraged to ask any questions at any time of the study. For answers to any pertinent questions about the research, you may contact Yakubu Adam (telephone number: 0208936867 or 0243578431. E-mail: hajyakub@yahoo.com) or Dr. Otoo (telephone number: 0248689464. E-mail: geotoo@yahoo.com)

Your rights as a Participant

This research has been reviewed and approved by the Ethical Review Committee of the Ghana Health Service (GHS-ERC). If you have any questions about your rights as a research participant you can contact the administrator of GHS-ERC, Hannah Frimpong through office line: +233 302681109; mobile: +233(0) 243 235225 or 0507041223; or email: Hannah.Frimpong@ghsmail.org

B. PARTICIPANT STATEMENT AND SIGNATURE

I certify that I voluntarily agree to answer the survey questions, that the survey has been explained to me. All my questions have been answered satisfactorily. I understand I am free to discontinue participation at any time if I so choose.

Date

Signature or thumbprint of Participant
(Thumbprint for those who cannot read and write)

If subject is under 18 years, a legal guardian must sign here:

I was present while the benefits, risks and procedures were read to the subject. All questions were answered and the subject has agreed to take part in the research.

(Signature of witness)

(Date)

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

Date

Name and signature of witness

C. INVESTIGATOR STATEMENT AND SIGNATURE

I certify that the participant has been given ample time to read and learn about the study. All questions and clarifications raised by the participant have been addressed.

Date

Signature of Person Who Obtained Consent

Appendix 3: Consent Form (Fante Translation)

Participant ID Number: ___ ___ ___ ___ **Date of interview (DD/MM/YY):** ___ ___ / ___ ___ / ___ ___

Sub-district code: ___ **Community code:** ___ ___ **Interviewer Code:** ___ ___

A. WOPEDZEE KRATAA

**SUSUGYINA: HENEDZIBANDZIIM ADZE SUAA MO NYANSAPƆ, HEN
SUSUHGYNINA EDZIBANAA ƆNA BOGYA NAASO ƆBOA HEN MOGYAM
AFRƆSAN WƆ APEMFƆM: HWƆHWƆM BEGYINA GOMOA ANEE BIAA A ƆWO
FIRIMFIRM MANTƆW MU**

HWƆHWƆFO: Yakubu Adam

Address: Department of Nutrition and Food Science; University of Ghana; P.O. Box LG134,
Legon, Accra

Asem a Ɛfa Adisua Yi Ho

Yereye nhwehwemu bi ne santir ne se yedze rekyrekyre apimfo Ɔwo kwan a wo be faso edzidzi yie Ɔwo Ɔmo yisen mu ama Ɔmo mogya sem ako yie. Yeresere wo am aboa hen Ɔwo nhwehwe yi mu osiande woyye opimfo a Ɔwo Gomoa East mansim mu. Wo mboa no adesua yi ho begye mbir beye n'awotwe du. Se wogye tum de wo boboa hen wo adesua yi ho a, yebe susu wo mogya wo bir a yebe tue wo nsa ano mo adesua n'ashese nye n'awiaye. Wobe bisa wo ho nse, wo fie mu nsem, nye edzibam a edzi no dadaa nye w'pomudzin mu nsemi; Bio, yebe susu mo tsentsen nye wo mo dur. Wei begye beye donhwir kor na yebe san esi do bi wo adesua yi n'ewieyi. Adesua yi n'akyir no, yebe ko do asra wo fie beye minute aduenu; n'awotue esien biara yebe ko so nye wo atwetwe nkomo af w'apomudzen wo nyisen yi ho. Ebokodo enya ofre wo tetefonso (beye sima enum) na ama wo nsem nye nkae afa w'edzidzi nye w'apomudzin ho. Me tuwo fo de koso na fa oral supplements nye edur fofor a wodze ema wo asopiti no.

Ɔhaw nye Atetee

Ɔhaw biara nyi ho de edzi wo ho behye adesua yi mu. Ɔhaw kakra be wo mu osiande yebe tue wo nsa ano tede ntonton aka wo. Daadaa nsrahwe nye tetefon fre no nso beha wo kakra nanso, mbir no beye kumaa bi.

Mfaso a Ɔwo Mu

Ɔye hen eni sua de hunu de, Ɔbesua senea ye dzidzi yie am won a wo ba no enya ahoodzen. Hen nhwehwemu yi, yepede yedze bo obiara a opede oboa apimfo ma wonya appomdzen ama w'awo mba a wowa ahoodzen nso.

Nsumemu

Asem biara a Ɔfa woho no be wo nsumemu. Wo dzin nnkɔpue hen krataa mu. Nhwehwe mu ye fo binom na edu bir bi a wo hwe. Biribiara a Ɔwo adesua yi mu no, yedzi besie wo University of Ghana.

Nea Wo benya

Adesua n'awie no, wo benya semina a wofre no SABA ebien nye ndaase de aboa hen.

Wopɛ Mu Na ɛbɛboa Hɛn Anaa Dɛ Ebɔtum Agyae

Ɛyɛ wo pɛ mu na ɛbɛboa hɛn wɔ adesua yi ho. Ɛbɔtum agyae wɔ bir biara a asotwe biara nyi ho

Sɛ Wo Pɛ Nkyerɛkyerɛ Mu Biara A Ebɔtum Afrɛ

Yɛ hyɛ wo nkuran dɛ ebɔtum ɛbisa asem biara wɔ bir a adesua yi rekɔdo no. Wo pɛ nyi ano wɔ asem bias biara ho a, frɛ Yakubu Adam (tetefon so: 0208936867 anaa 0243578431. E- mail: hajyakub@yahoo.com) anaa Dr Otoo (tetefon so: 0248689464. E- mail: geotoo@yahoo.com)

Tum a Ɛwɔ Sɛ Oboafɔ

Ghana Health Service wɔn Ethical Review Committee (GHS-ERC) a hwɛhwɛ mu na w'agyɛ adesua yi ato mu. Sɛ wowɔ asem bisi biara wɔ wo tum wɔ nhwɛhwɛ biara, ebɔtum afrɛ GHS-ERC administrator, Hannah Frimpong: tetefon: office line (+233 302681109); mobile (+233(0) 243 235225 anaa 0507041223); E-mail: Hannah.Frimpong@ghsmaail.org

B. Ntease a Nyea Oboafɔ No Nyia

W'akenkan mfaso, ɔhaw nye ɔkwan a krataa yi ka no ɛfa nhwɛhwɛ yi akyrɛ me na w'akyerɛkyerɛ me mu nso. Me nya akwei nya bias nsem a ɛfa nhwɛhwɛ yi ho na wɔ maa me mbuayɛ papaapa. Me gye dɛ wɔmfame ka nhwɛhwɛ yi ho.

Date

Oboafɔ nsa

Sɛ obi nndzi mfe du awɔtwe a, mbramu no nyia ɔhwɛ no nkyerɛw ha.

Nna me wɔ hɔ mɔ bir a mfaso, ɔhaw nye nkwan a ɛfa nhwɛhwɛ yi mu ho no, wɔ rekekan akyerɛ opimfo no. Oyii nsem bias nyinaa anon na afei ɔgyee tum dɛ ɔbɛboa nhwɛhwɛ yi mu

(Odashyɛ nsa)

(Date)

Sɛ nyiaa ɔreboa nhwɛhwɛ yi mu no ntum kekan a, ɔdashyɛ no nkyerɛw ha:

Nna me wɔ hɔ wɔ bir a mfaso, ɔhaw nye akwan a ɛfa nhwɛhwɛ yi mu ho, wɔ rekekan akyerɛ opimfo no. Oyii nsembisa nyinaa anak, afei ɔgyee tum dɛ ɔbɛboa nhwɛhwɛ

Date

Odashyɛ dzin nye nsa

C. Me ka no pefee dɛ dem mbre nhwɛhwɛ mu te fa, mfaso nye sentir nye ɔhaw a ɛwɔ ho yi no, dɛ ɔbɛboa no, m'akyerɛkyerɛ onyimpa a ɔwɔ sor no mu paa.

Date

Odashyɛ no nsa

Appendix 4: Participant Contact Information Form

Participant ID Number: ___ ___ ___ ___ Date of interview (DD/MM/YY): ___ ___ / ___ ___ / ___ ___

Sub-district code: ___ Community code: ___ ___ Interviewer Code: ___ ___

DEPARTMENT OF NUTRITION AND FOOD SCIENCE

UNIVERSITY OF GHANA, LEGON

TITLE OF PROJECT: Efficacy of Nutrition Education with an Emphasis on Consumption of Iron Rich Foods on Haemoglobin Levels of Pregnant Women: A Randomized Trial in Gomoa East District of the Central Region of Ghana.

CONTACT INFORMATION FORM

Map of Participant's Home with Landmarks



Describe directions leading to household where participant presently resides

Participant's contact information

Name _____

House no. _____ Tel. no. _____

Next of kin contact information (Husband/Relative/Neighbour/Friend)

Name _____

House No. _____ Tel: _____

Appendix 5: Nutrition Education Manual

**NUTRITION EDUCATION FOR
REDUCING PREGNANCY ANAEMIA**

TRAINING MANUAL FOR RESEARCH ASSISTANTS



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1. AN OVERVIEW OF THE PROJECT

This project is a study trial designed to provide nutrition education to pregnant women to reduce pregnancy anaemia. An approval for the study has been given by the Institutional Review Board of Noguchi Memorial Institute for Medical Research at the University of Ghana, Legon and the Ghana Health Service Ethical Review Committee.

The study is an MPHIL research work by Yakubu Adam and supervised by Dr Gloria Otoo and Dr W.B. Owusu, both lecturers in the Department of Nutrition and Food Science, University of Ghana.

The study is being conducted in the Gomoa East (GE) District of the Central region. Study participants will be pregnant women aged 15 to 49 years with gestational ages of 13 to 28 weeks who are attending antenatal clinics (ANC) in 4 health facilities in GE District namely, Nyanyano, Okyereko, Ojobi and Buduatta. Pregnant women to be recruited into the study should have baseline haemoglobin (Hb) levels between 7 and 11 g/dl and willing to participate by signing an informed consent form. Pregnant women who are severely anaemic, that is, Hb <7 g/dl will be excluded from the study and referred to a health facility for treatment. All study participants will continue to attend ANC and take all supplements and medications given to them at the health facility.

Pregnant women recruited into the study will be randomly assigned to one of two groups namely, Control group (CG) and Intervention group (IG). This is a single blind study, i.e. participants are not to know which group they belong to. Participants in both groups will be followed through home visits and phone calls for 10 weeks. Pregnant women in the CG will receive general nutrition education. Those in the IG will receive specific nutrition education emphasizing the consumption of iron rich foods in addition to the general nutrition education.

Data on demography, housing and income characteristics, nutritional knowledge, dietary intake, morbidity, anthropometry and Hb level will be collected on all participants at baseline and endline of the study.

It is hoped that the nutritional knowledge, intake of iron rich foods and consequently Hb levels of pregnant women in the intervention group will be improved by the end of the trial.

2. HOW TO USE THIS MANUAL

This manual has been prepared for research assistants who will be engaged to help in the implementation of field activities of the study. The manual provides an overview of the study to enable the research assistant gain ample understanding of the research work.

The participants' recruitment process has been explained in the manual. Also the data collection methods, Hb, weight and height measurements techniques as well as nutrition education lessons have been illustrated. The research assistant is encouraged to read through the various sections carefully before undertaking the field activities each time.

3. INTRODUCTION OF PROJECT TO HEALTH FACILITY

Permission to undertake the project has been obtained from the District Health Management Team (DHMT) of the GE district with an introduction letter from the Department of Nutrition and Food Science of the University of Ghana. The Principal Investigator will approach staff of selected health facilities for the study to introduce the study to them. Also, trained research assistants will be introduced to staff of the facilities.

4. RECRUITMENT OF STUDY PARTICIPANTS

4.1. Compilation of addresses/contact information of pregnant women

At the maternity units of selected health facilities, an attendance register of pregnant women who attend ANC will be obtained. From the register, addresses and telephone numbers of pregnant women aged 15-49 years and gestational age 13-28 weeks will be listed. The pregnant women will be approached either at the facility or home and informed about the study to seek their consent.

4.2. Obtaining consent from participants

The informed consent form will be read out clearly to the participant in a language that she understands in the presence of a witness and guardian in the case of under 18 years old pregnant women. If the participant agrees to participate, and passes the screening for the absence of severe anaemia, then she will sign or thumbprint the form and so will the witness and guardian (if applicable) and the person obtaining the consent.

4.3. Baseline haemoglobin measurement for eligibility

Measurement of Hb levels of pregnant women will be done at baseline and end line of the study. The Urit 12 Haemoglobin Meter will be used. Finger-prick blood will be obtained using a lancet. Free-flow blood without pressure avoids blood dilution.

Three simple steps for Measuring Capillary Blood Hb Using Urit-12 Haemoglobin Meter:

1. Turn on the meter. Insert the test strip
2. Apply blood sample to the test strip
3. Read the result

RIT-12 Haemoglobin Meter



Step 1. Turn on the meter. Insert test strip **Step 2** Apply blood sample **Step 3** Read the result

Baseline Hb of pregnant women will be measured. If the Hb is 7-11 g/dl then the participant is eligible to continue with the study. A pregnant woman whose Hb is less than 7 g/dl will be referred to a health facility for treatment. A total of 130 participants will be recruited consecutively from 4 health facilities: approximately equal numbers from each facility.

5. DATA COLLECTION

5.1. General guidelines

Data collection will be carried out at baseline and endline (10 weeks interval). Baseline data collection starts soon after recruited participants have been assigned to the 2 groups. Visit homes of participants for interviewing using the questionnaire. Read instructions at the beginning of each section of the questionnaire carefully. Be sure to obtain the right responses from participants before completing the questionnaire. Enter the appropriate codes for participants, sub-district, community and interviewer (to be provided) on each page of the questionnaires. Write boldly and clearly.

5.2. Techniques for conducting 24-hour recall dietary assessment

Ask the respondent to remember in detail all the food and drink they consumed during the past 24 hours. Prompt the respondent to remember eating and drinking episodes by time periods (e.g. starting on awakening), or linking to day time activities (e.g. arriving at work). In addition, the interviewer may use prompts to assist the respondent to estimate portion sizes of the items consumed. Use household models in the dietary intake assessment kit to help respondents

estimate quantities of foods and drinks consumed. Begin by listing all items consumed from the last time before the interview backwards to the past 24 hours. Go over list for the respondent to give portion sizes eaten. The interviewer records the dietary information which at the end is checked for omissions/errors.

5.3. Weight and height measurement procedures

Weight measurement:

- Turn on the scale to “zero” the scale
- Place standard weight on the scale to ensure accuracy of the scale
- If the readout is more than 0.5kg off the standard weight, change the batteries. Then place the standard weight on the scale again. If it is still off by more than 0.5kg, do not use this scale.
- If scale is accurate, begin assessments
- Ask the subject to remove extra layers of clothing, jewelry, and any items in her pockets
- Ensure that the body weight is evenly distributed between both feet
- Arms hang freely by the sides of the body, palms toward thighs
- Head is up and facing straight ahead
- Weight is recorded to nearest 0.1 kg
- Repeat the measurement; difference should not exceed 0.1kg

Height measurement

- Woman stands with back against the board (or whatever part of the body touches the board first; may be more than one body part)
- Body weight is evenly distributed on both feet
- Arms hang freely by the sides of the body, palms facing the thighs
- Legs are placed together, bringing knees or ankles together
- Woman stands erect; head is up and facing straight ahead
- Verify body position front and left
- Position head in Frankfort Horizontal Plane
- Woman inhales deeply holding her breath WITHOUT moving head or body
- Bring headpiece down onto the upper most point on the head; compress the hair
- Read and record the height to the nearest 0.1 cm
- Remember to tell the woman to let breath out
- Repeat the measurement; difference should not exceed 0.5 cm

6. HOME VISITS TO DELIVER NUTRITION EDUCATION MESSAGES

Visit each participant bi-weekly to deliver nutrition education messages. Each face to face session should take about 20 minutes. Encourage active involvement of the participant in the counselling sessions. About five minutes of follow up phone calls will be made to participants in the intervening weeks to reemphasize the key messages.

6.1. General nutrition education lessons for both CG and IG

Each participant in both the CG and IG will receive the General Nutrition Education (GNE) lessons on: 1) Hygiene, 2) Family planning, 3) Rest and exercise, 4) Danger signs in pregnancy and 5) Breastfeeding.

SESSION 1 (GNE-S1): HYGIENE

Objectives: By the end of the session, the participant should be able to

- Tell the importance of hygiene and sanitation
- Demonstrate the proper way of washing hands
- Describe ways of ensuring personal and environmental hygiene

Core Points:

- **What is Hygiene?** The act of keeping oneself clean: washing hands before and after using the toilet; bathing regularly; combing one's hair; brushing one's teeth; etc
- **When to wash hands:** before and after eating; after visiting the toilet; after attending social gatherings such as church, outdoorings, weddings, funerals, etc., after attending to a sick or injured person; after coughing and wiping the nose; after assisting a person with toileting; before cooking
- **Benefits/Importance of hand washing:** help minimize the spread of illnesses; diarrhoea prevention; cholera prevention; reduce intestinal worm infestation
- **Important ways of keeping the house clean:** sweeping; dusting; covering foods and utensils to avoid contamination from insects and rodents; clear surroundings of weeds and bushes to prevent pests

Other important messages on hygiene and sanitation

- Water from streams and rivers must be boiled and filtered before drinking and using for food preparation
- Avoid open defaecation
- Wash clothes often and sun dry

The participant should now be invited to ask questions for clarification on any aspect of the session. Ask the participants the steps she can take to improve hygiene and sanitation.

Thank the participant for her attention and participation

SESSION 2 (GNE-S2): FAMILY PLANNING

Objectives: By the end of the session, the participant should be able to:

- Explain the purpose of family planning
- Name some of the methods of birth control

Core points

- Family planning is the planning of when to have children and the use of birth control and other techniques to implement such plans.
- Enough resources (time, financial, social, environmental) are needed to raise a child
- Planning helps to assure availability of resources
- Family planning promotes the health of both mother and child
- If additional children are desired after a child is born, it is healthier for the mother and the child to wait at least 2 years after the previous birth before attempting to conceive
- After a miscarriage or abortion, it is healthier to wait at least 6 months
- Using contraception can help to avoid unwanted pregnancies and space births

Methods of family planning

- Calendar based methods may be less effective
- Intrauterine device (IUD) and implant: highly effective and convenient, requiring little user action; long-acting, reversible
- Vasectomy and tubal ligation; provide long-term contraception for those who completed their families
- Condom

The participant should now be invited to ask questions for clarification on any aspect of the session.

Thank the participant for her attention and participation

SESSION 3 (GNE-S3): REST AND EXERCISE

Objectives: By the end of the session, the participant should be able to:

- Tell the benefits of exercise during pregnancy
- Know when not to exercise

Core Points:

- It is better to continue with normal routine than resting.
- Physical activity during pregnancy lowers the risk of problems like low birth-weight and preeclampsia

Benefits of Exercise during Pregnancy

- Exercise helps to prevent excess weight gain
- Exercise promotes faster delivery
- Exercise may also help reduce the risk of gestational diabetes mellitus (GDM)
- Exercise may help in controlling blood glucose

Advise pregnant woman against strenuous physical activities because it may lead to growth retardation and preterm delivery

In general, pregnant woman should obtain 30 or more minutes daily of moderate-intensity physical activity

When Not to Exercise

Exercise should be avoided under the following conditions

- If you have pre-eclampsia or pre-term labour
- If you have pain, bleeding or unusual discharge

The participant should now be invited to ask questions for clarification on any aspect of the session. Let the participant say what physical activities she can engage in.

Thank the participant for her attention and participation

SESSION 4 (GNE-S4): DANGER SIGNS IN PREGNANCY

Objectives: By the end of the session, the participant should be able to:

- Describe the danger signs during pregnancy
- Know what to do when she experiences any of the danger signs

Core points:

Most women will have normal pregnancies with no complications. . It is important, however, to learn the warning signs that something is wrong. If you experience any of the symptoms, it is important to see your health care professional immediately. They can advise you as to what further steps may be necessary or help you prevent the more serious complications. Delaying care may also make the situation more serious.

Danger signs in pregnancy

Symptom	Possible problem
Vaginal bleeding	Miscarriage, placental abruption
Pelvic or abdominal pain	Miscarriage, ectopic pregnancy, abruption
Persistent back pain	Miscarriage, preterm labour
Gush of fluid from vagina	Preterm labour, miscarriage
Swellings of the hands/face/calf	Pregnancy Induced Hypertension (PIH)
Severe headache, blurry vision	PIH, Eclampsia
Regular contractions prior to 37 weeks	Preterm labour
Decreased/No Fetal Movement	Fetal distress, Fetal death
Dizziness/fainting/overheating of body	Dehydration, circulatory or heart problem
Heart palpitations	Dehydration, severe anemia, or a heart problem

The participant should now be invited to ask questions for clarification on any aspect of the session. Ask the participant to say what she can do if she experiences any danger sign.

Thank the participant for her attention and participation

SESSION 5 (GNE-S5): BREASTFEEDING

Objectives: By the end of the session, the participant should be able to:

- Explain why she should breastfeed her baby (benefits of breastfeeding)
- Describe how and when she should breastfeed

Core points

1. WHY SHOULD YOU BREASTFEED?

- Breast milk contains exactly the nutrients needed by the infant. These nutrients are easily absorbed from breast milk. Breast milk provides all the water an infant needs, even in a hot, dry climate. It also protects an infant against infection.
- Breastfeeding helps mother and baby to develop a close loving relationship. It also protects a mother's health. Exclusive breastfeeding gives the infant the best chance to grow and stay healthy
- Breastfeeding directly after birth will help the mother expel the placenta or afterbirth and reduce the bleeding.
- Colostrum (the first yellowish milk) also helps to clean the baby's stomach and eliminates the first black stools.

2. HOW AND WHEN SHOULD YOU BREASTFEED?

- Start breastfeeding within 30 minutes to 1 hour after birth. Colostrum protects your baby from infection and is the infant's first immunization. Do not give your baby water. It gets enough fluid from the milk.
- Feeding on demand after birth helps the breast milk to flow sooner and can help prevent engorged breasts. Feed the child day and night, this will be at least 10 times in 24 hours.
- The best way to feed a child 0-6 months of age is to give only breast milk (exclusively). This means that the child will take only breast milk and no additional food, water, pito, sugar water, gripe water, herbal preparations, koko, tin milk or other fluid/foods with the exception of medicines and vitamins if needed
- Breastfeed the child until one breast is empty, then shift to the other breast and empty that one
- Do not use feeding bottles to feed your child or even for water

The participant should now be invited to ask questions for clarification on any aspect of the session. Ask the participant to say what she can do if she experiences any danger sign.

Thank the participant for her attention and participation

6.2. Specific Nutrition Education (SNE) lessons for intervention group

IMPORTANT NOTE: THIS INFORMATION SHOULD ONLY BE GIVEN TO PARTICIPANTS IN THE INTERVENTION GROUP.

SESSION 1 (SNE-S1): IRON RICH FOODS, ENHANCERS AND INHIBITORS OF IRON ABSORPTION

Objectives: By the end of the session, the participant should be able to:

- Mention the best sources of iron in the diet
- Tell the food items that enhance iron absorption
- Tell the food items that inhibit iron absorption

Core points

- Iron rich foods from animal sources include red meat, organ meat (liver), fish, poultry
- Non-animal food sources of iron include legumes and green leafy vegetables
- Iron from animal food sources are more readily absorbed
- Food items that enhance iron absorption include meat, poultry, fish, and seafood as well as ascorbic acid or vitamin C, present in fruits, juices, potatoes and some other tubers, and other vegetables such as green leaves, and cabbage
- Food items that inhibit iron absorption include cereal bran, cereal grains, high-extraction flour, legumes, nuts, and seeds
- Foods that contain the most potent inhibitors include tea, coffee, cocoa, herbal infusions in general, certain spices (e.g. oregano), and some vegetables; and calcium, particularly from milk and milk products.

Ways to ensure optimal bioavailability of iron in the diet of pregnant women

- Separate tea drinking from mealtime - one or two hours later, the tea will not inhibit iron absorption because most of the food will have left the stomach;
- Include in the meal fruit juices such as orange juice, or another source of ascorbic acid such as tubers, cabbage, carrots, or cauliflower;

Food items that enhance or inhibit iron absorption

Enhancers of iron absorption	Inhibitors of iron absorption
Organ meat	Tea
Red meat	Coffee
Fish	Grain Cereals
Orange	Milk and milk products (calcium)
Green leafy vegetables	Cocoa
Fermented foods	Herbal infusions

Ask the participant about the steps she can take to ensure that she will have adequate iron rich foods in her die



FOOD SOURCES OF:



Vitamin C



Iron



IRON RICH FOODS



SESSION 2 (SNE-S2): PREVALENCE, TRENDS AND EFFECTS OF PREGNANCY ANAEMIA

Objectives: By the end of the session, the participant should be able to:

- Tell the signs and symptoms of anaemia
- Mention the groups mostly affected by anaemia
- Describe the effects of pregnancy anaemia

Lead the participant to recap what she learnt in the previous session. Congratulate her and reinforce her knowledge by reminding her of the core points. Now discuss the causes of pregnancy anaemia. Also dispel myths and give any additional information where necessary.

Core points

1. Signs and Symptoms of Anaemia

- Palour
- Tiredness
- Body weakness
- Dizziness
- Headache
- Breathlessness
- Rapid heartbeat

2. Children and women are the most affected groups by anaemia

3. About 7 out of 10 pregnant women in Ghana have anaemia

4. Effects of anemia during pregnancy:

- Increased risk of maternal and child mortality, haemorrhage, sepsis, perinatal mortality
- Decreased work productivity
- Impaired cognitive development of children
- Low birth weight

The participant should now be invited to ask questions for clarification on any aspect of the session. Ask participant about the steps she will take to avoid getting anaemia.

Thank the participant for her attention and participation

SESSION 3 (SNE-S3): CAUSES OF ANAEMIA

Objective: By end of the session, the participant should be able to:

- Explain the causes of anaemia in pregnancy

Lead the participant to recap what she learnt in the previous session. Congratulate her and reinforce her knowledge by reminding her of the core points. Now discuss the causes of pregnancy anaemia.

Core points

Anaemia is caused by many factors

- Poor dietary iron intake (most common cause, that is, 50% of anaemia)
- Poor dietary intake and/or absorption of vitamins A, B12, folate
- Malaria
- HIV/AIDS
- Infectious disease (e.g., chronic diarrhoea; TB)
- Genetic blood disorders (e.g., sickle cell trait, thalassemia)
- Helminthic infections (e.g. hookworm, schistosomiasis)
- Bacterial or viral infections
- Reproduction

The participant should now be invited to ask questions for clarification on any aspect of the session. Ask the participant about what actions she will take to protect herself from getting anaemia

Thank the participant for her attention and participation

SESSION 4 (GNE-S1, 2 & 3) : GENERAL NUTRITION EDUCATION

Lead the participant to recap what she learnt in the previous sessions. Congratulate her for her effort and encourage her to practice all the dietary recommendations on consumption of iron rich foods.

In this session, take the participant through sessions 1, 2 and 3 of the general nutrition education package (GNE-S1, GNE-S2 and GNE-S3).

SESSION 5 (GNE-S4 & 5): GENERAL NUTRITION EDUCATION

Reinforce the participant's knowledge on anaemia and iron rich foods. Discuss sessions 4 and 5 of the general nutrition education package (GNE-S4 and GNE-S5).

7. PHONE CALL MESSAGES

7.1. Phone call messages to participants in the CG (Phone call-CG)

Step 1: Greet and introduce yourself

Step 2: Ask whether you are speaking to the target participant (mention her name)

Step 3: Find out about her health and that of her family

Step 4: Tell her that you are calling to remind her about what you discussed during the previous meeting (mention the main issue briefly) and encourage her to implement all that she learnt

Step 5: Ask if she has any questions on the issues discussed. Respond if any and thank her for her time and remind her of your next visit/contact.

7.2. Phone call messages to participants in the IG (Phone call-IG)

Step 1: Greet and introduce yourself

Step 2: Ask whether you are speaking to the target participant (mention her name)

Step 3: Find out about her health and that of her family

Step 4: Tell her that you are calling to remind her about what you discussed during the previous meeting (mention the main issues briefly) and encourage her to implement all that she learnt. Emphasize the need for her to consume iron rich foods every day to ensure that her blood level improves or comes to normal.

Step 5: Ask if she has any questions on the issues discussed. Respond if any and thank her for her time and remind her of your next visit/contact

EAT YOUR IRON IN PREGNANCY



Source: <http://www.dailyiron.net/iron-rich-foods-for-pregnancy/>

Appendix 6: Ethical Clearance (Ghs-Erc)

GHANA HEALTH SERVICE ETHICAL REVIEW COMMITTEE

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

*My Ref. :GHS-ERC: 3
Your Ref. No.*



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

Hannah.

23rd March, 2015

Yakubu Adam
School of Public Health
University of Ghana
Legon, Accra

ETHICAL APPROVAL - ID NO: GHS-ERC: 18/02/15

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

“Efficacy of Nutrition Education with an Emphasis on Consumption of Iron Rich Foods on Haemoglobin Levels of Pregnant Women: A Randomized Trial in Gomoa East District of the Central Region of Ghana”

This approval requires that you inform the Ethical Review Committee (ERC) when the study begins and provide Mid-term reports of the study to the Ethical Review Committee (ERC) for continuous review. The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Please note that any modification without ERC approval is rendered invalid.

You are also required to report all serious adverse events related to this study to the ERC within seven days verbally and fourteen days in writing.

You are requested to submit a final report on the study to assure the ERC that the project was implemented as per approved protocol. You are also to inform the ERC and your sponsor before any publication of the research findings.

Please note that this approval is given for a period of 12 months, beginning March 23rd 2015 to March 22nd 2016.

However, you are required to request for renewal of your study if it lasts for more than 12 months.

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

SIGNED.....

DR. CYNTHIA BANNERMAN
(GHS-ERC CHAIRPERSON)

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

Appendix 7: Ethical Clearance (Nmimr-Irb)

NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH
Established 1979 *A Constituent of the College of Health Sciences*
University of Ghana

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INSTITUTIONAL REVIEW BOARD



Post Office Box LG 581
Legon, Accra
Ghana

My Ref. No: DF.22
Your Ref. No:

5th November, 2014

ETHICAL CLEARANCE

FEDERALWIDE ASSURANCE FWA 00001824

IRB 00001276

NMIMR-IRB CPN 027/14-15

IORG 0000908

On 5th November 2014, the Noguchi Memorial Institute for Medical Research (NMIMR) Institutional Review Board (IRB) at a full board meeting reviewed and approved your protocol titled:

TITLE OF PROTOCOL : Efficacy of Nutrition Education with an emphasis on Consumption of Iron rich foods on Haemoglobin Levels of Pregnant Women: A Randomised Trial in Gomoa East District of the Central Region of Ghana

PRINCIPAL INVESTIGATOR : Yakubu Adam, MPhil Cand.

Please note that a final review report must be submitted to the Board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to the IRB for review and approval prior to implementation.

Please report all serious adverse events related to this study to NMIMR-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till 4th November, 2015. You are to submit annual reports for continuing review.

Signature of Chair:

Mrs. Chris Dadzie
(NMIMR – IRB, Chair)

cc: Professor Kwadwo Koram
Director, Noguchi Memorial Institute
for Medical Research, University of Ghana, Legon