

**ANAEMIA AND DIETARY DIVERSITY AMONG PREGNANT
WOMEN IN MARGIBI AND GRAND CAPE MOUNT COUNTIES,
LIBERIA**

**THIS THESIS IS SUBMITTED TO THE DEPARTMENT OF
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BY

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SCIENCE DEGREE IN DIETETICS**

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DECLARATION

I, Geetah S. Saydee, hereby declare that this dissertation is the result of my own diligent research work I undertook at the Department of Dietetics, School of Biomedical and Allied Health Sciences, University of Ghana. Neither the whole nor any part of it has been, is being or is to be submitted for another degree at this or any other University.

All references cited are fully acknowledged.

Signed: 

Date: October 27, 2020

Geetah S. Saydee

DECLARATION BY SUPERVISOR

This Master's thesis in Margibi and Grand Cape Mount Counties, Liberia, entitled "Anaemia and Dietary Diversity among Pregnant Women," was done under my supervision and has not been submitted to any other university or college for a degree.



Supervisor Signature:

Dr. Freda Intiful

Date: 19/10/2020

ABSTRACT

Background

Globally, anaemia remains a severe public health concern among women of reproductive ages including pregnant women in developing countries like Liberia. Anaemia can be attributed to nutritional deficiency resulting from factors such as inadequate or poor dietary intake, food insecurity, infections. Poor dietary diversity also leads to increased micronutrient deficiencies. Nevertheless, there is limited documentation of anaemia prevalence and dietary diversity among pregnant women in Liberia.

Aim

The aim of this study was to assess dietary diversity and the prevalence of anaemia among pregnant women in Margibi and Grand Cape Mount Counties, Liberia.

Method

A cross sectional study design was used. A systematic sampling procedure was used to recruit 139 pregnant women between 15-49 years from antenatal clinics in Margibi and Grand Cape Mount counties. Data were collected through interviewer administered questionnaires. Dietary intake information was obtained through a 24-hour dietary recall. Based on this, dietary diversity was obtained following the FAO dietary diversity determination protocol for women in their reproductive ages. Hemoglobin status was determined using the hemocue analyzer. SPSS version 23 software was used for data analysis. Descriptive statistics such as percentages, means and standard deviation were applied to analyze the data. Statistical inferences were drawn using t-tests and chi square tests. Statistical significance was set at $p < 0.05$.

Results

The mean age was 24.0 (7.0) years. Nearly all the pregnant women (98.1%) consumed from the grains group. Lesser percentage (23.7%) consumed from the vitamin A-rich fruits and vegetables group. The mean Minimum Dietary Diversity among women of reproductive age (MDD-W) was 3.57 ± 1.01 . Also, 54% of the pregnant women were anaemic. The mean hemoglobin level was $10.44 \text{ g/dl} \pm 1.46$. There was no significant association between dietary diversity and anaemia among the pregnant women.

Conclusion

The prevalence of anaemia among the pregnant women was of public health concern among the pregnant women. Many of the pregnant women had poor dietary diversity. There is an imperative need to encourage diversity in dietary intake through awareness, education, and knowledge in dietary diversity and improve access to diverse foods for a healthy life.

DEDICATION

I would like to dedicate this work to women in Liberia and beyond.

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LIST OF ABBREVIATIONS

ANC	Antenatal Care
CDC	Centers of Disease Control and Prevention
DDS	Dietary Diversity Score
EVD	Ebola Virus Disease
FAO	Food Agriculture Organization
FEWSN	Famine Early Warning Systems Network
FSN	Food Security & Nutrition
GARPR	Global AIDS Response Progress Reporting
GOL	Government of Liberia
HIV	Human Immune Virus
IDDS	Individual Dietary Diversity Score
IMF	International Monetary Fund
LISGIS	Liberia Institute for Statistics & Geo-Information Services
LMIC	Low and middle-income countries
MDD-W	Minimum dietary diversity for women of reproductive ages
MPEA	Ministry of Planning & Economic Affairs
STD/STI	Sexual Transmitted Disease/ Sexual Transmitted Infections
SDG	Sustainable Development Goals
UL	University of Liberia
UN	United Nations
USAID	United States Agency for International Development
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Anaemia is defined as the decrease in number of circulating red blood cells (RBC) or the total quantity of haemoglobin level (Balarajan, Ramakrishnan, Özaltın, Shankar & Subramanian, 2011). Globally, anaemia remains a severe public health concern among individuals from different age groups (World Health Organization, 2015). Studies have shown that iron deficiency contributes to half of the anaemia burden among various age groups (Ma, Schouten, Wang, Xu, Zheng, & Wang, 2009; Yesuf, Abriha, & Wassie et al., 2014). Anaemia among different age groups results in a decrease red blood cell volume and leads to inadequate supply of oxygen to various body organs (Shah, 2019). Infants, women of reproductive age including pregnant women are among those mostly affected (Ahmad, Bashanfer & Morish et al 2018).

Anaemia can pose serious complications during pregnancy and highly occurring worldwide in both developed and developing nations (Gebre & Mulugeta, 2015). Several studies show that maternal anaemia and iron deficiency have affected about 500 million women of reproductive age (Melku, Addis, Alem & Enawgaw, 2014; Aziz, Abbasi, Feroz & Saleem, 2019). Studies have shown that globally pregnancy is found to be associated with about 75% anaemia condition that can be attributed to nutritional deficiency (Mbule, Byaruhanga, Kabahenda & Lubowa, 2013; Oladapo, Daru, Zamora, Fernández-Félix, Vogel, Morisaki, Tunçalp & Torloni, et al., 2018). The prevalence of anaemia per year in developing countries is estimated to be 43% and has resulted in more than 115,000 maternal deaths and 591,000 prenatal deaths (Balarajan et al., 2013). Studies have revealed that around the world the occurrence of anaemia in pregnancy is greater than twenty percent

and more than eighty percent in most countries (Carlo, Filippo-Spano, & Giardina, 2015; Musa, Elbashir, Adam, Abdelrahman & Gasim, 2012). In low and middle-income countries (LMIC) about 56% of anaemia occurs among pregnant women (Black, Victora, Walker, Bhutta, De Onis & Uauy, 2013). Research has shown that anaemia has both short and long-term health complications among pregnant women resulting in neural tube defects, preterm delivery, growth retardation of the unborn baby in the uterus resulting in poor brain development, risk of abortion, low birth weight and high risk of mortality for the foetus (Abu-Ouf & Jan 2015).

The causes of anaemia among pregnant women in low and middle-income countries include an inadequate or poor dietary intake, infections (such as malaria, HIV, and hookworm infestation) age, parity, educational and socioeconomic status, food insecurity, hygiene conditions and genetic predisposition (Msuya, Hussein, Uriyo, & Stray-Pedersen, 2011; Okube, Mirie, Odhiambo, Sabina & Habtu, 2016).

Dietary diversity has been defined as the quantity of diverse foods from different food groups that are consumed over a precise reference period (Lockett et al., 2015). Nonetheless, studies have shown that the diets of pregnant women are mainly repetitive (Lee, Talegawkar, Merialdi & Caulfield, 2013). Eating diverse foods is an internationally accepted recommendation for a healthy diet because it promotes quality health status of mother and child, with positive health outcomes such as reduced incidence of maternal and child mortality (Fadeiye, Adegbenro & Olumakaiye, 2016).

1.2 Problem Statement

Globally, the prevalence of maternal anaemia is 38.2%. Regional reported prevalence are Europe (24.5%), Latin America, the Caribbean (28.3%), Oceania (29%), the South-East Asia region with the highest prevalence of 48.7%, and Africa the second highest (46.3%) and less than 20% in North America (WHO 2015; WHO 2019; Figueiredo, Gomes-Filho, Silva, Pereira, Da Mata, Lyrio, Souza, Cruz & Pereira, 2018). West Africa had the highest anaemia prevalence (38-62%) among pregnant women resulting from iron-deficiency (WHO, 2016; Harika, Faber, Samuel, Kimiywe, Mulugeta & Eilander, 2017).

In West Africa, it was shown that anaemia among pregnant women increased in Liberia, Sierra Leone and Guinea because of the Ebola Virus Disease (EVD). The EVD led to the shutting down of antenatal (ANC) services resulting in women giving birth outside health facilities and increasing maternal deaths (Dunbar, Richards, Woldeyohannes, Van den Bergh, Wilkinson & Tamang, 2017; Ly, Sathananthan, Griffiths, Kanjee, Kenny & Gordon, 2016). According to the World Bank the prevalence of anaemia among pregnant women in Liberia was reported at 37.7% (WHO, 2015).

The Liberia Nutrition Profile published by the United States Agency for International Development (USAID) in 2018, indicated 35% of reproductive age women between the ages of 15 to 49 years to be anaemic due to many factors including micronutrients deficiency that may be a result of food insecurity and under nutrition (USAID, 2018). Famine Early Warning Systems Network (FEWS NET) classified Liberia as moderately food insecure. The problem of food insecurity, under-nutrition and anaemia resulted from the 14 years civil crisis and was worsened by the 2014-2015 Ebola epidemic in which over 10,000 people were infected, and more than 4,000 casualties recorded (Center for Disease

Control, 2016; Emmet, Kali & Macon, 2016). Food insecurity is a problem in Liberia with 51.2% of households suffering from food shortages and poor dietary intakes contributing to maternal mortality (FEWS NET, 2017; LISGIS, 2017).

Maternal deaths in Liberia increased from 578 per 100,000 live births in 2000 to 1,072 deaths per 100,000 in 2013 (Ministry of Planning & Economic Affairs & University of Liberia, 2000; LISGIS, 2013). Compared to a sub Saharan African average of 450 maternal deaths per 100,000 live births, this maternal mortality is very high. Maternal mortality in urban centers in 2008 was 686 per 100,000 live births compared to 1,057 per 100,000 maternal deaths in rural areas. It has been revealed that anaemia is one of the main medical causes of maternal mortality in Liberia (Government of Liberia, 2012).

Although there are national policies to prevent and treat anaemia during pregnancy such as iron supplementation and proper dietary intake the true prevalence and causes of anaemia in most parts of the world is not clearly defined. It is also observed that adequate information on the micronutrient status in women of reproductive ages particularly in the West Africa region is lacking in Liberia, such information on the magnitude and characteristic of dietary diversity and anaemia among pregnant women is inadequate and almost nonexistent in published public health records.

1.3 Justification of study

The maternal healthcare delivery system is relatively weak and worsened over the years as maternal deaths increased from 578 per 100,000 live births in 2000 to 1072 deaths per 100,000 in 2013 in Liberia (MPEA & UL, 2000, LISGIS, 2013). Inadequate micronutrient intake during pregnancy in developing countries has contributed to anaemia complication and low haemoglobin level; which are of importance in preventing anaemia (WHO 2014;

Rahnman, Abe, Kanda, Narita, Bilano, Ota, Gilmour & Shibuya, 2016; Greenwood, Alwan, Cade, McArdle, Hayes & Simpson, 2015).

In view of the prevailing maternal health circumstances, the Government of Liberia in 2012 initiated the Road Map for Accelerating the Reduction of Maternal Mortality and Newborn Morbidity and Mortality of the National Health Plan and Policy as the country's commitment to achieve United Nations Sustainable Development Goals (SDGs). The target of the SDG number 3 is to reduce the maternal mortality ratio to less than 70 per 100,000 live births by 2030. To reduce maternal mortality, it is very necessary to focus on pregnant women to ensure that they are provided with most helpful attention in terms of health care.

Also, empirical evidence on the prevalence of anaemia and dietary diversity among pregnant women in different counties in Liberia is lacking. To fill these gaps, the study determined the prevalence of anaemia and dietary diversity among pregnant women in Margibi and Grand Cape Mount Counties in Liberia. The results will provide stakeholders such as the Ministry of Health, public health practitioners, nutritionists/ dieticians, medical doctors, physician assistants, nurses and midwives with data to help improve the practices and wellbeing of pregnant women.

1.4 Hypotheses

This study tested the following hypotheses;

1. There is low prevalence of anaemia among pregnant women in Margibi and Grand Cape Mount Counties, Liberia
2. There is no relationship between dietary diversity and haemoglobin concentrations among pregnant women in Margibi and Grand Cape Mount Counties, Liberia.

1.5 Aim and Specific Objectives

1.5.1 Aim

To assess dietary diversity and the prevalence of anaemia among pregnant women in Margibi and Grand Cape Mount Counties, Liberia.

1.5.2 Specific objectives

1. Assess the dietary diversity among pregnant women in Margibi and Grand Cape Mount Counties, Liberia.
2. Assess anaemia among pregnant women in Margibi and Grand Cape Mount Counties, Liberia.
3. Determine the relationship between dietary diversity and hemoglobin of the pregnant women in Margibi and Grand Cape Mouny Counties, Liberia

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

Anaemia presents as the last phase of iron deficiency among women of reproductive ages in both developed and developing countries posing health burden until now (McMahon, 2010). World Health Organization (WHO) assessment revealed more than 2 billion people, constituting over 30% of the world's population are affected by anaemia (WHO, 2008). Furthermore, Abriha, Yesuf & Wassie, (2014) estimated that the prevalence of anaemia in developing countries is 43 % compared to 9 % developed countries.

Studies by Bánhidý, Acs, Puhó, & Czeizel (2011) and Kefiyalew, Zemene, Asres & Gedefaw, (2014) have asserted that anaemia contributes to 20% of all maternal deaths. Anaemia is determined based on the hemoglobin concentration levels (Morrone, Nosotti, Piombo, Scardella, Spada & Pitidis, 2010). The outcome of pregnancy primarily depends on the level of blood volume plasma being supplied during the pregnancy period (Bukar et al., 2008; Sayehmiri et al., 2015).

The Centers of Disease Control and Prevention (CDC) and WHO definitions have stated that anaemia occurs when the hemoglobin concentration is less than 11 g/dL during pregnancy (WHO/CDC, 2008; WHO, 2011). Anaemia is said to be severe when haemoglobin concentration is less than 7.0 g/dL, moderate when haemoglobin is between 7.0 and 9.9 g/dL, and mild when haemoglobin is from 10.0 to 10.9 g/dL (WHO/CDC, 2008; WHO, 2011). The World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) guidelines further describes anaemia in a different way depending on the trimesters in pregnant women (<11.0 g/dl in the first trimester and in the third trimester,

<10.5 g/dl in the second trimester) (Darvishi, Azami, Sayehmiri & Qavam, 2015). Public health specialist also tends to classify anaemia based on the following levels $\geq 40\%$ severe, 20-30% moderate, 5-19% mild and 0-4.9% normal in the population for diagnosing among pregnant women (WHO, 2011).

Anaemia can be classified into two categories during the period of pregnancy namely: pathological anaemia and physiological anaemia (Chowdhury, Rahman & Moniruddin, 2014). The pathological anaemia arises due to nutritional deficiencies such as iron, folate, Vitamin B₁₂ and Protein (De-Regil, 2015; Christian 2010). Physiological anaemia, on the other hand, involves the imbalance between increase in plasma and corresponding red bloods (Sabina, Zaheer, Khan, Zakaria & Chavan, 2015).

Studies have shown that insufficient maternal dietary intakes of micro nutrients affect the mother and developmental events of the offspring during pregnancy (Darnton Hill & Mkpuru, 2015; Khoushabi & Saraswathi, 2010). Dietary status of a woman is central and crucial as it defines pregnancy outcome (Black, Allen, Bhutta, Caulfield, Onis, Ezzati, Mathers et al., 2008). Saaka (2013) has asserted that adequate nutrient intake during pregnancy is important for the satisfactory birth outcome and most advantageous to the health of the mother. Cheng, Dibley, Zhang, Zeng and Yan, (2009) provided scientific evidence that nutrient intake during pregnancy has a serious role in foetal development and pregnant women should increase the diversity of their food intake.

Moreover, Labadarios, Steyn and Nel (2011) have argued extensively that the more food groups are included in a person's daily diet, the greater the chances of meeting nutrient requirements. Furthermore, Baer, Watts and Rockett, 2007 established that maternal intake

of carbohydrates, protein, fatty acids and micronutrients have important effects on growth of the foetus and perinatal outcomes (Kiboi, Judith Kimiywe, & Chege, 2017).

2.2 Iron deficiency in pregnancy

Iron plays an essential role in health and contributes to the immune system and antibodies of an individual (Desta, Kassie, Chanie, Mulugeta, Yirg & Merkeb, 2019). The red pigment of the blood is made up of iron (Christian, 2010). This is important for the functioning of organs and tissues which are vital to the body for multiple metabolic processes including DNA synthesis and electron transport (Lee, Talegawkar, Merialdi, & Caulfield, 2013). The body needs iron to make haemoglobin, which is the protein in red blood cells (RBCs) that carries oxygen to organs (Abu-Saad, 2010).

Anaemia in pregnancy can lead to several complications such as low birth weight, preterm delivery and both neonatal and maternal mortality (Shao, Lou, Rao, Georgieff, Kaciroti, Felt, Zhao & Lozoff, 2012). It has been revealed that iron deficiency decreases the concentration of iron that has been reserved for the foetus (Gambling, Kennedy & McArdle, 2011). Uncorrected iron deficiency anaemia can lead to problems during pregnancy including heart complication and growth retardation (McArdle, 2014).

In iron-deficiency anaemia, the body cannot meet the standard level of iron due to inadequate food intake during pregnancy (Gordon, 2012, Kelkitli, Ozturk, Aslan, et al., 2016). Anaemia develops when the body stores of iron drop and therefore the body is unable to support normal red blood cell production (Olatunbosun, Abasiattai, Ibanga, & Morgan, 2014; Pavord, 2012). The low red blood cell count indicates that the amount of oxygen in the blood is lower than its normal value (Yip, 2000). The bone marrow is where

the red blood cell is produced, and the cells carry oxygen to all the body's tissues and organs (Allen, 2000). Protein is needed for DNA synthesis and other tissues (Balarajan et al., 2013).

2.3 Consequences of anaemia during Pregnancy

It is well established that anaemia in pregnancy poses a substantial risk in increasing the incidence of both maternal and foetal morbidity and mortality (Kalaivani, 2009). About 3% of maternal mortality in Africa is directly attributable to anaemia (Khan, Wojdyla, Say, Gülmezoglu & Looket, 2006). In essence, maternal anaemia contributes to an increase in low birth weight, perinatal mortality, still birth, preterm and neural tube defect on foetus (Zerfu, Umeta & Baye, 2016). Meanwhile, Ibrahim (2011) and Hojaji, (2015) indicated that anaemia in pregnancy reduces the blood level and leads to impaired function and cardiac failure.

Additionally, insufficient maternal folate status has been linked to placenta abruption, preeclampsia, spontaneous abortion, stillbirth, preterm delivery, and low birth weight (George, Mills, Johansson, Nordmark, et al., 2002; Shao, 2012). Meanwhile, Tobias, Steer, Emmett, Tonkin, et al., (2005) and Ouedraogon, (2012) has provided evidence that the inadequate intake of folate during pregnancy also adversely affects the development and growth of offspring. Ogundipe, Hoyo, Stbye, Oneko and Manongi (2012) has explained that iron deficiency during pregnancy are risk factors for iron deficiency anaemia, preterm delivery, low birth weight, and this contributes to poor neonatal health and increased maternal mortality.

2.4 Dietary diversity needs in Pregnancy

Dietary diversity has been defined as the consumption of an adequate variety of food groups. It has been empirically accepted as an aspect of quality diet and can indicate adequate nutrition in pregnancy (Becquey, Capon & Martin-Prével, 2009). Zainal- Badari et al., (2012) has emphasized that adequate nutrient intake is necessary for good nutrition and often been associated with food variety and diet quality of individuals.

Hence, the adequate dietary intake during pregnancy is important and can influence birth results. Ekesa, Blomme, and Garming, (2011) and Yenebat, Adugna, and Asmamaw, (2019) observed that increasing the variety of foods and food groups in the diet helps to ensure the adequate intake of essential nutrients, particularly micronutrients for the wellbeing of the mother and the development of foetus. For this reason, dietary diversity during pregnancy is considered very essential in improving and reducing the risk of neonatal and infant deaths (Haidar, 2010). Forouzanfar, Alexander, Anderson and Bachman (2015) established that a high-quality nutrient intake are the foundation of human existence and healthy life and is heavily dependent upon the intake of adequate quantity and quality sources of diverse food groups. Vakili, Abedi, Sharifi and Hosseini, (2013) have asserted that for health and development of an individual, a good nutrition is significant and essential for high-quality health and wellbeing.

Nevertheless, many persons particularly women of reproductive ages are undernourished. According to the State of Food Security & Nutrition in the World 20 18 report, globally number of people are undernourished due to unavailability of food which has increased from around 804 million in 2016 to nearly 821 million in 2017 (FSN World Report, 2018). Several studies have revealed that food consumption pattern in Africa shows high

consumption from food sources such as rice, maize porridge corn or brown bread with a small quantity coming from vegetables and animal sources among pregnant women (Saaka, Oladele, Larbi, & Hoeschle-Zeledon, 2017). Among these energies dense food groups maize was the dominant of the cereal followed by rice millet and wheat which included 59%, 78% and 81% respectively of their energy (Abebe, Bogale & Hambidge, 2008; Moursi, Arimond, Dewey, Tre`che, Ruel & Delpuech, 2008; Kobi-ro, Delil, Zinab & Tamiru, 2019).

Voster, Kruger and Margetts (2011) and Ali, Thaver and Khan, (2014) added that the need for nutrition education and perception is necessary during pregnancy in order to have the sufficient dietary need for mother and fetus. The FAO/WHO (2007) have established diet-based guidelines for nutrient requirements and recommendations during pregnancy, in assessing and utilizing dietary information that can be of use in improving the livelihood of a pregnant woman as well as her child.

2.5 Dietary Diversity Score

Hoddinott and Yohannes (2002) and Arimond, Wiesmann and Becquey (2010) have provided available scientific suggestions that dietary diversity scores can be used to measure diet quality of pregnant women. Accordingly, Ruel, (2003) defined dietary diversity as the number of different foods or groups of food consumed over a given period, regularly in a day or in a week. The adequate nutrient intake during pregnancy can be assessed based on dietary diversity scores. Lander, Hambidge, Westcott, Tejeda, et al., (2019) and Arimond and Ruel (2003) have attempted the concept in a number of places among some population groups on non-quantitative assessment of actual food consumption. Dietary diversity can be measured by using several methods such as a

household or individual dietary diversity questionnaire in which dietary diversity score is used (FAO, 2007).

Accordingly, dietary diversity scores are created by adding either the number of individual food items that have been consumed over a reference period or the various food groups (Ruel, 2010). Individual Dietary Diversity Score (IDDS) uses 16 food groups which include. Cereals; Vitamin A rich vegetables and tubers; white roots and tubers; dark green leafy vegetables; other vegetables; Vitamin A rich fruit; other fruits; organ meat; flesh meat; eggs; fish; pulses/Legumes, nuts and seeds; milk and milk products; oils and fats; sweets and sugar and condiments and spices (FAO, FHI360, 2016). The IDDS aims is to capture nutrient adequacy and studies have shown that an increase in individual dietary diversity score is related to increased nutrient adequacy (Foote, Murphy, Wilkens & Carlson, 2004; Ekesa et al, 2011).

2.6 Socio-economic Factors

Socio- economic factors contribute to anaemia among pregnant women and is one of the most public health problems in developing countries (Balarajan et al., 2013; Hassan et al, 2014). Gebre and Mulugeta, (2015) explained that among pregnant women, anaemia is found mainly among women of rural communities than that of women in the urban setting due to financial income. Social, cultural and socio-economic predicaments like illiteracy, poverty, lack of awareness, cultural and religious taboos, unavailability of food poor dietary habits, and high prevalence of parasitic infestation exert influence on the intake of nutritional status (Nguyen, 2018).

The Socio-economic status of pregnant women plays a vital role in their dietary intakes (Gwatkin, 2007). Harris-Fry, Azad, Kuddus, Shaha, et al., (2015) found Socio-economic

factors to be associated with the household size which contributes to food insecurity hence posing a nutritional problem. Food insecurity can be defined as inadequate availability, accessibility and affordability of sufficient dietary intake of food that are safe socially (González, Jiménez, Madrigal, Muñoz, and Frongillo, 2008). Individuals are affected by food security owing to their occupation and economic status and so food intake is based on his/her income thus making it food insecure (Ivers & Cullen, 2011). In Liberia, the population of 2.2 million or 50.9% of the people is classified as poor and 51.2% of households suffer from food shortages (LISGIS, 2016).

2.6.1 Demographic Factors

Several studies have observed that demographic, social, environmental and geographic determinants are associated with anaemia (Habte, Asrat and Magafu, 2013). Hassan, Mamman, Adaji and Terfa (2014) argue that cultural practices, traditional beliefs and norms of the society affect nutritional intake during pregnancy. Other factors include age, parity, household size, marital status, gender (Taruvunga, Muchenje and Mushunje, 2013). Age is a determining factor of nutrient consumption when a female is the head of the house as compared to men (Méjean, Deschamps, Bellin-Lestienne, et al., (2010). Ismail, Kahkashan, Antony, Sobhith (2017) indicated that anaemia in pregnant women in middle income countries varies in lifestyles, socio-demography and nutritional factors such as age, parity, educational and socioeconomic status, food insecurity, hygiene conditions, nutritional deficiencies and genetic.

The economy of a country affects the health system of a country and individual life; Liberia is among the world poorest countries (World Bank; 2015). It has been revealed in the health sector that poverty is a major factor contributing to poor health outcome in Liberia (IMF,

2015). Average of the population live below \$1.25 US per day and medical services are being paid by individuals themselves (World Bank 2015). Liberia is among the countries with high fertility rates compared to sub-Saharan Africa as HIV/AIDS, STD/STIs are all public health concern (GARPR, 2013). Education, water-borne diseases, malaria and environmental problems have contributed to worsen the anaemia situation (LIGIS, 2008; IMF, 2015; US State Department Liberia, 2015).

2.7 Vitamin A and C and anaemia among pregnant women

Dietary consumption is related to anaemia during pregnancy which is a common hematological disorder. Studies among sub-Saharan Africa regions have revealed that among pregnant women food insecurity and malnutrition remain a major task (Chakona & Shackleton 2017). In sub-Sahara Africa study, it has been revealed that anaemia has been prevalent among pregnant women due to absence or insufficient intake of minerals and vitamins (Iron, Vitamin A and Zinc) (Chakona & Shackleton 2017; Von Grebmer, Bernstein, Hossain, Brown, et al., 2017). The shortage of macro- and micro-nutrients during pregnancy contributes to issues with nutritional deficiency, inadequate intrauterine growth development, inherited malformations, preterm deliveries, and pregnancy complications (Bawadi, 2010; Breymann, 2015).

In Tanzania, there was a prevalence of micronutrient deficiencies among women aged 15-49 years that contributed to them being anaemic due to knowledge deficit on food choices (Mosha & Philemon, 2010).

2.8 Socio-cultural practices among pregnant women

Income from pregnant women is a related socio-economic factor that has been linked to insufficient diet for mother, foetus and food security for the household size (Gewa, Oguttu & Yandell (2012). Nutrition knowledge about the appropriate food choices has been barrier, misconception of food, and beliefs during pregnancy. Environment factors and access to food makes it difficult to obtain and consume dietary practices. Additionally, in Kenya, families control food preferences for pregnant women. In Kenya, grandmothers, mothers- in-law, and other older female relatives, friends and neighbors have influences and restriction on the kind of food that should be consumed (Riang'a, Broerse & Kisaka, 2017). It has been identified that culture is an appropriate way of life of an individual society which is found to be very diverse across the world. Pregnant women in various parts of the world have cultural practices that forced them to abstain from/some healthy foods due to conventional eating habits, even though the food is available in abundance (Myaruhucha, 2009)..

2.9 Effect of Culture and Pica practice on nutrition in pregnancy

Culture which is defined as a natural way of life of people has been found to be very diverse across the world (Fawcett, Fawcett & Mazmanian, 2016). There have been long term changes in terms of values, norms and even behavior by individuals and the changes include changes in diet and lifestyle (Adusi-Poku, Edusei, Bonney, & Otupiri, 2012). Pregnant women tend to abstain from eating healthy and necessary food in various parts of the world due to traditional food habits even if the foods are available in abundance (Kutalek, Wewalka, Auer, Wilson et al., 2010). For example, in a study conducted by Patil et al., (2010) in India 63.7 percent of the study population said that some vegetables/fruits

should be avoided during pregnancy (Patil et al., 2010). Another investigation by Keding and Krawinkel, (2008) in Tanzania found that although women have some knowledge of certain foods and importance they did not necessarily consume the foods.

A study among pregnant women in southern Tanzania revealed that 69% avoided fish and farm meats and eggs due to fear of giving birth to a sterile child (Marchant, Armstrong-Schellenberg, Edgar, Ronsmans, et al., (2002). Similarly, in Ghana, most girls had varied myths and misconceptions about foods that should be avoided in pregnancy and tend to be associated with poor nutrition practices and anaemia (Hogrey, 2018).

The practice of pica also poses a challenge to nutrient intakes (Miao, 2015; Young 2010). This is the consumption of nonfood substances such as chalk, laundry starch, ice, clay etc. (Ezugwu, 2013). A study among pregnant women in Kenya revealed that 11% practiced pica which is an everyday practice seen among women in Kenya, especially during pregnancy (Ngozi, 2008; Riang'a, Broerse & Kisaka Nangulu, 2017). A study in Tanzania revealed that about 44.9% pregnant women consumed pica and acknowledge that the practice is dangerous (Nyanza, Joseph, Premji, Thomas & Mannion, 2014).

Geophagia, the practice of eating earth or soil like substances such as chalk or clay is widespread across the world and is mainly practiced in developing countries due to poverty and food insecurity (Meel, 2012). According to Hogrey (2018), pica or clay eating is practiced among pregnant adolescent women in Ghana. It is associated with the cause of iron deficiency among pregnant women (Louw, du Preez, Malan, van Deventer, et al., 2007; Kutalek et al., 2010).

In Sub-Sahara African countries (Kenya, Ghana, Rwanda, Nigeria, Tanzania, and South Africa) the practice of geophagy is prevalent among pregnant women but differs from one

region to another. About 10-75 % of pregnant women consume geophagy during pregnancy (Njiru, Elchalai and Paltiel, 2011). A study done in Pretoria reported that 54.0% of the pregnant women engaged in geophagia among those who practice, at least 75.2% consumed about 3 teaspoons per day. Moreover, the practice of geophagia by pregnant women is believed to act as a source of iron supplement which is being practiced among the educated and non-educated women (Macheka, 2016).

A study on food avoidance among Ghanaian pregnant women found some avoiding meat, snails or certain vegetables to avoid giving birth to a drooling or a 'spirited' child. (Arzoaquoi, Essuman, Gbagbo, Tenkorang et al., 2015). A study in Kenya revealed that 60% of pregnant women avoided certain animal source foods such as tongue, heart, udder and male reproductive organs, meat and eggs. Another 20% also avoided avocado and oily food with the belief to prevent giving birth to a large baby, less blood, lack of birth power, miscarriages or stillbirths, both maternal and infant deaths and poor skin conditions after birth (Riang'a, Broerse & Kisaka Nangulu, 2017).

Several studies have shown that alcohol intake during pregnancy is becoming a public health issue and posed negative effects for both mother and fetal development (Culley, Ramsey, Mugenyi, Kiwanuka, et al., 2013; Adusi-Poku, 2012; Popova, 2017). Lange, Probst, Gmel, Rehm, et al., (2017) and Kable (2015), documented that prenatal alcoholic drink during pregnancy or before birth adversely affects the embryo developmental and the child. Thus, accordingly Isaken (2015) and Charness (2018) found that alcohol intake during pregnancy poses risk to the health and mental development of the child. Da Pilma Lekettey, Dako-Gyeke, Agyemang and Aikins, (2017) in a study in James Town, Accra among pregnant women revealed alcohol consumption led to spontaneous abortion and

other maternal complications. Similarly, studies by Moise, (2019) in Zambia and Guelinckx, (2010) Louw, Peltzer and Matseke, (2011) in Belgium were observed among pregnant women with the consumption of alcohol posing adverse effect on maternal outcomes. According to LISGIS, (2013) in Liberia, 26.8% of women, 50.4% of men, 21.5% of pregnant women and 22.6% of breastfeeding women consumed alcohol.

CHAPTER THREE

3.0 METHOD

3.1 Study Design

A cross sectional study design was employed for this study.

3.2 Study areas

The study was conducted in Ministry of Health antenatal health facilities in Margibi and Grand Cape Mount Counties in Liberia.

Margibi County

Margibi County is the sixth populated county in Liberia. It is predominately inhabited by the Kpelle and Bassa ethnic groups. Geographically, Margibi is in the north to central coast of Liberia with a population of 209,923 persons (LISGIS, 2008). The West of Margibi County is Montserrado County and on the north is Bong County. The East of Margibi County is Grand Bassa County and the south is the Atlantic Ocean. The agricultural crops produced in the county are mainly rice and cassava. The largest rubber plantation is in Margibi County. Recent data revealed that 52.2 percent of the populations in Margibi County are poor (LISGIS, 2016).

The C. H. Rennie Government Hospital located in the urban city of Kakata, Margibi County was selected for the study. The C.H. Rennie Hospital is a secondary health facility with 50 hospital beds (Ali et al., 2015). The C.H. Rennie Government Hospital is the only public referral health facility in the County.

Grand Cape Mount County

Grand Cape Mount County has a population of about 129,817 in 2008 (LISGIS, 2010).

Grand Cape Mount County is surrounded by Gbarpolu County on the north and the southeast part is Bomi County. The country of Sierra Leone is on the north, while the Atlantic Ocean lies to the west. The chief crops grown in Grand Cape Mount County are rice, cassava and sugarcane. The ethnic groups in the county are Vai and Gola.

The St. Timothy Government Hospital located in the urban city of Robertsport, Grand Cape Mount County was selected for the study. The St. Timothy Hospital is a secondary health facility with 50 hospital beds (Ali et al., 2015).

St. Timothy Hospital provides inpatient and full outpatient services including antenatal care and major complicated cases from around the county are referred there. In addition, Sinje Health Center was another selected study site with primary health care services located in Sinje, Grand Cape Mount County. The health center provides outpatient and antenatal care services and major complicated cases. St. Timothy Hospital provides inpatient and full outpatient services including antenatal care and major complicated cases from around the county are referred there. In addition, Sinje Health Center was another selected study site with primary health care services located in Sinje, Grand Cape Mount County. The health center provides outpatient and antenatal care services and major complicated cases.

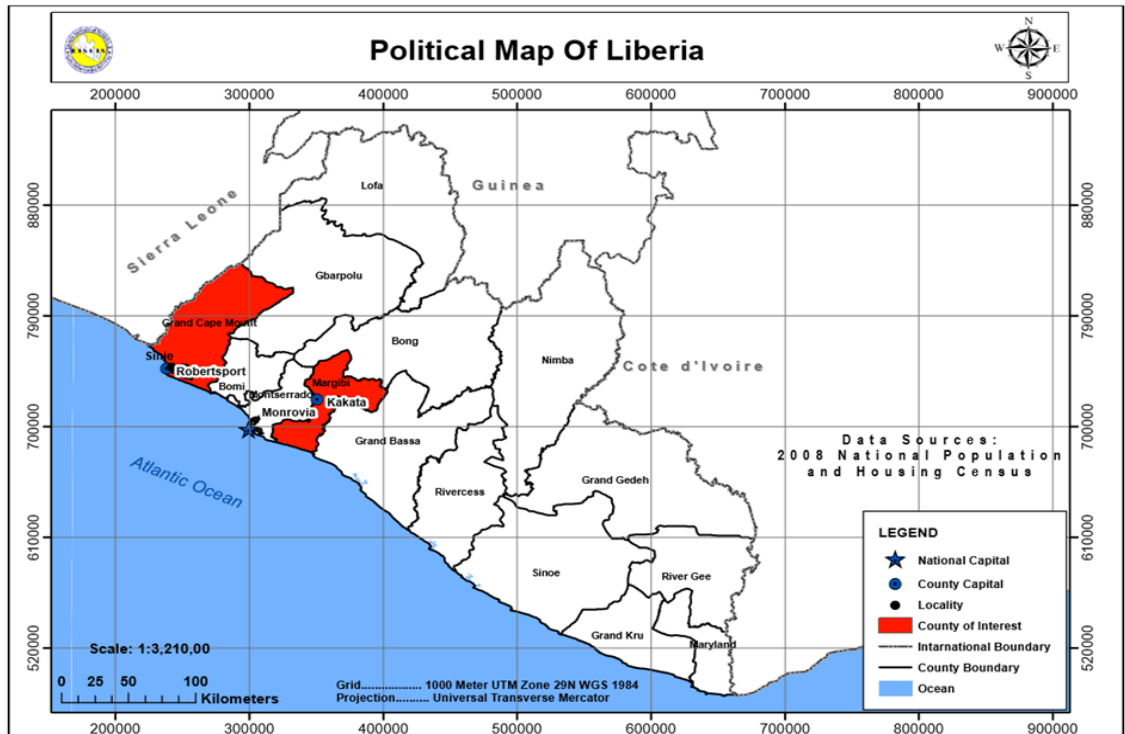


Figure 3.0 Location of study areas on the political map of Liberia
 Source: Liberia Institute for Statistics & Geo- Information Services, 2019, the map of Liberia

3.3 Study population

The study population consisted of pregnant women aged 15-49 years who attended antenatal clinics at three health facilities in Margibi and Grand Cape Mount Counties Liberia.

3.4 Sample size determination

The sample size was determined from the estimated population of pregnant women, aged 15-49 years in 2018 by Liberia Institute for Statistics & Geo-Information Services for Margibi and Grand Cape Mount Counties respectively and through the procedure provided by Cochran (Cochran, 1963) with the formula;

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

Where **n**= minimal sample size

Z= confidence interval constant at (1.96)

P= estimated proportion of pregnant women aged 15-49 years in the population in Margibi and Grand Cape Mount Counties = .09.

e = standard error (.05).

Hence, the sample size of 126 pregnant women was determined and included in the study.

However, due to non-response, 10 % of the sample size was added to the estimated sample size to obtain to total sample size of 139 pregnant women for the study. Thus, the number

of pregnant women was proportionally allocated by the estimated number of pregnant

women in each of the two counties. In 2018, Margibi county estimated pregnant women =

67,477 and 39,941 in estimated pregnant women in Grand Cape Mount County. So that,

Margibi County, 67,477 + Grand Cape Mount County, 39,941 =107,418 estimated

pregnant women. Sample size for Margibi County = Estimated pregnant women in Margibi

/ Total estimated pregnant women for the two counties X Sample Size = (67,477)/

(107,418) = 0.628. The sample size for Margibi county is =0.628 x139=87 pregnant women

to be interviewed in Margibi County in C. H. Rennie Hospital in Kakata City

Sample size for Grand Cape Mount County = Estimated pregnant women in Grand Cape

Mount / Total estimated pregnant women for the two counties X Sample Size =

39,941/107,418=0 .372 x 139 total sample of pregnant =52 pregnant women to be

interviewed in Grand Cape Mount County in St. Timothy Hospital in Robertsport City and

Sinje Health Center.

The sample size for Grand Cape County is $= 0.372 \times 139 = 52$ pregnant women. It was proposed that 31 pregnant women were selected and interviewed in St. Timothy Hospital in Robertsport City and 21 pregnant women were interviewed in Sinje Health Center in Sinje, Grand Cape Mount County.

3.5 Inclusion criteria

The study included apparently healthy pregnant women between the ages of 15-49 years attending antenatal clinic at the selected health facilities.

3.6 Exclusion criteria

The study excluded pregnant women aged 15-49 years who did not consent to participate in the study. Those who attended the health facility for reasons other than antenatal purposes were excluded.

3.7 Sampling procedure

At each of the antenatal clinics, eligible pregnant women were recruited using systematic sampling. Starting from the first pregnant woman who reported for antenatal clinic for a day, every other pregnant woman was approached to participate in the study. Those who were eligible and consented to participate were recruited into the study. This was done until the expected sample size was reached.

3.8 Data Collection and Procedure

The data was collected through interviewer administered questionnaires and results of biochemical tests.

3.8.1 Sociodemographic information

Structured questionnaires were used to obtain information on the sociodemographic characteristics of the participants. Information such as age, marital status, occupation, household number, educational level was obtained.

3.8.2 Dietary intake information

3.8.2.1 24-hour dietary recall

A one day 24-hour dietary recall assessment method was used to obtain information on their dietary intakes. The pregnant women were aided with household measures and food models to recall foods they had taken over the past 24 hours. The method consists of precisely recalling, describing and quantifying the intake of foods and beverages consumed in the 24-hour period prior to, or during the day before the interview, from the first intake in the morning until the last foods or beverages consumed at night (before going to bed or later, in the case of those who got up at midnight and ate and/or drank something).

3.8.2.2 Determination of Minimum dietary diversity for women of reproductive ages (MDD-W)

Dietary diversity was determined following the FAO/FHI360 (2016) protocol for determining minimum dietary diversity for women of reproductive ages. This was based on the information derived from the 24-hour dietary recall. The 24-hour dietary recall record from each pregnant woman was used to assess the number of different food eaten by respondents. The foods were grouped into 10 main groupings as follows: Grains, tubers and white roots and plantains, Pulses (lentils, peas and beans), Nuts and seeds, Dairy, Poultry, fish and meat, Eggs, Dark green leafy vegetables, Other Vitamin A-rich fruits and

vegetables, Other vegetables, Other fruits. A score of one was recorded as food consumed by pregnant woman from a particular food group and zero as food not consumed.

3.9 Laboratory procedures

The blood haemoglobin concentration was measured using a HemoCue HB 301 (HemoCue AB, Sweden) analyzer instrument designed for the measurement of haemoglobin concentration. A Blood sample of 10 μ L was obtained from eligible participants by finger pricking using a lancet and sample blood was put into the HemoCue HB analyzer for reading results.

3.10 Ethical considerations

3.10.1 Ethical clearance

Ethical approval was obtained from the Ethics and Protocol Review Committee of the College of Health Sciences, University of Ghana and from the University of Liberia Institutional Review Board.

3.10.2 Permission and Informed consent

Permission was sought from the management of the health facilities where the study was carried out. Pregnant women recruited into the study provided consent after they were provided with information about the study.

3.11 Data Management/ confidentiality

During the individual interviews, privacy was ensured, and questionnaires were kept away from unauthorized persons. Data collected was kept confidential and only accessible to the investigator. Participants were assigned codes to conceal their identity from unauthorized

individuals. The data on questionnaires and laboratory analysis were transferred into a statistical software and password protected. Printed of the questionnaires and laboratory reports were kept under lock and key to guard them from unauthorized individuals.

3.12 Data Capture and Analysis

Data from the questionnaires was coded and in putted into Statistical Package for the Social Sciences (SPSS) and analyzed.

3.12.1 MDD-W determination

MDD-W was determined by awarding a score of 1 when a food was consumed from a food group and zero when the food was not consumed. Each individual was expected to attain a maximum score of 10 and a minimum score of 0 that is if no food had been consumed over the 24hour period. The total score ≥ 5 was graded as good dietary diversity and < 5 was graded as poor dietary diversity among the respondents (FAO, 2016; Custodio, et al., 2020).

3.12.2 Biochemical analysis

The World Health Organisation (2011) recommended serum concentration classification was used to classify the anaemia category of the pregnant women as follows:

Classification	Hemoglobin range
Normal	≥ 11 g/dL
Mild	10.0 - 10.9 g/dL
Moderate	7.0 - 9.9 g/dL
Severe	< 7.0 g/dL

3.13 Statistical Analysis

The Statistical Packages for Social Sciences (SPSS) version 23 software was used for analysis. Descriptive statistics such as percentages, means and standard deviation was applied to analyze data. Pearson's chi squared test was used to test for association between demographic characteristics and anaemia prevalence as well as dietary diversity status. T-test was used to test for the differences in means of haemoglobin concentrations and dietary diversity between the trimesters of pregnancies and between the two counties.

CHAPTER FOUR

4.0 RESULTS

4.1 Background Characteristics of pregnant women

The background characteristics of the pregnant women are described in table 4.1. The survey interviewed 139 pregnant women in three health facilities. The mean age was 24 (7.0) years. Most of the pregnant women were Christians (72.7%). More than one-third (35.3 %) were without formal education. Also, about one third were married (33.8%). The average household size was 5.3. Most of the pregnant women were petty traders. Nearly all the respondents in Grand Cape Mount (92.3%) were petty traders compared to those in Margibi County (71.3%). The findings show 41% earned between US\$ 25-50 a month. About 45% were within the third trimester of their pregnancy.

4.2 Minimum Dietary Diversity (MDD-W) among Pregnant Women by food consumption.

Figures 4.1, 4.2 and 4.3 show the consumption of food according to the food groups by the pregnant women in Margibi County, Grand Cape Mount and the 2 counties combined respectively. The highest consumption was in the grains, tubers, roots and vegetables group. More than 98% consumption were observed in all counties. Poor consumption was seen in the nuts and seeds as well as the other fruits group in the counties. At least, close to 90% ate from the meat group. However, consumption from the egg group was very low: 28.7% in Margibi and 7.7% in Grand Cape Mount. In general, more than half (63.3%) consumed green leafy vegetables.

Table 4.1: Background Characteristics of Pregnant women (N=139)

Variable	Margibi (n=87)	Grand Cape Mount (n=52)	Total (N=139)
Age (years)			
Mean (SD)	24.0 (7.0)	24.0 (6.0)	24.0 (7.0)
Range	17-31	17-31	17-31
Religion			
Christian	81 (93.1)	20 (38.5)	101 (72.7)
Muslim	6 (6.9)	32 (61.5)	38 (27.3)
Education			
None	18 (20.7)	31 (59.6)	49 (35.3)
Primary	26 (29.9)	17 (32.7)	43 (30.9)
Secondary	31 (35.6)	4 (7.7)	35 (25.2)
High school Graduate	8 (9.2)	0 (0.0)	8 (5.8)
Some college education	1 (1.1)	0 (0.0)	1 (0.7)
Graduate degree	1 (1.1)	0 (0.0)	1 (0.7)
Other specify	2 (2.3)	0 (0.0)	2 (1.4)
Marital status			
Single	34 (39.1)	10 (19.2)	44 (31.7)
Married	16 (18.4)	31 (59.6)	47 (33.8)
Co-Habitation	37 (42.5)	11 (21.2)	48 (34.5)
Household size			
1	2 (2.3)	0 (0.0)	2 (1.4)
2	11 (12.6)	0 (0.0)	11 (7.9)
3	11 (12.6)	6 (11.5)	17 (12.2)
4	10 (11.5)	1 (1.9)	11 (7.9)
5	11 (12.6)	11 (21.2)	22 (15.8)
6	16 (18.4)	14 (26.9)	30 (21.6)
7+	26 (29.9)	20 (38.5)	46 (33.1)
Average Household size	4.9	5.8	5.3
Occupation status			
Teacher	3 (3.4)	1 (1.9)	4 (2.9)
Petty trader	62 (71.3)	48 (92.3)	110 (79.1)
Other	0 (0.0)	3 (5.8)	3 (2.2)
Not working	22 (25.3)	0 (0.0)	22 (15.8)
Income (\$ USD)			
No income	25 (28.7)	0 (0.0)	25 (18.0)
<25	25(28.7)	32 (61.5)	57 (41.0)
25-50	21 (24.1)	19 (36.5)	40 (28.8)
51-100	11 (12.6)	0 (0.0)	11 (7.9)
101-150	0 (0.0)	1 (1.9)	1 (0.7)
151-200	(4.6)	0 (0.0)	4 (2.9)
>200	1 (1.1)	0 (0.0)	1 (0.7)
Gestational Age			
0- 12 weeks: First trimester	14(16.1)	11(21.2)	25(18.0)
13-28 weeks: Second trimester	40(46.0)	12(23.1)	52(37.4)
29-40 weeks: Third trimester	33(37.9)	29(55.8)	62(44.6)

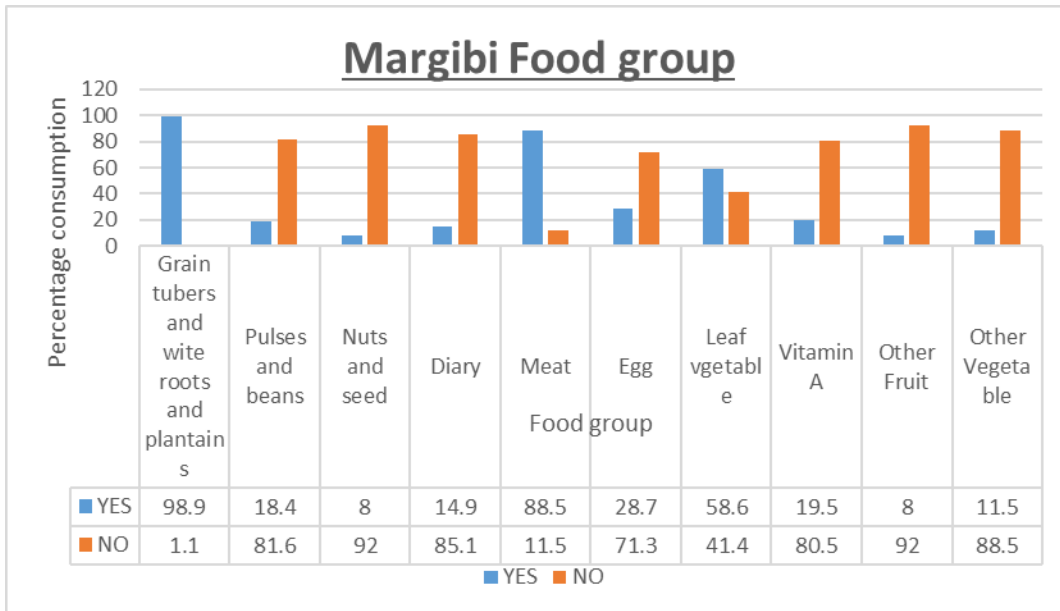


Figure 4.1 Percentage of Consumption from food groups (Margibi Count)

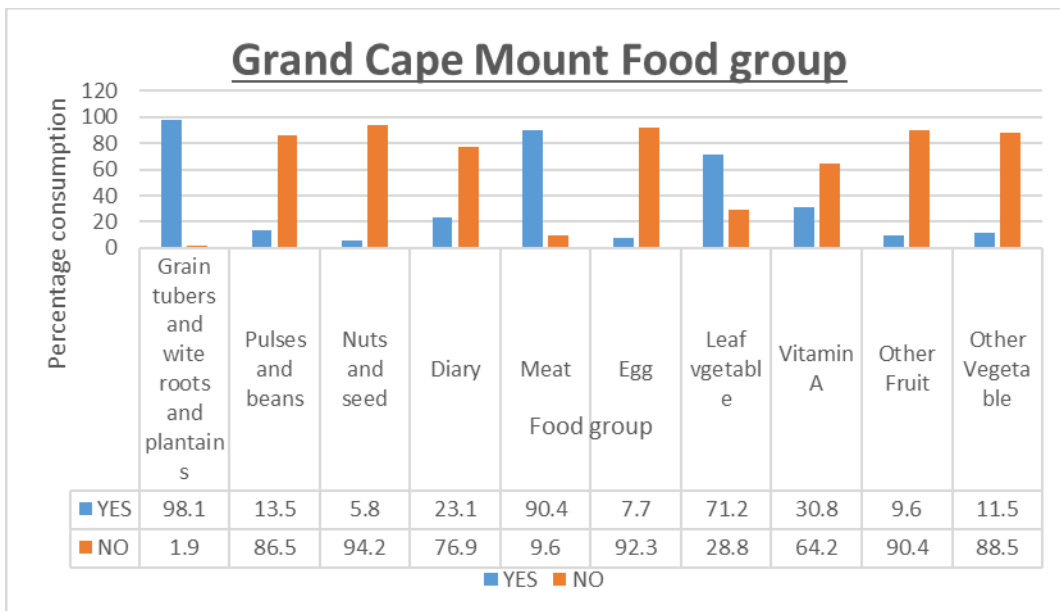


Figure 4.2 Percentage of Consumption from food groups (Grand Cape Mount County)

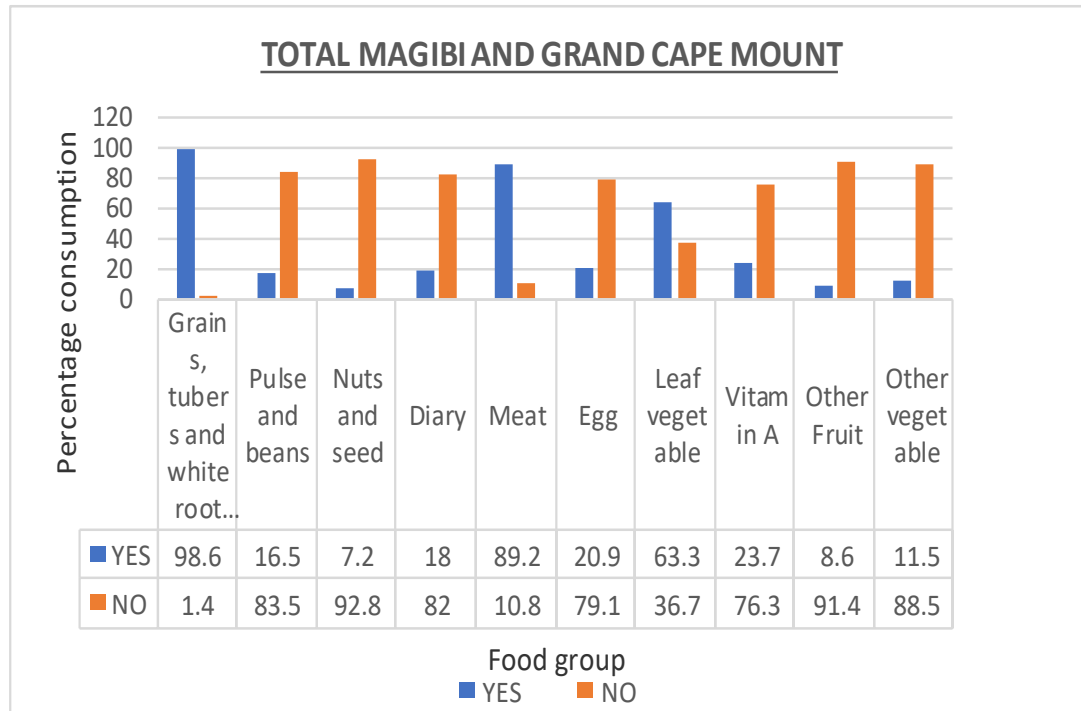


Figure 1.3 Percentage of Consumption from food groups (TOTAL)

4.3 Minimum Dietary Diversity Scores (MDD-W) of Pregnant Women

Table 4.2 shows the mean minimum dietary diversity score (MDD-W) of the women. The mean score was 3.56 (1.00) for both counties combined and 3.55 (0.96) for Margibi County and 3.58 (1.09) in Grand Cape Mount County. The results indicate a mean score less than 5 for both counties. There was no significant difference between the mean scores.

Table 4.2: Mean dietary diversity score of Pregnant women (N=139)

	Margibi	Grand Cape	Total	P-value
	(n=87)	Mount (52)		
Dietary Diversity Score	3.55 ± 0.96	3.58 ± 1.09	3.56 ± 1.00	0.452

Significant at P<0.05.

The Mean DDS was 3.36 (0.81) among first trimester and 3.48 (1.18) in third trimester for both counties. Furthermore, the DDS was 3.3 (1.1) among third trimester and 3.5 (0.76) in first trimester in Margibi County. DDS was 3.18 (0.87) and 3.69 (1.26) in the first and third trimesters respectively in Grand Cape Mount County. (Table 4.3).

Table 4.3: Minimum Dietary Diversity Score and pregnancy status by selected Counties (N=139)

Trimester of pregnancy	County		
	Margibi (n=87)	Grand Cape Mount (n=52)	Total (N=139)
	Dietary Diversity	Dietary Diversity	Dietary Diversity
	Mean (SD)	Mean (SD)	Mean (SD)
0- 12 weeks: First trimester	3.5 (0.76)	3.18 (0.87)	3.36 (0.81)
13-28 weeks: Second trimester	3.78 (0.86)	3.75 (0.75)	3.77 (0.83)
29-40 weeks: Third trimester	3.3 (1.1)	3.69 (1.26)	3.48 (1.18)
Total	3.55 (0.96)	3.6 (1.09)	3.57 (1.01)

Figure 4.4 shows the percentage who had good diversity and those with poor diversity. For the total population, 83.5 had poor diversity. Poor diversity in Margibi (85.1) was higher than in Grand Cape Mount (80.8).

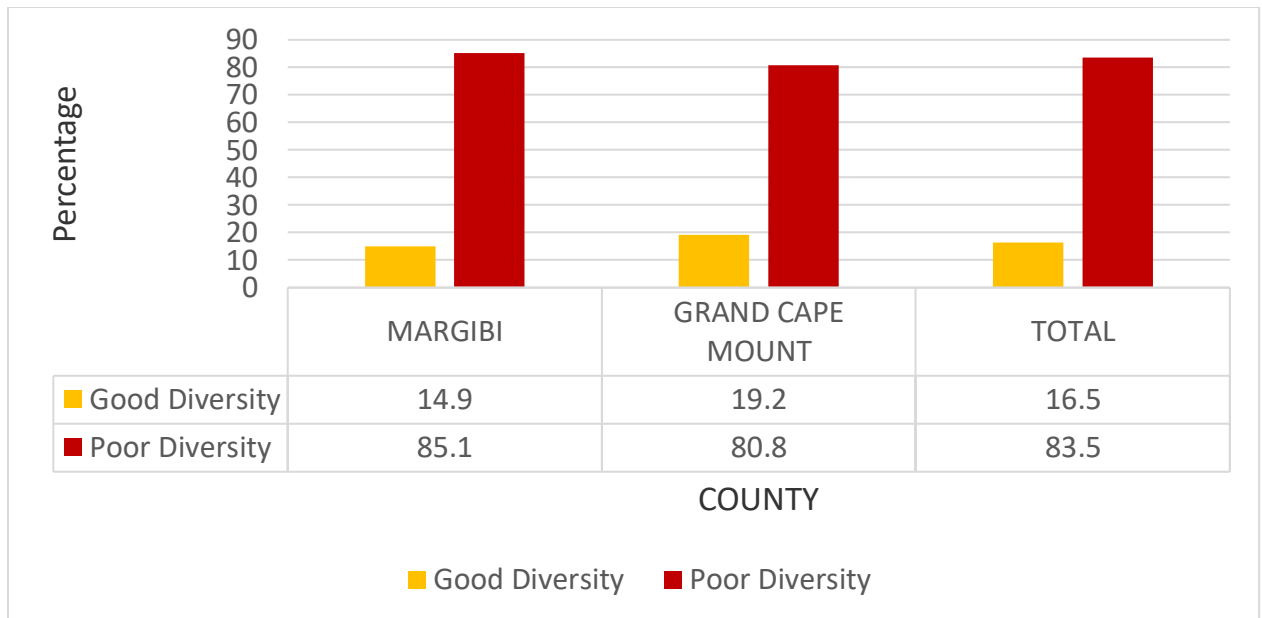


Figure 4.4 Percentage with good and poor dietary diversity

4.4 Minimum Dietary Diversity Scores and pregnancy status

Dietary diversity scores were compared with trimester of pregnancy (Figure 4.5, 4.6, 4.7). The results revealed that poor dietary diversity was prevalent in all the trimesters. However, it seemed poor diversity was slightly higher in the first trimester in all counties than the other trimesters.

4.5 Other Dietary practice during pregnancy

Figure 4.8, 4.9, and 4.10 describes dietary practices such as alcohol consumption, supplement intake and eating outside the home. Overall, Alcohol consumption during pregnancy was over 70%. Intake of supplement was also low (36%).

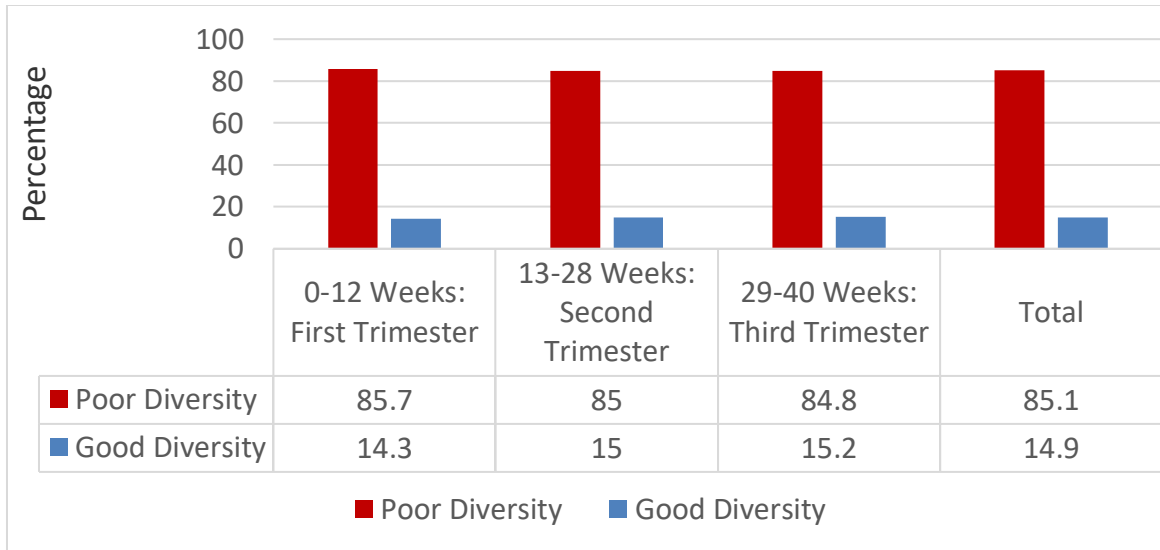


Figure 4.5 Minimum Dietary Diversity Scores according to trimester of pregnancy in Margibi County

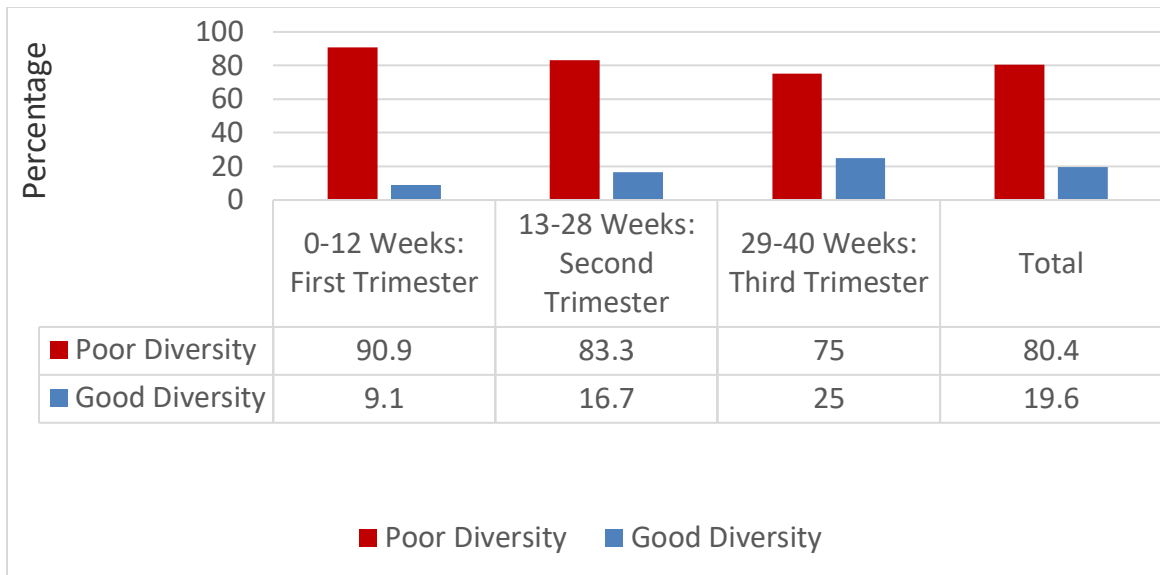


Figure 4.6 Minimum Dietary Diversity Scores according to trimester of pregnancy in Grand Cape Mount County

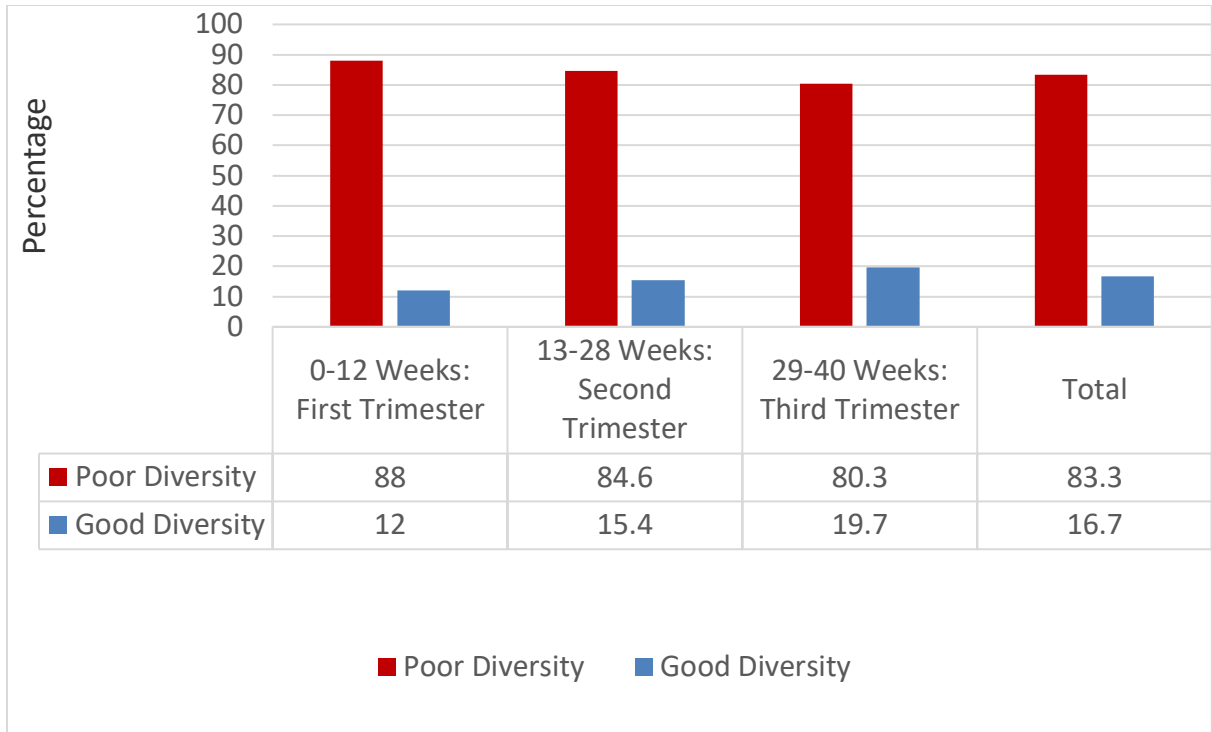


Figure 4.7 Minimum Dietary Diversity Scores according to trimester of pregnancy in both Counties

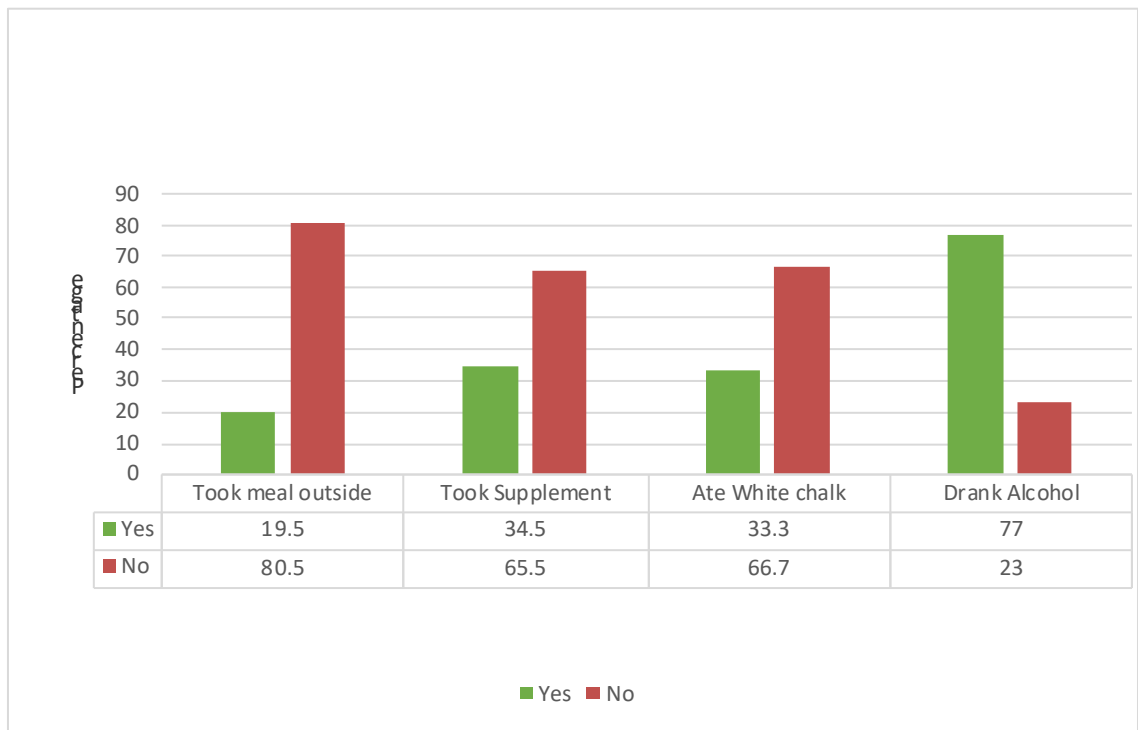


Figure 4.8 Other dietary practices (Margibi County)

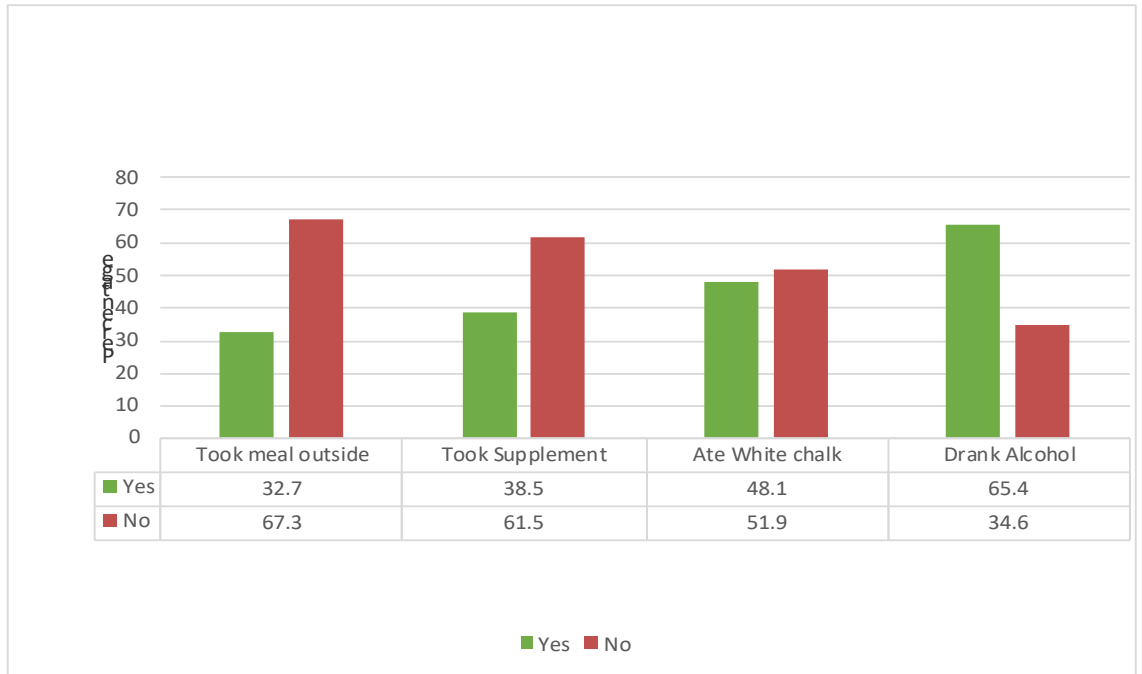


Figure 4.9 Percent of pregnant women and Dietary Practices in Grand Cape County

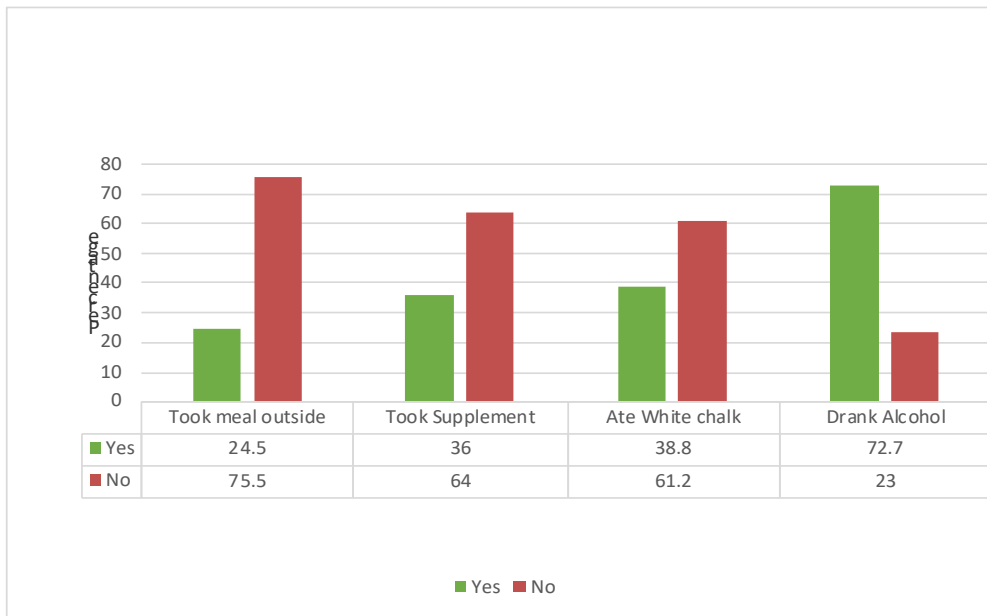


Figure 4.10 Percent of pregnant women and Dietary Practices in both Counties

4.6 Anaemia status of the pregnant women

The anaemia status of the pregnant women is described in table 4.4. The mean hemoglobin was 10.44 (1.46) g/dl. In addition, 54% were anaemic based on WHO haemoglobin level classification of anaemia. Anaemia was more prevalent in Margibi (59.8%) than in Grand Cape Mount (44.2%).

Table 4.4: Percent distribution of pregnant women by anaemic status in selected counties (N=139)

	Margibi N (%) (n= 87)	Grand Cape Mount N (%) (n=52)	Total N (%)	P-value N (%)
Mean \pm SD (Hb) (g/dl)	10.44 \pm 1.39	10.43 \pm 1.58	10.44 \pm 1.46	0.351
Normal	35 (40.2)	29 (55.8)	64 (46.0)	
Mild	23 (44.2)	9 (39.1)	32 (42.7)	
Moderate	26 (50.0)	10 (43.5)	36(48.0)	
Severe	3 (5.8)	4 (17.4)	7 (9.3)	
Total anaemia	52 (59.8)	23 (44.2)	75 (54)	

*Significant at P <0.05

** The percent distribution of anaemic status, mild, moderate and severe was determined in relation to total anaemic.

4.7 Hemoglobin Status of Pregnant Women by Selected Counties

Anaemia status according to trimester is described in table 4.6. Anaemia was more prevalent in the first trimester in Grand Cape Mount (54.5%) as compared to Margibi (42.9%). However, in the second (60%) and third (66.7%) trimesters, anaemia was higher in Margibi County as compared to Grand Cape Mount (41.7 and 41.4 respectively).

Table 4.5: Anaemia severity according to trimester of pregnancy (N=139)

Hemoglobin status	Margibi			Grand Cape Mount			Total		
	1 st Trimester	2 nd Trimester	3 rd Trimester	1 st Trimester	2 nd Trimester	3 rd Trimester	1 st Trimester	2 nd Trimester	3 rd Trimester
Normal ($\geq 11.0\text{g/dl}$)	8 (57.1)	16 (40.0)	11 (33.3)	5 (45.5)	7 (58.3)	17 (58.6)	13 (52.0)	23 (44.2)	28 (45.2)
Mild anaemia (10.0-10.9g/dl)	2 (14.3)	10 (25.0)	11 (33.3)	3 (27.3)	2 (16.7)	4 (13.8)	5 (20.0)	12 (23.1)	15 (24.2)
Moderate anaemia (7.0-9.9g/dl)	4 (28.6)	11 (27.5)	11 (33.3)	2 (18.2)	2 (16.7)	6 (20.7)	6 (24.0)	13 (25.0)	17 (27.4)
Severe anaemia ($< 7.0\text{g/dl}$)	0 (0.0)	3 (7.5)	0 (0.0)	1 (9.1)	1 (8.3)	2 (6.9)	1(4.0)	4 (7.7)	2 (3.2)
Total anaemia	6 (42.9)	24 (60.0)	22 (66.7)	6 (54.5)	5 (41.7)	12 (41.4)	12 (48.0)	29 (55.8)	34 (54.8)
Mean (SD)	10.12(1.03)	9.77(1.00)	9.63(0.99)	9.88(1.04)	10.1(0.97)	10.15(1.03)	10.02 (0.99)	9.86 (0.99)	9.88 (0.99)

The association between anaemia and dietary diversity is shown in table 4.6. No significant association was observed between anaemia and dietary diversity ($p= 0.327$)

Table 4.6: Association between anaemia and dietary diversity (N=139)

Hemoglobin Status	Margibi n (%)		Grand Cape Mount n (%)		Total N (%)		p-value
	Poor	Good	Poor	Good	Poor	Good	
Normal	27 (77.1)	8 (22.9)	24 (82.8)	5 (17.2)	51 (79.7)	13 (20.3)	0.327
Mild	22 (95.7)	1(4.3)	6 (75.0)	2 (25.0)	28 (90.3)	3 (9.7)	
Moderate	22 (84.6)	4 (15.4)	7 (70.0)	3 (30.0)	29 (80.6)	7 (19.4)	
Severe	3 (100)	0 (0.0)	4 (100)	0 (0.0)	7 (100)	0 (0.0)	
Total Anaemia	47 (90.4)	5 (9.6)	17 (77.3)	5 (22.7)	64 (86.5)	10 (13.5)	

***chi-squared test, Significant at $P<0.05$**

CHAPTER FIVE

5.0 DISCUSSION

Anaemia is a serious global health public problem among pregnant women and associated with maternal health and healthy development of the foetus. The aim of the study was to assess the anaemia status of pregnant women in the selected areas in Margibi and Grand Cape Mount Counties in Liberia which was then related to their dietary diversity. This study is essential as it addresses some present knowledge and research gaps in the condition of pregnant women in Liberia.

5.1 Dietary Diversity among Pregnant Women

The study shows that 98% of the pregnant women from both counties consumed food from groups containing grains, tubers, roots, 90% meat and 63.3% green leafy vegetables with poor consumption from the nuts, dairy, eggs as well as the other fruits groups. The findings from this study agree with findings from Burkina Faso where 98.6 % of pregnant women were found to have consumed from the grain, cereal, tubers and roots group (Becquey and Martin-Preveal 2009). Also, Abebe et al., (2008), revealed that rice, maize, millet and corn were highly consumed among pregnant women in Ethiopia. In Kenya, 98.4% of women consumed cereals compared to 20.1% who ate from the meat, poultry and fish food group (Kobiro et al., 2018). In the present study, consumption from the meat, poultry and fish group was also reported to be low. This is consistent with findings among Burkinabe women where the diet was reported to lack or contains low amounts of animal products, vitamin A, C and other vegetables (Becquey and Martin-Prevel, 2009). This current study also supports with other findings from other sub-Saharan African countries where the

absence or insufficient intake of minerals and vitamins (Iron, Vitamin A and Zinc) in the dietary intake were reported to be relatively low (Chakona & Shackleton, 2017).

Most pregnant women in Liberia are affected by food security owing to their occupation and low socioeconomic status. This is because food intake is based on their low income thus making them food insecure. In Liberia, the population of 2.2 million or 50.9% of the people is classified as poor and 51.2% of households suffer from food shortages (LISGIS, 2016).

Micronutrients plays an essential role in health and contributes to the immune system and antibodies during pregnancy (Hassan, et al., 2014). The limited consumption of micronutrients decreases the concentration of iron that has been reserved for the foetus (Gambling, Kennedy & McArdle, 2011). The deficiency of these micronutrients in pregnant women's diet has an adverse effect on the outcomes for both the mother and the foetus. Low concentrations of red blood cells leads to risk of maternal mortality, perinatal mortality, low birth weight and neural tube defects (NTD) (Haider 2010; Christian 2010; Kalaivani, 2009; De-Regil, 2015). Additionally there is increased risk of mental retardation, restriction of fetal growth and small-for - gestational age (SGA) in the infant. For the pregnant mother, hypertension, preeclampsia, increased risk of premature delivery, and perinatal mortality could occur (Ogundipe et al., 2012; De-Regil 2015).

5.2 Minimum Dietary Diversity Score (MDD-W) of Pregnant Women

A MDD-W of 5 or more is indicative of good diversity in the diet. The result of this study showed that the mean MDD-W was 3.56 (1.00). This result is similar to the mean score of 3.68 (2.10) in Northwest Ethiopia (Yenebat et al, 2019) but lower compared to 4.2 (1.5) in Northern Ghana (Saaka, et al, 2017). A high percentage (83%) of the pregnant women had

poor dietary diversity. This is comparable to reports from Oromiya region of western Ethiopia where 74.6% of pregnant women reported poor dietary diversity (Desta et al, 2019).

According to Moursi (2008) and Arimond et al., (2010), good dietary diversity is indicative of good micronutrient status. Therefore, it is worrying that many of the pregnant women could not attain good dietary diversity status. Poor dietary intake among pregnant women is one of the serious problems among vulnerable communities resulting in different types of nutritional deficiencies that can lead to intrauterine growth retardations. Monotonous diets, cereal-based diets lacking diversity and malnutrition increases the risk of obstructed labor (Kiboi, et al 2017; Lander et al 2019; Ekesa et al., 2011).

5.3 Other Dietary Practices during Pregnancy

Geophagia, the practice of eating earth or soil like substances such as white chalk, clay is widespread across the world. This study reported that 38.8% of the pregnant women took soil like substances in the course of the pregnancy. This appears to be lower than reported in Tanzania (63.7%), Ghana (47%) and Nigeria (50-64%) (Myaruhuche, 2009; Ezugwu, et al 2013; Ngozi, 2008; Riang'a, Broerse & Kisaka Nangulu, 2017). According to Hogrey (2018), pica or clay eating is practiced among pregnant adolescent women in Ghana. It is associated with the cause of iron deficiency among pregnant women (Louw, Du Preez, Malan, van Deventer, et al., 2007; Kutalek, Wewalka, Auer, Wilson et al., 2010). Other negative consequences of practicing pica are heavy metal poisoning, especially lead, micronutrient imbalances by binding with ingested food thereby preventing absorption in the small intestines consequently leading to mental retardation as result of poor nutrition.

(Miao, 2015; Young et al., 2010). It also causes severe gastrointestinal difficulties such as constipation and parasitic infestation (Fawcett, 2016; Kelkitli et al., 2016).

A worrying trend that was observed was the rather high prevalence (72.7%) of alcohol consumption among the pregnant women. This is comparable to reports from Ireland (60%). Lower prevalence have been reported in Denmark (46%) Tanzania (34.1 %) Sierra Leone (14.8 %) and in Ghana (20.4 %) (Adusi-Poku et al, 2012; Louw, et al, 2011; Isaksen et al, 2015; Popova, et al, 2016). Such level of consumption of alcohol could lead to poor appetite, diversion of food related resources for alcohol consumption and the associated poor dietary diversity intake which will be detrimental to the health of the mother and the development of the fetus. Studies in James Town, Ghana revealed that alcohol intake lead to abortion and other maternal complications (Dapilma et al., 2017). Alcohol consumption in pregnancy has detrimental effects on the developing fetus. This could lead to miscarriage, stillbirth, and a range of lifelong physical, behavioral, and intellectual disabilities in the foetus. All these disabilities are known as fetal alcohol spectrum disorders (FASDs) (Charness et al., 2018; Kable et al., 2015).

5.4 Hemoglobin Status of Pregnant Women

The present finding reveals that 54% of the pregnant women were anaemic in the selected counties. Hence, this study shows anaemic prevalence higher than the global, Africa and Liberia prevalence of 38.2%, 46.3 %, and 35% respectively (World Health Organization, 2018 USAID, 2018). The figure however falls within the West African range of between 38-62% (WHO, 2016; Harika, Faber, Samuel, Kimiywe, Mulugeta & Eilander, 2017). The result of the present study is also comparable to the findings of Olatunbosoum et al, (2014) among pregnant women in Nigeria (54.6%) and Ethiopia (56.8%) (FAO, FHI360, FANTA,

2016). Additionally, higher prevalence of anaemia has been reported in some other parts of Africa; Uganda (63%), Egypt (62.2%), Benin (68.3%) and Ghana (71.6%) among adolescent girls (Mbule, 2013; Ibriham et al., 2011; Ouedraogo, 2012; Hogrey, 2018). Anaemia in pregnancy has dire consequences. These include low birth weight and both neonatal and maternal mortality, heart complication, neural tube defects, preterm delivery, growth retardation of the unborn baby in the uterus resulting in poor brain development, risk of abortion (McArdle, 2014; Shao et al., 2012).

Additionally, the causes of anaemia among pregnant women in low and middle-income countries include an inadequate or poor dietary intake, infections (such as malaria, HIV, and hookworm infestation) age, parity, educational and socioeconomic status, food insecurity, hygiene conditions and genetic predisposition (Okube et al., 2016). The high prevalence of anaemia among this group of pregnant women can be explained by many factors. The first could be low consumption from the green leafy vegetable and meat/fish and poultry group. Even though the results from the food group consumption indicates a considerable number consuming from these groups, it is likely that the consumption may be inadequate to meet their daily requirements. Inadequate consumption can be attributed to high cost of meat/fish products. According to Chakona and Shackleton (2017) and Hojaji (2015), high cost of meat/fish prevents enough consumption. The World Health Organization recommends that pregnant women take iron and folate supplements to help prevent anaemia (WHO, 2012). A large percentage of the pregnant women were not taking any form of supplements and therefore could also have attributed to the high anaemia prevalence. According to the National Health Plan and Policy, although it is recommended that pregnant women in Liberia be given iron and folate supplements to

prevent anemia and other complications nevertheless, “only two in ten women took iron tablets” (LISGIS 2013). Pregnant women need to be encouraged to take their dietary supplements to prevent anaemia.

Limitation of the study

A 24-hour dietary recall relies mainly on the memory of participants, therefore, this may affect the ability to accurately recall foods that were eaten during the period under investigation.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The consumption of the women is predominantly from the grains, cereals and tubers group, with many showing poor dietary diversity. High prevalence of anaemia (54%) was observed among the pregnant women. In addition, unwholesome social and behavioral practices during pregnancy such as consumption of alcoholic beverages and practice of pica was seen among pregnant women.

6.2 Recommendations

It is necessary to fully implement national policy strategies that will promote the consumption of diversified diet in the communities. The policy will improve quality dietary intake and nutritional status among pregnant women. During pregnancy it is necessary to carry out nutritional screening among pregnant women receiving antenatal care services to recognize those at nutritional risks in time for correction. It is also recommended that education on the danger and risk of alcohol consumption during pregnancy be carried out.

Additionally, further research needs to be done in other counties in Liberia to know the dietary status among the pregnant women. It also recommended for future research to be conducted on dietary diversity, nutritional status and anaemia of HIV infected pregnant women.

Therefore it is imperative to encourage diversity in dietary intake through awareness, and nutrition education. This is to ensure promotion of dietary diversity and behavioral change in the community and health facilities.

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APPENDIX A: LETTER OF INTRODUCTION

Dear respondent

My name is Geetah S. Saydee. I am a Liberian and student at University of Ghana. I am conducting a study on Anemia and Dietary Diversity among pregnant women attending selected health facilities in Margibi and Grand Cape Mount Counties. I will ask you questions about your dietary intake, household and also take some sample of blood from your finger to check your haemoglobin status. The questionnaire usually takes 45-60 minutes. Whatever information you shall provide will be kept strictly confidential and will not be shown to any other persons. Participation in the study is voluntary and you can choose not to answer any individual question or all of the questions.

Thank

Researcher: Geetah S. Saydee

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APPENDIX B: INFORMED CONSENT

Study Procedures

In this study, I will ask you dietary, demographic and socio-economic questions that you will be required to answer as correctly as possible. The questionnaire will take between 4560 minutes to complete. You will then be directed to the laboratory for blood sample collection, needed for determination of haemoglobin levels. A qualified laboratory technician will draw some blood from your finger.

Risks

What are the risks involved in participating in the study?

There are no serious risks involved. The process of drawing blood will have no serious risks to you, however, it will involve pricking your finger with a small needle which may cause little pain and discomfort at the site of the needle prick. Necessary care will be taken to stop the discomfort in a short while within the same day, as minimal as possible, and the laboratory technician will ensure that you have stopped bleeding before letting you go. I will also ask questions on your dietary intakes.

Benefits

Are there any benefits to me for participating in the study?

During this study there are no direct benefits to you for participating. However, the findings from the study may contribute to knowledge on maternal and child health care and may be used in formulating policies that will help improve nutrition status of pregnant women of all communities in the country.

Ethical issues and Confidentiality

Whatever information you shall provide will be kept strictly confidential and will not be shown to any other persons. Participation in the study is voluntary and you can choose not to answer any individual question or all of the questions.

**Ask the participant if they have any questions and address them before they sign the consent form.*

You can contact the Health Research Ethics committee at the addresses provided below if you have any concerns or complaints that have not been adequately addressed by the researcher.

University of Liberia Institutional Review Board

E-mail: Post address:

Ethics and Protocol Review Committee

College of Health Sciences

University of Ghana

Korle-Bu

APPENDIX C: LETTER OF CONSENT

By signing below, I _____ a resident of _____ location, Margibi and Grand Cape Mount Counties, agree to take part in this research study. I hereby declare that:

- I have been informed about the research and I have understood the benefits and the risks involved.
- I have had the chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is voluntary and I have not been pressured to take part in it.
- I may choose to leave the study at any time and that I will not be penalized or prejudiced in any way.
- I have been assured of confidentiality on any information that will be given

Signature /Thumb Print of respondent

Date

Signature of Investigator

Date

Signature /Thumb Print of witness

Date

APPENDIX D: QUESTIONNAIRE SAMPLE

Department of Nutrition and Dietetics, College of Health Sciences, School of
Biomedical and Allied Health Sciences, University of Ghana

Interview schedule

Serial NO _____

Date _____

Dear respondent,

This interview schedule is designed to gather information for a Master of Nutrition and Dietetic (MSc) thesis work and the aim is assessing anemia and dietary diversity among pregnant women in Margibi and Grand Cape Mount Counties. Please answer honestly and all information provided in the process will be treated with great confidentiality. Thank you.

Please fill out the spaces provided, and/or check your appropriate choice for a given item.

County: _____

Name of District: _____

Name of Clan: _____

Name of City: _____

Name of Town: _____

Name of Village: _____ Type of area: { } Urban (1)
Rural (2)

SECTION A: Socio-demographic information

1. Age(years): _____

2. Religion: (a) Christian [] (b) Muslim [] (c) Other []

3. Highest Educational level: (a) None [] (b) Primary [] (c) Secondary [] (d) High school Graduate [] (f) Vocational [] (g) some college education [] (h) graduate degree [] (i) Others (specify) _____

4. Marital status: (a) Single [] (b) Married [] (c) Divorced/Separated [] (d) Widowed/widower [] (e) Co-habitation

5. Household size (no.):

6. Major occupation: (a) Farmer [] (b) Teacher [] (c) Health worker [] (d) petty trader [] (e) Others(specify).....

7. Income/month: (a) <LRD 5,000 [] (b) LRD 5,000- 10,000 [] (c) LRD 10,000-20,000 [] (d) LRD 20,000- 30,000 [] (e) LRD 30,000- 40,000 [] (f) >LRD 40,000 []

8. How old (in weeks) is your pregnancy (gestational age)?

0- 12 weeks: First trimester []

13-28 weeks: Second trimester []

29-40 weeks: Third trimester []

SECTION B: DIETARY DIVERSITY QUESTIONNAIRE *Please describe the foods (meals and snacks) that you ate yesterday during the day and night, whether at home or outside the home. Start with the first food eaten in the morning. Write down all food and drinks mentioned by the respondent. When the respondent has finished, probe for meals and snacks not mentioned. When the respondent recall is complete, fill in the food groups based on the information recorded above. For any food groups not mentioned, ask the respondent if a food item from this group was consumed.*

BREAKFAST	SNACK	LUNCH	SNACK	DINNER	SNACK

Question Number	Food group	Examples	YES=1 NO=0
1.	Grains, tubers and white roots and plantains	bread, noodles (spaghetti), biscuits, cookies or any other foods made from millet, sorghum, maize, rice, wheat, white potatoes, white yams, cassava, or foods made from roots e.g.fufu, farina (gari), dipper, Eddoes, GB, Dumber etc	
2.	Pulses and beans)	Beans,lentils and peas.	
3.	Nuts and seeds	almond, groundnuts, benne seed, ogushi seed	
4.	Diary	milk, cheese, yogurt, ice cream or other milk products	
5.	Meat, poultry, and fish	beef, pork, lamb, goat, rabbit, dog, cat, guinea pig, poultry, meat, organ, birds, fresh and dried fish and shell fish.	
6.	Eggs	Eggs (Chicken, duck, and guinea fowls)	
7.	Dark leafy greens and vegetables	Eddoesleaves, cassava leaves, sweet potatoes leaves, palava sauce, bitter leaves, fever leave, water greens collard greens,	
8.	Other Vitamin A-	other vegetables (e.g. tomato, onion, eggplant), including wild vegetables ripe	

	rich fruits and vegetables	mangoes, dried apricots, dried peaches, pumpkin, carrots, bitterball, kaytaylay, or sweet potatoes that are orange inside + other locally available vitamin Arich fruits (e.g.sweet pepper)	
9.	Other vegetables	Legumes, green beans, tomato, cucumber and okra.	
10.	Other fruits	Other fruits, including wild fruits e.g. orange, apple, tangerine, pawpaw, lemon etc.	
Did you eat anything (meal or snack) OUTSIDE of the home yesterday			
Did you take any food supplement such as multivitamins?			
Did you eat putter (white chalk) / clay since you were pregnant			
Have you drank any alcoholic beverage since you were pregnant			

SECTION C: Laboratory Diagnosis

Series No: _____

HEMOGLOBIN LEVEL (g/dl)	CLASSIFICATION

APPENDIX E: ETHICAL CLEARENCE



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October 25, 2019

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Korle-bu
Accra, Ghana

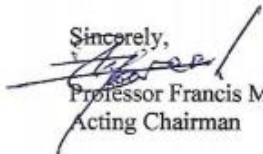
**Subj: Anacmia And Dietary Diversity Among Pregnant Women in Margibi and Grand Cape
Mount Counties, Liberia**

Dear Ms. Saydee:

Per the Policies and Procedures Handbook or the Institutional Review Board (IRB), pages 24-48, the University of Liberia Institutional Review Board approved your research described above through an expedited review on October 18, 2019. As part of its responsibility, the IRB will evaluate the research throughout to ensure adherence to human subject practices. The approval for the research ends November 30, 2020.

During the course of this research, please inform the IRB immediately of any changes or occurrences in the procedures relating to human subjects. Apart from the protection of human subjects, you are prohibited from changes in the protocol that has been approved by the IRB. All changes must be communicated to the IRB without delay.

Sincerely,


Professor Francis Manweah
Acting Chairman

Email: franmaweah@yahoo.com
Phone (+231)886517382



UNIVERSITY OF GHANA COLLEGE OF HEALTH SCIENCES

ETHICAL AND PROTOCOL REVIEW COMMITTEE

Ref. No.: EPRC/SEPT/2020

September 30, 2020

Ms. Geetah Slamie Saydee
Dept. of Nutrition and Dietetics
School of Biomedical and Allied Health Sciences

ETHICAL CLEARANCE

Protocol Identification Number: CHS-Et/M.1 –5.8/2020-2021

FWA: 000185779

IORG: 0005170

IRB: 00006220

The College of Health Sciences Ethical and Protocol Review Committee (EPRC) on September 24, 2020 reviewed and approved your research protocol.

Title of Protocol: "Anaemia and dietary diversity among pregnant women in Margibi and Grand Cape Mount Counties, Liberia"

Principal Investigator: Ms. **Geetah Slamie Saydee**

This approval requires that you submit six-monthly review report(s) of the study to the Committee and a final full review report to the EPRC at the completion of the study. The Committee may observe, or cause to be observed, procedures and records of the study before, during and after implementation.

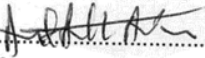
Please note that any significant modification(s) to this project/study must be submitted to the Committee for review and approval before its implementation.

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

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

This ethical clearance is valid until September 30, 2021.

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

Signed: 

Professor Andrew Anthony Adjei

Chair, Ethical and Protocol Review Committee

cc: **Provost, CHS**
Dean, SBAHHS
Head, Nutrition and Dietetics

APPENDIX F: LETTER TO HEALTH FACILITIES



UNIVERSITY OF GHANA
DEPARTMENT OF NUTRITION AND DIETETICS
SCHOOL OF BIOMEDICAL AND ALLIED HEALTH SCIENCES

Ref. No.:

P .O. Box KB 143
Korle-Bu
Accra

27th November, 2019

The Hospital Medical Director
C.H Rennie Government Hospital
KaKata City
Margibi Country, Liberia

Dear Sir/Madam,

LETTER OF INTRODUCTION- MS. GEETAH S. SAYDEE

The above named person is a final year MSc student of the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, University of Ghana, who is carrying out a study on the topic: “**Anaemia and Dietary Diversity among Pregnant Women in Margibi and Grand Cape Mount Countries, Liberia**”

This is in partial fulfilment of the requirements for the award of Master of Sciences Degree in Dietetics at the University of Ghana, School of Biomedical and Allied Health Sciences. As part of the academic requirements, she is required to carry out a research project in the final year.


Permission is being sought for her to collect data from your hospital from 18th February, 2020 to 31st March, 2020.

I would be grateful if you could give her the necessary assistance. Please do not hesitate to contact me for any further information.

Attached is a copy of the ethical approval letter and a participant information sheet for the study.

Thank you.

Yours faithfully,


Matilda Asante Ph.D, RD.
Head of Department



UNIVERSITY OF GHANA
DEPARTMENT OF NUTRITION AND DIETETICS
SCHOOL OF BIOMEDICAL AND ALLIED HEALTH SCIENCES

Ref. No.:

P .O. Box KB 143
Korle-Bu
Accra

27th November, 2019

The Medical Director
Sinji Health Center
Sinji, Grand Cape Mount Country
Liberia

Dear Sir/Madam,

LETTER OF INTRODUCTION- MS. GEETAH S. SAYDEE

The above named person is a final year MSc student of the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, University of Ghana, who is carrying out a study on the topic: **“Anaemia and Dietary Diversity among Pregnant Women in Margibi and Grand Cape Mount Countries, Liberia”**

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Matilda Asante Ph.D, RD.
Head of Department



UNIVERSITY OF GHANA
DEPARTMENT OF NUTRITION AND DIETETICS
SCHOOL OF BIOMEDICAL AND ALLIED HEALTH SCIENCES

Ref. No.:

P .O. Box KB 143
Korle-Bu
Accra

27th November, 2019

The Hospital Medical Director
St. Timothy's Government Hospital
Robertsport City
Grand Cape Mount Country
Liberia

Dear Sir/Madam,

LETTER OF INTRODUCTION- MS. GEETAH S. SAYDEE

The above named person is a final year MSc student of the Department of Nutrition and Dietetics, School of Biomedical and Allied Health Sciences, University of Ghana, who is carrying out a study on the topic: **"Anaemia and Dietary Diversity among Pregnant Women in Margibi and Grand Cape Mount Countries, Liberia"**

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