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Anaemia and Dietary Diversity among Pregnant Women in Margibi and Grand Cape Mount Counties, Liberia

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Abstract

Background: Globally, anaemia remains a severe public health concern among women of reproductive ages, including pregnant women in developing countries such as Liberia. Poor dietary diversity is a major contributor to micronutrient deficiencies. However, there is limited documentation of anaemia prevalence and dietary diversity among pregnant women in Liberia.

Objective: The present study assessed the prevalence of anaemia and dietary diversity among pregnant women in the Margibi and Grand Cape Mount Counties in Liberia.

Methods: The study design was cross-sectional. Systematic sampling was used to recruit 139 pregnant women between 15 - 49 years from antenatal clinics in Margibi and Grand Cape Mount counties. Dietary intake obtained from a 24-hour recall was used to assess dietary diversity following the FAO dietary diversity determination protocol for women in their reproductive ages. Anaemia was determined from blood obtained from finger pricks using a Hemocue.

Results: Nearly all the pregnant women (98.1%) consumed grains. Conversely, only a few women (23.7%) consumed vitamin A-rich fruits and vegetables. Anaemia was discovered in 54% of the pregnant women. The mean haemoglobin level was 10.44 ± 1.46 g/dl. The mean Minimum Dietary Diversity among women of reproductive age (MDD-W) was 3.57 ± 1.01. There was no significant association between anaemia and dietary diversity among 12 pregnant women. Poor dietary diversity was observed in 83.5% of the pregnant women, 85.1% in Margibi and 80.8% in Grand Cape Mount, respectively.

Conclusion: This study confirms evidence of anaemia and poor dietary diversity among pregnant women. It highlights evidence for the need to encourage and improve diversity in dietary intake. This can be achieved through awareness, education and knowledge of dietary diversity during pregnancy.

Keywords: Anaemia, Dietary diversity, Pregnancy, Liberia

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INTRODUCTION

Anaemia remains a serious public health problem across different age groupings [1], affecting infants and women of reproductive ages the most, with serious complications in pregnancy, both in developed and developing nations [2]. Maternal anaemia and iron deficiency affect approximately 500 million women of reproductive age [3], with about 75% of the anaemia in pregnancy attributed to nutritional deficiency [4]. Globally, the prevalence of anaemia in women of childbearing age was 29.9% [5]. The prevalence of anaemia per year in developing countries was estimated at 43% and has resulted in more than 115,000 maternal deaths and 591,000 prenatal deaths [6]. Approximately 56% of pregnant women in low- and middle-income countries (LMICs) suffer from anaemia [7]. The prevalence of anaemia in women of childbearing age (15-49 years) and pregnant women in Liberia has been

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reported to be 42.6% and 49.7%, respectively [8]. Anaemia is a pregnancy-related complication that contributes to the high maternal mortality rate in Liberia [9]. Maternal deaths in Liberia increased from 578 per 100,000 live births in 2000 to 1,072 deaths per 100,000 live births in 2013. The maternal mortality ratio (MMR) in Liberia for the seven years before the 2019-2020 Liberia Demographic and Health Survey (LDHS) was estimated at 742 maternal deaths per 100,000 live births. The confidence interval ranged from 485-1,000 deaths per 100,000 live births [10].

Liberia is challenged with food insecurity, with as much as 32% of the population classified as moderately or severely food insecure. According to the Liberia Chronic Food Insecurity report, the majority of the population in all counties consumes a diet of inadequate quality. The highest deficits in severity and quality of dietary diversity were recorded in Lofa, Bong, Nimba, and Rivercess and lowest in Greater Monrovia and Grand Cape Mount. Factors attributed to the lack of good dietary quality included poor incomes, constrained access to a diverse array of foods, and limited knowledge about the importance of dietary diversity. The Famine Early Warning Systems Network (FEWS NET) classified Liberia as moderately food insecure [11]. Dietary diversity successfully measures the diversity of the diet of an individual [12]. Studies have shown that the diets of pregnant women are mainly repetitive and generally lack diversity [13]. Eating diverse foods is an internationally accepted recommendation for a healthy diet because it promotes the quality health status of the mother and child, with positive health outcomes such as a reduced incidence of maternal and child mortality [14]. In Mozambique (rural), Burkina Faso (urban), Bangladesh (rural), the Philippines (urban/peri-urban) and Mali (urban), the dietary diversity score was used as a good indicator for assessing micronutrient adequacy [15]. Although there are some national policies to prevent and treat anaemia during pregnancy, such as iron supplementation and proper dietary intake, the prevalence of anaemia in most parts of the world remains a global health challenge [1]. It is also observed that adequate information on the micronutrient status of women of reproductive ages, particularly in Liberia, is lacking. Information on the magnitude and characteristics of dietary diversity and anaemia among pregnant women is inadequate and almost nonexistent in published public health records.

MATERIALS AND METHODS

Study design and sites

A cross-sectional study design was employed in this study in three locations in Liberia: two Ministry of Health antenatal health facilities, Charles Henry (C. H) Rennie and St. Timothy Government Hospitals in Margibi and Grand Cape Mount Counties and a primary health services centre in Grand Cape County. These locations were purposefully chosen because of the high prevalence of poverty and the fact that the hospitals are major referral centres for the healthcare of the populace [16]. The C. H. Rennie Government Hospital is located in the urban city of Kakata, the sixth most populated in Liberia, whereas the St. Timothy Government Hospital is located in the urban city of Robertsport. Both hospitals are secondary health facilities and the only public referral hospitals in the counties, with 50 beds each [16]. The primary health services centre, Sinje, provides outpatient and antenatal care services for major complicated cases.

Sample size and selection

A total of 139 apparently healthy pregnant women aged 15 - 49 years who attended ante-natal care services at all three selected health facilities were included in this study. The sample size was determined using the Cochrane formula (1963).

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

Where n is the minimal sample size, Z is the confidence interval constant at 1.96, P = 0.09 representing the estimated proportion of pregnant women aged 15 - 49 years in the population in Margibi and Grand Cape Mount Counties and Se representing the standard error of 0.05. The calculated sample size determined was 126. However, 10% of the sample size was added to arrive at 139 to cater for the non-response rate. Based on the different populations of the two counties, weighting was used to obtain sample sizes of 87 and 52 for Margibi and Grand Cape Mount, respectively. Any other woman who attended the health facilities for reasons other than antenatal care was excluded from this study.

Data collection, tools and procedure

At each of the antenatal clinics, eligible pregnant women were recruited using the systematic sampling technique. Starting from the first pregnant woman who reported to the antenatal clinic for a particular day, every other pregnant woman was approached to participate in the study. Those who were eligible and consented to participate were recruited until the target sample size was reached. Data were collected through interviewer-administered questionnaires and biological samples for biochemical tests performed by qualified laboratory scientists. The data collected included sociodemographic, dietary and laboratory determinations of haemoglobin status. Structured questionnaires were used to obtain information on the sociodemographic characteristics of the participants. A 24-hour recall was used to obtain information on dietary intake and subsequently used to determine the dietary diversity score of each participant following the protocol [17] for determining the minimum dietary diversity for women of reproductive ages (MDD-W). The pregnant women were aided with household measures and food models to recall foods they had taken over the past 24 hours. The method consisted of precisely recalling, describing and quantifying the intake of foods and beverages consumed in the 24-hour period prior to the day of 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). The 24-hour dietary recall record from each pregnant woman was used to assess the number of different foods eaten by respondents. The foods were entered into ten 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, and other fruits. A score of one was recorded as food consumed by a pregnant woman from a particular food group, and zero was recorded as food not consumed. Blood haemoglobin concentration was measured using a HemoCue HB 301 (HemoCue AB, Sweden) analyser designed to measure haemoglobin concentration. Ten µL of blood obtained from a finger prick was quickly put into the HemoCue HB analyser, and the haemoglobin concentration was read from the digital screen. Haemoglobin concentrations were determined based on the recommended serum concentration classification [18] for anaemia status in pregnant women (Table 1).

Table 1: Serum concentration classification

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

Maternal dietary diversity for reproductive women (MDD-W) was determined by awarding a score of 1 when 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 if no food had been consumed over the 24 hours. A total score of ≥ 5 was graded as good dietary diversity and < 5 as poor dietary diversity among participants [19].

Data analysis
Data were analysed using Statistical Package for the Social Sciences (SPSS 23.0). For descriptive statistics, data were transformed into percentages, means and standard deviations. Pearson's chi-squared test was used to assess the association between demographic characteristics and anaemia prevalence as well as dietary diversity status. The Mann-Whitney test was used to examine the differences in means of haemoglobin concentrations and dietary diversity between the two counties (Margibi and Grand Cape Mount), while one-way ANOVA was used to test for differences according to trimester of pregnancy.

RESULTS

Background characteristics of pregnant women
One hundred thirty-nine (139) pregnant women from three health facilities in two counties were recruited. The mean age for the participants was 24 years. Most of the pregnant women were Christians (72.7%). More than one-third (35.3%) were without formal education. The average household size was 5.3, with most of the pregnant women being petty traders. About 40% of the participants earn between $25 to $50 a month. Approximately 45% were within the third trimester of their pregnancy (Table 2).

Anaemia status of pregnant women
The distribution of pregnant women by anaemic status is described in Table 3. The mean haemoglobin was 10.44 (1.46) g/dl, with no significant difference between counties. In addition, 54% were anaemic based on the WHO haemoglobin level classification of anaemia. Anaemia was

Table 2: Background characteristics of pregnant women

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)	8 (5.8)	
Some college education	1 (1.1)	1 (0.7)	
Graduate degree	1 (1.1)	0 (0.0)	1 (0.7)
Other	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			
1-3	24 (27.5)	6 (11.5)	30 (21.5)
4-6	37 (42.5)	26 (50.0)	63 (45.3)
7+	26 (29.9)	20 (38.5)	46 (33.1)
Average household size	4.9	5.8	5.3
Occupation status			
Formal	3 (3.4)	1 (1.9)	4 (2.9
Informal	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 (US $)			
No income	25 (28.7)	0 (0.0)	25 (18.0)
<25	25 (28.7)	32 (61.5)	57 (41.0)
25-100	32 (36.7)	19 (36.5)	51 (36.7)
101-200	0 (0.0)	1(1.9)	5 (3.6)
>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)

Table 2. Percent distribution of pregnant women by anaemic status in selected counties

	Margibi n (%) (n = 87)	Grand Cape Mount. n (%) (n=52)	Total N (%) (N=139)	p-value
Mean ± SD (Hb) (g/dl)	10.44 ± 1.39	10.43 ± 1.58	10.44 ± 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)	

Table 3: Anaemia severity according to trimester of pregnancy

Hemoglobin status	Margibi County			Grand Cape Mount County			Total		
	1st Trimester	2nd Trimester	3rd Trimester	1st Trimester	2nd Trimester	3rd Trimester	1st Trimester	2nd Trimester	3rd Trimester
Normal (≥11.0 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 (10.0-10.9 g/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 (7.0-9.9 g/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 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)

Data are presented as n (%) unless otherwise stated.

Table 4: Percentage Consumption from food Groups (N=139)

Food groups	Margibi (%) (n = 87)	Grand Cape Mount (%) (n = 52)	Total (%) (N = 139)
Grain tubers, white roots and plantains	88.9	98.1	98.6
Pulses (lentils, peas and beans)	18.4	13.5	16.5
Nuts and seeds	8.0	5.8	7.2
Diary	14.9	23.1	18.0
Poultry, fish and meat	88.5	90.4	89.2
Egg	28.7	7.7	20.9
Dark leafy vegetables	58.6	71.2	63.3
Other vitamin A rich fruits and vegetables	19.5	30.8	23.7
Other fruits	8.0	9.6	8.6
Other vegetables	11.5	11.5	11.5

more prevalent in Margibi than in Grand Cape Mount County (59.8% vs. 44.2%). Haemoglobin status also varied across the trimesters (Table 4).

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

The percentage consumption from each food group is described in Table 5. Consumption was highest in the grains tubers, white roots and plantains group (98.6%) and least in the nuts and seeds group (7.2%). The mean dietary diversity score for both counties was 3.56 (1.00). There was also no significant difference in dietary diversity scores for either county (P = 0.452). Both counties scored low (< 5) on the dietary diversity score: 3.55 ± 0.96 for Margibi and 3.58 ± 1.09 for Grand Cape. Overall, poor dietary diversity was observed in the diet of 83.5% of the pregnant women, 85.1% in Margibi and 80.8% in Grand Cape Mount, respectively. We compared the dietary diversity scores for both counties

Table 5. Minimum dietary diversity score and pregnancy status by selected counties

Trimester of pregnancy	County		
	Margibi (n = 87) Mean (SD)	Grand Cape Mount (n = 52) Mean (SD)	Total (N = 139) Mean (SD)
First trimester (0-12 weeks)	3.50 (0.76)	3.18 (0.87)	3.36 (0.81)
Second trimester (13-28) weeks	3.78 (0.86)	3.75 (0.75)	3.77 (0.83)
Third trimester (29-40 weeks)	3.30 (1.1)	3.69 (1.26)	3.48 (1.18)
Total	3.55 (0.96)	3.60 (1.09)	3.57 (1.01)

Table 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	0.327
Normal	27 (77.1)	8 (22.9)	24 (82.8)	5 (17.2)	51 (79.7)	13 (20.3)	
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)	

across the trimesters. The mean dietary diversity scores of the pregnant women for the duration of the pregnancy remained low and no different in either county. It was, however, lowest in the first trimester (Table 5).

Minimum dietary diversity scores and haemoglobin status

We assessed the relationship between dietary diversity and haemoglobin status for the cohort (Table 6). No significant association was observed between haemoglobin status and dietary diversity scores (p= 0.327). It was interesting to observe that in Margibi County, out of 74 women who exhibited poor dietary diversity, more than half (63.5%) had between mild-to-severe haemoglobin levels, whereas only 6.8% of women who exhibited a somewhat good dietary diversity score had a mild or moderate haemoglobin level.

DISCUSSION

This study assessed the prevalence of anaemia, dietary diversity and the relationship between both outcomes among pregnant women in two counties from the western coast of Liberia. The results revealed that at least half (54%) of the pregnant women in the study were anaemic. Within the counties, 59.8% and 44.2% were anaemic in Margibi and Grand Cape Mount, respectively. The prevalence of anaemia in this study was higher than previously recorded in the Liberia Demographic and Health Survey [10] and still higher than the global prevalence [5]. Similarly, a high prevalence of anaemia has been reported in Uganda [20], Benin [21], Ghana [22] and Egypt [23]. The high prevalence of anaemia among this group of pregnant women can be explained by many factors. Firstly, there could be low consumption from the green leafy vegetable and meat/fish and poultry groups. Even though the results from the food group consumption indicate a considerable amount of consumption from these groups, it is likely that the amount consumed may be inadequate to meet daily requirements. Inadequate consumption can be attributed to the high cost of meat/fish products. According to some researchers from South Africa and Iran [24-25], the high cost of meat/fish affects adequate consumption. The World Health Organization recommends that pregnant women take iron and folate supplements to help prevent anaemia [26]. A considerable number of pregnant women from both countries were not taking any form of supplements. This could have contributed 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 anaemia and other complications, "only two in ten women took iron tablets" [27]. Pregnant women need to be encouraged to take their dietary supplements to prevent anaemia.

In this study, about 99% of the pregnant women from both counties consumed food from groups containing grains, tubers, roots, 89% meat and 63.3% green leafy vegetables, with poor consumption of nuts, dairy, eggs and other fruit groups. The findings from this study agree with findings from South Africa, where 98.4% of pregnant women were found to have consumed grain, cereal, tubers and roots [28]. Chakona et al. [25] also revealed that rice, maise, 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 [29]. In the present study, consumption from the meat, poultry and fish group was low, consistent with findings among Burkinabe women where the diet was reported to lack or contain low amounts of animal products, vitamin A, C and other vegetables [28]. Our results suggest similar 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 [30]. Most pregnant women in Liberia are affected by food insecurity influenced by their occupation and low socio-economic status. This is because poverty affects access to food and subsequent intake. In this study, almost all participants had a monthly income of less than a hundred dollars. With low or inadequate income, access to food is limited, and with that, food insecurity [11].

Micronutrients play an essential role in health and contribute to the immune system and antibody functions during pregnancy [31]. The limited consumption of micronutrients decreases the concentration of iron that has been reserved for the foetus [32]. 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 lead to a risk of maternal and perinatal mortality, low birth weight and neural tube defects (NTDs) [33-36]. Additionally, there is an increased risk of mental retardation, fetal growth restriction, and small for gestational age (SGA) in infants. For the pregnant mother, hypertension, preeclampsia, increased risk of premature delivery, and perinatal mortality could occur [36-37].

An MDD-W of 5 or more is indicative of good diversity in the diet. Our result showed a mean MDD-W of 3.56 (1.00), similar to the mean score of 3.68 (2.10) in Northwest Ethiopia [38] but lower compared to 4.2 (1.5) in Northern Ghana [39]. A high percentage (83%) of the pregnant women did not achieve minimum dietary diversity and were likely to have lower micronutrient intake. This is comparable to reports from the Oromiya region of western Ethiopia, where 74.6% of pregnant women reported poor dietary diversity [40]. According to Kiboi et al. [40] and Lander et al. [41], good dietary diversity is indicative of good micronutrient status. Therefore, it is worrisome that many pregnant women cannot 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 increase the risk of obstructed labour [42-44].

Conclusion

Dietary intake among women from these counties was predominantly from the grains, cereals and tubers group, with many showing poor dietary diversity. There was a high prevalence of anaemia observed in these pregnant women. To reduce the burden of anaemia in women of childbearing age and children, it is necessary to fully implement national policy strategies that will promote the consumption of diverse foods in the communities. The policy will improve quality dietary intake and nutritional status among pregnant women. Regular and frequent nutritional screening during pregnancy is necessary among pregnant women receiving antenatal care services to recognise those at risk of micronutrient malnutrition in time for dietary modification. It is also imperative to encourage diversity in dietary intake through awareness and nutrition education. This is to ensure the promotion of dietary diversity and behavioural change in the community and health facilities. Additionally, further research needs to be done in other counties in Liberia to determine the dietary status of pregnant women.

DECLARATIONS

Ethical considerations

Ethical Clearance was obtained from the Institutional Review Board of the University of Liberia and The Ethical and Protocol Review Committee of the College of Health Sciences, University of Ghana (CHS-Et/M.1-5.8/2020-2021).

Consent to publish

All authors agreed to the content of the final paper.

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Competing Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Author contributions

GS, FI and MS conceptualised and collected data for the project, YD, FI, GS and KP analysed data and wrote the manuscript.

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Availability of data

Data will be made available on request.

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