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Iron deficiency anaemia and its associated risk factors among lactating mothers in Ghana

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Abstract

Background: Anaemia is one of the most common conditions affecting human physiology. Iron deficiency, with or without anaemia, reduces the working capacity of individuals and the entire population. The aim of the study was to establish the prevalence of anaemia; iron deficiency anaemia using serum ferritin levels and factors associated with iron deficiency anaemia among lactating mothers in the district.

Materials & methods: This study was conducted at St. Elizabeth Hospital, Hwidiem in the Ahafo Region of Ghana. Full blood count analysis, serum ferritin, malaria and other measurements such as Body Mass Index (BMI) and diet assessment were done for all the participants. A structured questionnaire was used to collect information on risk factors and demographic characteristics. $p>0.05$ was considered statistically significant.

Results: The overall prevalence of iron-deficiency anaemia among lactating mothers was 26%. The bivariate analysis showed 13 (50%) positive malaria participants ($p = 0.011$), 5 (63%) who experience loss of appetite most times ($p = 0.003$), 17(50%) participants who had no access to regular meal ($p = 0.001$), four or less antenatal visit ($p = 0.004$), once a week intake of meat and sea foods ($p = 0.001$), cereal and legumes intake 2-4 a day ($p = 0.044$) were associated with iron deficiency anaemia.

Conclusion: IDA prevalence of 26% during lactation may be due to infant iron demands in breast milk. Measures must therefore be put in place for a thorough examination of anaemia in this population which should include the assessment of iron biomarkers and not just haemoglobin levels.

Keywords: lactating mothers; iron deficiency; anaemia

Introduction

Globally, more than 40 percent of women are anaemic due to iron, folate, and other micronutrient deficiencies [1-3]. Southern Asia, Central and West Africa have the highest prevalence of anaemia among pregnant women. High-risk groups for anaemia as well as moderate-severe anaemia include the elderly, reproductive-age, pregnant women, Hispanics, and non-Hispanic blacks [4]. Although the causes of anaemia are variable, iron deficiency remains a major contender. In some countries, considerable reductions in the prevalence of anaemia have been achieved; however, overall progress has been

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insufficient. Further actions are required to reach the World Health Assembly target of a 50% reduction in anaemia in women of reproductive age by 2025 [2].

The most recent Ghana Demographic and Health Survey (GDHS) estimates the prevalence of anaemia among pregnant women and lactating women to be 51 per cent, and 36%, respectively, among women [5].

In high-income countries, data exist on the prevalence of iron deficiency (ID) due to the assessment of specific iron status biomarkers (ferritin, transferrin saturation, total iron-binding capacity and transferrin receptor) in pregnancy [6]. However, in many low- and middle-income countries, including Ghana, such assessments are not part of routine care; therefore, data on the prevalence of ID among pregnant women and lactating mothers are not available. Instead, ID is estimated using anaemia prevalence (haemoglobin (Hb) status) as a proxy, when about half of anaemia is attributed to ID. Data show that a wide range of ID and ID anaemia (IDA) [6] exists among pregnant women, irrespective of the country of origin. Although many studies have emphasized anaemia during pregnancy [7, 8], anaemia also affects other groups of women, including adolescent girls, postpartum mothers, and lactating mothers. Lactating mothers are vulnerable to anaemia. During lactation, mothers are susceptible to anaemia due to maternal iron depletion and blood loss during childbirth [9]. Lactating mothers are highly susceptible to iron depletion if their nutrient intakes are inadequate. Although studies have been conducted on IDA among pregnant women in Ghana [7, 8], to date, information on the IDA status of lactating mothers and the associated factors is limited.

The aim of the study was to establish the prevalence of anaemia; iron deficiency anaemia using serum ferritin levels and factors associated with iron deficiency anaemia among lactating mothers in the Ghana.

Materials and methods

This study was conducted at St. Elizabeth Hospital, Hwidiem, Asutifi South District of the Ahafo Region of Ghana. The Asutifi South District is an administrative district in the Ahafo Region. The Asutifi South District was carved out from the Asutifi District in July 2012 with Hwidiem as the district capital. The district was in the western part of the Bono and Ahafo Regions. It shares boundaries with Asutifi North District to the north, Ahafo Ano North District to the east, Asunafo Municipal to the west, Atwima Mponua District to the southeast, and Asunafo South District to the southwest. The total land areas of the district are approximately 597, 244 square kilometers. The district is located between latitudes 6°40’ and 7°15’ North and longitudes 2°15’ and 2°45’ West. Majority (74.7%) of the population (15 years and older) are economically active while 25.3 % are economically not active. The information on employment status reveals that, majority of the people (63.7%) are self-employed which gives rise to a large private informal sector that provides 91.4 % employment to the economically active people while the public (government) sector constitutes only less than five percent (4.9%) in the district. The district is agrarian, with 71.8 % of households engaged in agricultural activities, such as crop farming, animal rearing, and fish farming. Of the households engaged in agriculture, 70.9 % were in rural areas, while 29.1% were in urban areas.

St. Elizabeth hospital is a Catholic Health delivery facility in Goaso Diocese. It is in the Asutifi-South district (Ahafo region), Ghana, and provides quality healthcare to all its neighbouring communities. It started as a leprosy camp in 1955 and evolved into a district hospital over the years. The hospital provides Curative, Preventive and Promotive, Rehabilitative, Diagnostic, and Special Programs.

Study design was a hospital-based cross-sectional study involving lactating mothers visiting the St Elizabeth hospital for post-natal care. Study population was all lactating mothers aged 15 – 45 years receiving postnatal care from March 2022 to September 2022 at St. Elizabeth hospital, Hwidiem were recruited for this study.

Ethical consideration: Ethical approval for the conduct of this study was provided by the Institutional Review Board of the University for Development Studies (UDS/RB/080/22) and permission sought from St. Elizabeth hospital. The objectives and procedures of the study were explained to all participants. All participants consented to participate by means of the thumbprints or signatures. The study was voluntary participation, and the right of participants to discontinue at any stage of the study was made known to them.

Sampling method: A simple random sampling method was used to select 100 participants for this study. Each day at the postnatal clinic, lactating mothers were screened using a structured questionnaire to identify those that met the inclusion criteria.

Inclusion/Exclusion criteria: Lactating mothers aged 15-45 years who visited the ANC clinic of St Elizabeth hospital for post-natal care, Hwidiem between the months of March to September 2022 who consented to the study were recruited. Lactating mothers with inflammatory illness such as Sickle cell disease, liver disease etc. were excluded from the study

Data collection

A structured questionnaire was used to collect information on the socio-demographic characteristics of the study participants, the risk factors associated with iron deficiency anaemia in lactating mothers and their dietary intake.

Determination of haemoglobin (Hb) levels, red blood cell count (RBC) and mean cell volume (MCV).

Two (2) mls of venous blood samples were collected into ethylenediaminetetraacetic acid (EDTA) tubes and used to determine haematological indices such as haemoglobin levels, Red Blood Cell count, and Mean Cell Volume of participants using the Sysmex Haematology Analyzer (XP-300 Automated Haematology Analyser, Rhode Island, RI, USA). Lactating mothers were considered anaemic if their haemoglobin level was < 12 g/dL.

Determination of serum ferritin (SF) levels

Three (3) mls of venous blood was collected from the participants into serum gel separator tubes and centrifuged at 4000 rpm for 5 min to obtain the serum. The serum was used for the analysis of serum ferritin, using a sandwich enzyme- linked immunosorbent assay (ELISA) technique (R&D system Inc, USA) at the St. Elizabeth hospital biochemistry laboratory. The optical density of serum ferritin was measured at 450 nm within 15 minutes using a multipurpose microplate ELISA reader (Mindray MR-96A, Guangdong, China). All analyses were performed in duplicate. Serum iron deficiency was defined as a serum ferritin level < 15 μg/L [1].

Statistical data analysis

The dependent variable in this study was obtained from the serum ferritin level (<15 μg/L is termed iron deficiency, and ≥15 μg/L as normal) and haemoglobin level (<12 g/dl as anaemia and ≥12 g/dl as normal). It was then grouped into categorical variables as follows: anaemia with no ID, IDA, no ID and anaemia, and ID with no anaemia.

The independent variables were demographic variables, such as age, marital status, occupation, gestational age, level of education, and residence. Proximate factors such as gravidity, parity, antenatal visits, body mass index (BMI) classified as underweight (<18.5 kg/m^2), normal (18.5–25 kg/m^2) and overweight (>25 kg/m^2), and malaria as tested positive or negative. Nutritional factors, such as loss of appetite, access to regular meals, and other key food items, such as meat, fish, and eggs, were also discussed as independent variables.

Field data collected were entered into the designed data collection template in Microsoft Excel sheet 2016, daily until data collection from the field was completed. Stata version 15 was used to analyze the data. Bivariate analysis was performed using Pearson Chi-square test of independence to assess associations between IDA and factors of iron deficiency anaemia of being IDA. Non-parametric and Kruskal-Wallis rank tests were performed to test the relationship between IDA and complete blood count parameters.

Results

Socio-demographic factors of participants

Out of 100 female participants that were recruited for this study, 31 (31%) had low ferritin level, and 64 (64 %) were anaemic (Table 1). Of the 64 anaemic females, 26 (41%) had iron deficiency anaemia, 38 (59%) were anaemic with no iron deficiency (ferritin≥15ug/L), 31 (86%) were normal for both anaemia and iron deficiency and 5 (14%) had iron deficiency with no anaemia. The overall prevalence of iron deficiency anaemia among the study group was 26% (Table 2). Participants between ages 41-45 years (40%) were found to have IDA, but the association was not statistically significant (p = 0.5247). There was no statistically significant association between IDA and the socio-demographic factors (Table 2).

Table 1: Prevalence of iron deficiency and anaemia.

Variable	*N = 100*	
	Frequency	*Prevalence (%)*
Iron deficient	31	31
Not iron deficient	69	69
Anaemic	64	64
Not anaemic	36	36

Proximate factors of participants

Malaria positive females, 13 (50%) had iron deficiency anaemia and there was significant association (p = 0.011). A significant association (p = 0.0028) was found between loss of appetite and IDA in lactating mothers who lost appetite “most times” (63 %). No access to regular meals (50%) was associated with IDA (p = 0.0012) (Table 3). Fewer than four antenatal visits (60%) were significantly associated with IDA (p = 0.004). There was a significant association between meat and seafood intake and IDA once a week (50%) as

Table 2: Iron deficiency anaemia (IDA) and socio-demographic factors.

Variable		*Iron deficiency anaemia by ferritin and Hb level*				*N = 100*
		Anaemia without ID (%)	*IDA (%)*	*Non ID with no anaemia (%)*	*ID with no anaemia (%)*	*p-value*
Age (yrs)						0.5247
	16-20	2 (25)	2 (25)	3 (38)	1 (13)	
	21-25	4 (31)	5 (38)	3 (23)	1 (8)	
	26-30	11 (33)	11 (33)	9 (27)	2 (6)	
	31-35	9 (36)	4 (16)	12 (48)	0 (0)	
	36-40	9 (56)	2 (13)	4 (25)	1 (6)	
	41-45	3 (60)	2 (40)	0 (0)	0 (0)	
Marital status						0.1556
	Single	18 (30)	17 (28)	22 (36)	4 (70	
	Married	20 (51)	9 (23)	9 (23)	1 (3)	
Educational level						0.7234
	No formal education	2 (67)	1 (33)	0 (0)	0 (0)	
	Basic	12 (48)	5 (20)	7 (28)	1 (4)	
	Secondary	6 (29)	7 (33)	8 (38)	0 (0)	
	Tertiary	18 (35)	13 (25)	16 (31)	4 (8)	
Occupation						0.173
	Unemployed	6 (30)	5 (25)	9 (45)	0 (0)	
	Non-formal	21 (54)	10 (26)	6 (15)	2 (5)	
	Formal	5 (22)	7 (30)	10 (44)	1 (4)	
	Students	6 (33)	4 (22)	6 (33)	2 (11)	
Religion						0.8423
	Christians	32 (37)	23 (26)	28 (32)	4 (5)	
	Muslim	6 (46)	3 (23)	3 (23)	1 (8)	
Total		38 (59)	26 (41)	31 (86)	5 (14)	

Percentages are in parentheses. P-value < 0.05 was considered statistically significant.

the highest (p = 0.001) (Table 4). Cereals and legumes, 2-4 a day (33%), and other foods, 5 + a week, were statistically significant and associated with IDA (p = 0.044) (Table 5).

Complete blood count parameters of participants

None of the haematological parameters showed any statistically significant differences among the four groups of the study population. The MCV for IDA was less than 80 fL, indicating IDA, but this was not statistically significant (p = 0.400) (Table 6).

Discussion

Key public health concerns and interventions have overlooked the impact of anaemia on breastfeeding mothers and their children. Iron deficiency anaemia is the most common micronutrient deficiency worldwide affecting mothers and children [10]. Breastfeeding mothers are more susceptible to certain factors, such as blood loss during childbirth, maternal iron depletion during lactation, and inadequate nutrient intake [2].

The study showed that 26 (26%) lactating mothers had iron-deficiency anaemia in the Asutifi South District.

Table 3: Prevalence of iron deficiency anaemia (IDA) and associated factors in lactating mothers.

Variable		*Iron deficiency anaemia by ferritin and Hb level*				*N = 100*
		Anaemia without ID (%)	*IDA (%)*	*Non-ID with no anaemia (%)*	*ID with no anaemia (%)*	*p-value*
Malaria						0.011
	Negative	30 (41)	13 (18)	27 (36)	4 (5)	
	Positive	8 (31)	13 (50)	4 (15)	1 (4)	
BMI						0.814
	Underweight	0 (0)	1 (100)	0 (0)	0 (0)	
	Normal	21 (38)	14 (25)	18 (32)	3 (5)	
	Overweight	17 (40)	11 (26)	13 (30)	2 (5)	
Loss of appetite						0.0028
	Never	13 (29)	7 (16)	21 (47)	4 (9)	
	Rarely	11 (41)	10 (37)	6 (22)	0 (0)	
	Sometimes	13 (65)	4 (20)	3 (15)	0 (0)	
	Most times	1 (13)	5 (63)	1 (13)	1 (13)	
Access regular meal						0.0012
	No	10 (29)	17 (50)	6 (18)	1 (3)	
	Yes	28 (42)	9 (14)	25 (38)	4 (6)	
Total		38 (59)	26 (41)	31 (86)	5 (14)	

Percentages in parentheses. $p < 0.05$ was considered statistically significant and bolded.

Table 4: Iron deficiency anaemia (IDA) and proximate factors.

Variable		*Iron deficiency anaemia by ferritin and Hb level*				*p-value*
		Anaemia without ID (%)	*IDA (%)*	*Non ID with no anaemia (%)*	*ID with no anaemia (%)*	
Alcohol intake						0.4112
	No	31 (38)	19 (23)	28 (34)	4 (5)	
	Yes	7 (39)	7 (39)	3 (17)	1 (6)	
Gravidity						0.4202
	One	10 (45)	5 (23)	5 (23)	2 (9)	
	Two	11 (26)	13 (31)	16 (38)	2 (5)	
	Three	9 (38)	7 (29)	7 (29)	1 (4)	
	Four and more	8 (67)	1 (8)	3 (25)	0 (0)	
Parity						0.4735
	One	16 (31)	14 (27)	18 (35)	4 (8)	
	Two	12 (38)	9 (28)	10 (31)	1 (3)	
	Three	5 (50)	2 (20)	3 (30)	0 (0)	
	Four and more	5 (83)	1 (17)	0 (0)	0 (0)	
Antenatal visit						0.004
	Three or less	4 (50)	4 (50)	0 (0)	0 (0)	
	Four	5 (33)	9 (60)	1 (7)	0 (0)	
	Five	10 (36)	8 (29)	7 (25)	3 (11)	
	Six	10 (43)	2 (9)	9 (39)	2 (9)	
	Seven	9 (35)	3 (12)	14 (54)	0 (0)	

Meat & sea foods						0.001
	Once a week	1 (50)	1 (50)	0 (0)	0 (0)	
	2-4 per week	23 (56)	8 (20)	8 (20)	2 (5)	
	5+ a week	11 (28)	14 (36)	14 (36)	0 (0)	
	Once a day	2 (22)	3 (33)	4 (44)	0 (0)	
	2-4 a day	1 (11)	0 (0)	5 (56)	3 (33)	
	Total	38 (59)	26 (41)	31 (86)	5 (14)	

Percentages in parentheses. $p < 0.05$ was considered statistically significant and bolded.

Table 5: Iron deficiency anaemia (IDA) and proximate factors.

Variable		*Iron deficiency anaemia by ferritin and Hb level*				*p-value*
		Anaemia without ID (%)	*IDA (%)*	*Non ID with no anaemia (%)*	*ID without anaemia (%)*	
Cereal and legumes						0.044
	Once a week	10 (53)	4 (21)	3 (16)	2 (11)	
	2-4 per week	9 (36)	6 (24)	10 (40)	0 (0)	
	5+ a week	16 (47)	10 (29)	8 (24)	0 (0)	
	Once a day	0 (0)	0 (0)	3 (75)	1 (25)	
	2-4 a day	3 (17)	6 (33)	7 (39)	2 (11)	
Dairy & egg food						0.093
	Once a week	15 (37)	16 (39)	7 (17)	3 (7)	
	2-4 per week	10 (29)	8 (23)	15 (43)	2 (6)	
	5+ a week	0 (0)	0 (0)	1 (100)	0 (0)	
	Once a day	13 (59)	2 (9)	7 (32)	0 (0)	
	2-4 a day	0 (0)	0 (0)	1 (100)	0 (0)	
Fruits & vegetables						0.072
	Once a week	3 (33)	3 (33)	2 (22)	1 (11)	
	2-4 per week	20 (57)	7 (20)	6 (17)	2 (6)	
	5+ a week	7 (26)	6 (22)	12 (44)	2 (7)	
	Once a day	5 (26)	9 (47)	5 (26)	0 (0)	
	2-4 a day	3 (30)	1 (10)	6 (60)	0 (0)	
Others						0.023
	Once a week	9 (36)	6 (24)	10 (40)	0 (0)	
	2-4 per week	25 (47)	13 (25)	12 (23)	3 (6)	
	5+ a week	3 (21)	7 (50)	4 (29)	0 (0)	
	Once a day	1 (14)	0 (0)	4 (57)	2 (29)	
	2-4 a day	0 (0)	0 (0)	1 (100)	0 (0)	
Total		38 (59)	26 (41)	31 (86)	5 (14)	

Percentages in parentheses. $p < 0.05$ was considered statistically significant and bolded.

Table 6: CBC parameter stratified according to ferritin level of participant (N = 100).

Variable	*Iron deficiency anaemia by ferritin level*				*p value*
	Anaemia without ID	*IDA*	*Non ID with no anaemia*	*ID with no anaemia*	
RBC x 10^9/L	3.99 (3.6-4.17)	3.65 (3.35-3.94)	4.36 (4.14-4.69)	3.56 (3.46-4.37)	0.638
MVC (fL)	85.7 (83.2-86.9)	77.05 (75.1-78.3)	85.5 (84.3-88.0)	77.5 (76.6-78.3)	0.400
MCH (pg)	29.2 (28.4-30.4)	24.95 (24.2-25.8)	29.5 (28.5-31.5)	26 (25.3-26.10)	0.556
MCHC(g/dl)	33.45 (32.6-34.3)	30.25 (30-31)	33 (32.5-33.9)	31 (30.1-31.3)	0.946
WBC x 10^9/L	8.9 (7.2-11.6)	9.05 (6.3-10.4)	8.5 (7.2-10.9)	9.6 (6.6-10.2)	0.603
PLT x 10^9/L	290 (181-348)	227 (196-309)	222 (175-304)	254 (225-307)	0.657

Abbreviations: Hb=Haemoglobin, MCV=Mean Cell Volume MCH=Mean Corpuscular Haemoglobin, MCHC=Mean Corpuscular Haemoglobin Concentration, WBC=White Blood Cell, PLT= Platelet L=litre, g/dl=Grams per decilitre, fL=Femtolitre, pg=Picogram; Non-parametric data (presented in medians (25^{th}-75^{th} percentile)) generated by Kruskal Wallis Test, p < 0.05 was considered statistically significant

These findings were lower than studies reported in other parts of the world such as India where 59% of lactating mothers have been reported to have anaemia [11] and higher than other studies done in Myanmar which reported an anaemia prevalence rate of 60.3% in lacta

ting women [12] and 36.5% anaemia prevalence among lactating mothers in some East Africa countries [13]. This value is also higher than that reported (anaemia-34%; iron deficiency-16% and iron deficiency anaemia-7.5%) in urban areas in Ghana [14]. Anaemia remains a public health problem according to WHO 2008 classification. The prevalence of anaemia and iron deficiency anaemia among lactating mothers in Asutifi South may be due to the economic and cultural norms of providing nutritional care to lactating mothers during the breastfeeding period. Breast-feeding mothers are advised to take some time away for three to six months and eat a diverse range of meals.

Regarding background factors, there was no significant association between iron deficiency anaemia and age, educational level, occupation, religion, or marital status of lactating mothers.

In relation to the proximate factors, loss of appetite most times, no access to regular meals, once a week meat and seafood intake, 2-4 a day cereal and legume intake were found to be significantly associated with iron deficiency anaemia among lactating mothers. Iron deficiency and IDA are directly affected by diet, as iron is typically ingested through iron-rich and nutrient-dense foods. Dietary iron is absorbed by the gastrointestinal tract. When an individual's diet lacks one of these two criteria, the result is ID and possibly IDA over time. These conditions depend on the severity of the deficiency as well as other factors. Dietary iron is found in a variety of foods, but is particularly high in red meats, seafood, green leafy vegetables, dark chocolate, beef liver, and nuts. Iron-fortified foods include cereal and most other grain products are recommended compared to non-iron fortified cereal products which are obtained directly from the farm gate since the study area is rural-urban.

Participants who had four or fewer antenatal visits had anaemia and IDA, possibly because they did not receive adequate pre- and postnatal education on iron supplementation and iron-rich nutrition. Malaria was also found to be significantly associated (p = 0.011) with anaemia and IDA. In malaria-endemic areas, it is often difficult to detect iron deficiency in individuals. Serum ferritin concentrations of <12 µg/L are highly predictive of depleted iron stores, regardless of the presence or absence of infection or inflammation. Serum ferritin concentrations increase rapidly during malaria infection, probably as part of the host immune response. In the absence of malaria, serum ferritin concentrations of <12 µg/L often fail to detect iron deficiency, as indicated by the higher estimated prevalence of iron deficiency [10]. The Mean Cell Volume level for IDA in this study was found to be less than 80 fL indicating microcytic anaemia.

Recommendations: Measures must therefore be put in place for a thorough examination of anaemia in this population which should include the assessment of iron biomarkers (total iron binding capacity, transferrin, transferrin saturation, and ferritin) and not just haemoglobin levels. This will help determine the cause of anaemia before supplementation is started, which is especially important in countries such as Ghana, where there are many potential causes of anaemia. Preventive measures such as nutritional guidance offered to pregnant and lactating mothers should be intensified.

Limitation: The study was limited by its inability to assess the full iron profile of the participants.

Conclusion

Chapter 1 Chapter 2 IDA was prevalent among lactating mothers due to infant iron demands in breast milk. ID contributed to 26% of prevalent anaemia. Anaemia and IDA remain major public health problems during pregnancy and lactation in Ghana, and a significant proportion of anaemia in this population is attributable to causes other than ID.

Data Availability

All relevant data are available in this article and its supplementary file.

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Conflicts of interests

The authors declare that they have no conflicts of interest.

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