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ORIGINAL ARTICLE

Second Trimester Anaemia in Pregnant Ghanaians

Anemie du Deuxieme Trimestre Chez les Femmes Enceintes Ghaneennes

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ABSTRACT

BACKGROUND: **Anaemia is considered a severe public health problem by WHO and is seen as such in Ghana. Its prevalence in pregnancy has remained high despite improved antenatal care. The main purpose of this study was to determine the current anaemia prevalence and aetiology other than iron deficiency.**

METHODS: **This was a cross-sectional study. A total of 214 pregnant women were studied. Women were administered a questionnaire related with the subject and blood samples were drawn. Full blood count was performed within four hours and serum iron, folate and vitamin B12 were studied. Other tests done included sickling and Hb electrophoresis , stool routine examination for hookworm infestation, thick and thin film for malaria parasitaemia. Dietary intake was also looked at to determine whether it contributed to anaemia seen in these subjects.**

RESULTS: **Anaemia was detected in 150 (70%) of the 214 pregnant women studied. Using the World Health Organisation criteria for anaemia, 81 subjects had mild, 66 moderate and 3 had severe anaemia. Anaemia was more prevalent in young adults (82%) than in teenagers and subjects above 35years (p=0.018). Primigravidae (21%) and multigravidae (67%) were more likely to be anaemic than grandmultigravidae (12%). Anaemia was more prevalent in the low social class group (94%). Nutritional intake of both anaemic and non-anaemic subjects was found to be adequate and thus iron deficiency anaemia, which was found to be the commonest cause of anaemia, was probably due to intake of diet low in bioavailable iron. There was very little consumption of fruits and vegetables that facilitate iron absorption. Twenty seven anaemic subjects had low serum iron levels. Transferrin saturation was low in 39 subjects; 24 of these also had low serum iron, which was suggestive of iron deficiency. Folate and vitamin B12 deficiency did not play significant role in the aetiology of anaemia. Malaria and hookworm infestation were also not found to be significant in the causation of anaemia.**

CONCLUSIONS: **The prevalence of anaemia (70%) in pregnant Ghanaians in their second trimester is unacceptably high. Twenty seven (18%) of the 70% anaemic subjects had low serum iron and six (4%) had low serum folate levels. None of the subjects had vitamin B_{12} deficiency. Generally dietary intake in pregnant women in this study was adequate, but significant proportion of their meals was of the type low in bioavailable iron as more cereals and tubers were consumed. The kind of diet, which most people can afford in Africa is low in proteins and vitamins, but high in carbohydrate with high phytate contents and this reduces iron absorption. Iron and folic acid prophylaxis for all women of child bearing age is recommended and emphasis on a more balanced nutritional intake at antenatal clinics should be encouraged. WAJM 2014; 33(4): 229–233.**

Keywords: **Anaemia, Iron deficiency, 2nd Trimester, Pregnancy, Ghanaians.**

RÉSUMÉ

CONTEXTE: L'anémie est considérée comme un problème de santé publique grave par l'OMS et de même que par le Ghana. Sa prévalence pendant la grossesse reste élevée, malgré l'amélioration des soins prénatals. Le but principal de cette étude était de déterminer la prévalence actuelle de l'anémie et de l'étiologie autre que la carence en fer.

METHODES: Il s'agissait d'une étude transversale. Un total de 214 femmes enceintes ont été étudiées. Un questionnaire a été administré aux femmes en rapport avec le sujet et les échantillons de sang ont été obtenus. La numération formule sanguine complète a été faite dans les quatre heures et le fer sérique, l'acide folique et la vitamine B12 ont été aussi étudiés. Les autres tests effectués incluaient la falciformation et l' électrophorèse de l'Hb, l' examen de routine des selles pour l'ankylostome, la goutte épaisse pour le paludisme. L'apport alimentaire a été également étudié pour déterminer s'il a contribué à l'anémie chez ces sujets.

RESULTATS: L'anémie a été détectée chez 150 (70%) des 214 femmes enceintes étudiées. En utilisant les critères de l'Organisation mondiale de la Santé pour l'anémie, 81 sujets avaient une anémie légère, 66 modérée et 3 souffraient d'une anémie sévère. L'anémie était plus fréquente chez les jeunes adultes (82%) que chez les adolescentes et les sujets de plus de 35 années (p = 0,018). Les primipares (21%) et les multipares (67%) étaient plus susceptibles d'être anémiques que les grandes multi gravides (12%). L'anémie était plus élevée dans le groupe de classe sociale basse (94 %). L'apport nutritionnel des sujets anémiques et non anémiques s'est avéré suffisant et donc l'anémie par déficit en fer , qui s'est avéré la cause la plus fréquente de l'anémie, était probablement due à l'apport alimentaire pauvre en aliment riche en fer. Il y avait très peu de consommation de fruits et légumes qui facilitent l'absorption du fer. Vingt-sept sujets anémiques avaient des niveaux de fer sérique bas. La saturation de la transferrine était basse chez 39 sujets; 24 d'entre elles avaient également de faible taux de fer sérique, qui était suggestive d'une carence en fer. L'acid folique et la carence en vitamine B12 ne jouent un rôle important dans l'étiologie de l'anémie. Le paludisme et l'ankylostome n'ont pas un rôle signifiant dans la cause de l'anémie.

CONCLUSIONS: La prévalence de l'anémie (70%) chez les femmes enceintes Ghanéennes dans leur deuxième trimestre est trop élevée. Vingt-sept (18%) des 70% de sujets anémiques avaient un taux de fer sérique bas et six (4%) avaient des niveaux de folates sériques bas. Aucun des sujets avaient une carence en vitamine B12. Généralement l'apport alimentaire chez les femmes enceintes dans cette étude était suffisant, mais une proportion importante de leurs repas était pauvre en fer bio disponible et que plus de céréales et de tubercules ont été consommés. Le type de régime alimentaire, dont la plupart des gens peuvent se permettre en Afrique est faible en protéines et vitamines, mais riche en glucides à haute teneur en phytates et cela réduit l'absorption du fer. La prophylaxie en fer et en acide folique chez toutes les femmes en âge de procréer est recommandée et un accent particulier sur un apport nutritionnel plus équilibré dans les cliniques prénatales doit être encouragés. **WAJM 2014; 33(4): 229–233.**

Mots-Clés: anémie, carence en fer, 2e trimestre, grossesse, Ghanéennes.

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Abbreviations:

INTRODUCTION

Anaemia in pregnancy is a common problem in most developing countries and a major cause of morbidity and mortality especially in areas where malaria is endemic. In pregnancy, anaemia has a significant impact on the health of the foetus, as well as that of the mother. It accounts for twenty percent (20%) of maternal deaths in Africa.[1]

Anaemia and iron deficiency in particular, cause a lot of morbidity during and after pregnancy, and a dis-proportionate number of cases occur in emerging countries.[2,3] Some of the adverse events associated with iron deficiency anaemia include increased lethargy and fatigue, decreased capacity for physical work, preterm birth and low birth weight, as well as increased maternal mortality.[4–7] Though these adverse events exact a heavy toll in terms of ill-health, premature death and lost earnings, iron deficiency and anaemia in general remain endemic, and there has not been a major change in global prevalence.[8–11] Some major causes of anaemia have many other damaging effects or health consequences beyond anaemia. For example, malaria is well known to cause severe anaemia in many tropical areas, particularly among primigravidae, and it also contributes to the low birth weight of infants.[12] In most developed countries, iron deficiency is the main cause of significant anaemia during pregnancy,[13] as shown by the efficacy of iron supplementation in preventing maternal anaemia. In developing countries, especially where severe maternal anaemia is more common, other nutritional factors and infections, including malaria, can often coexist with iron deficiency, contributing to anaemia[13]. In addition to poor intake of bioavailable iron, which is a common problem in developing countries and is related to low intake of haem iron from animal sources, hookworm infection is prevalent in many tropical areas.[14] Hookworm causes upper gastrointestinal blood loss, which contributes directly to iron deficiency anaemia.[15]

In Ghana, very few studies have been conducted to determine causes of anaemia in pregnancy and iron and folic acid supplementation during pregnancy is a national policy. If the woman begins antenatal clinic attendance early enough in the pregnancy and iron deficiency anaemia is present, correction of the anaemia would be expected by the 3rd trimester.

There is also paucity of baseline data on anaemia in pregnant Ghanaians. Such data are critical to generate hypotheses and maternal interventional strategies. It also helps to identify socio-demographic risk factors for anaemia in pregnancy.

METHODS

Setting: The study was conducted at the antenatal outpatient clinic of Mamprobi polyclinic. The clinic sees over 150 patients per day and has over 10,000 deliveries each year. All patients were on the national health insurance scheme and received intermittent presumptive treatment for malaria and iron supplementation.

Study Population

The study included women attending antenatal clinic for the 1st time and who were in the 2nd trimester. The second trimester was chosen in this study because most pregnant women are referred for antenatal care during this period. Women 18 to 40 years were eligible and those with chronic diseases such as tuberculosis, diabetes mellitus, severe hypertension, sickle cell disease were excluded. Women who after the study had been explained to them refused to give verbal or written informed consent were also excluded.

Enrolment, data and specimen collection occurred during a single outpatient visit.

Historical Data

A socio-demographic and health questionnaire that included possible risk factors for anaemia and iron deficiency in particular was administered. All the women were educated on anaemia and its complications and taken through a health questionnaire.

Sampling and Laboratory Methods

Once informed consent was obtained, blood samples from participants were obtained via venipuncture. The following tests were performed,a full blood count and film comment were done using the sysmex 2000xi , Serum Iron and Total iron binding capacity(TIBC) were done using the pointers method which is a manual quantitative analysis which uses a spectrophotometer to read absorbance of iron tests . Serum Ferritin was done using Vidas automated analyzer. Anaemia was defined as a haemoglobin concentration <11g/dl and iron deficiency as serum ferritin concentration <16ug/l and TIBC more than 400ug/dl (normal range – 250–400ug/dl). The ARCHITECT i Chemiluminesent microparticles immunoassay was used for serum vitamin B12 and folate assay because it is a sensitive method and highly specific.

Expected Values for Vitamin B_{12}:

Deficient – 86–172 pg/ml
Normal – 179 to 1162 pg/ml

Expected values for serum folate:

Deficient – 0.79 – 7.63nmol/l
Borderline – 7.64 – 12.19nmol/l
Normal – >12.19nmol/l

Thick and thin blood smears was used for the detection of malaria parasites .The thin film was used to speciate. Stool tests were done to detect the presence or absence of intestinal parasites. Sickling was done using 2% Sodium meta-bisulphite method and haemoglobin electrophoresis using cellulose acetate was also done.

Data Analysis

Data was entered using Microsoft excel and the statistical analysis was performed using the statistical package for social sciences (SPSS) version 16.0 Software (SPSS Inc. Copyright 2007, Chicago, USA). Numerical variables were described as mean and standard deviation. The student t-test (for numerical variables) was used for the comparison of two groups, while analysis of variance (ANOVA) was used for the comparison of more than two groups. Chi-square was used to compare proportions within various groups.

The level of significance was set at $p<0.05$.

The University of Ghana Medical School Ethical and Protocol Review Committee approved the study.

RESULTS

Two hundred and fourteen pregnant women in their second trimester were recruited during the study period (January to June 2008), 150 (70%) of them were found to be anaemic (Hb <11g/dl) using the WHO criteria.

Anaemia and Age

Of the 214 cases included in the study, 150 were anaemic.. Six percent (6%) of the anaemic subjects were teenagers (13–19 years), 82% were young adults (20–35 years) and 12% were above 35 years. The mean age for anaemic patients was 26.8 ± 5.3 years and for non-anaemic patients 28.8 ± 6.0 years. Thus the anaemic subjects were significantly younger than the non anaemic subjects (P=0.018).

One-way ANOVA showed no significant difference in the iron, TIBC and ferritin levels between the age groups of the anaemic subjects (p=0.817, 0.769, and 0.195**,** respectively).

Dietary Intake

Analysis of food intake showed many of the patients having milk, fish, or eggs as part of breakfast. Though the quantities were not indicated, these sources of protein are known to be of high quality. Cereals were the main foods taken for breakfast.

The meals for lunch and supper were similar with increased proportion of subjects consuming more fish, eggs, and beef to improve the dietary quality. The major energy sources were cereals and root tubers. There was little or no consumption of fruits and vegetables.

Laboratory Results

From the blood film comment, 96 (64.0%) of the anaemic patients had normocytic normochromic anaemia. Fifty (33.3%) had microcytic hypochromic anaemia. (Table 1).

Only four (2.7%) patients had macrocytosis. Sixteen (32%) of the patients who had microcytic hypochromic anaemia had low serum iron. Eleven (40.7%) had normocytic normochromic anaemia and low serum iron. A total of twenty seven (27) anaemic subjects had low serum iron levels. Table 2 shows sixteen (59.3%) of them having microcytic hypochromic anaemia and low serum iron, thirty (26.1%) with normal serum iron and two (25.0%) with high serum iron. Thus, a total of forty-eight (32.0%) anaemic subjects had microcytic hypochromic cells. Ninety-eight (65.3%) of anaemic subjects had normocytic normochromic anaemia, with eleven (40.7%) having low serum iron levels. Table 3 shows fourteen subjects with low serum iron also had low ferritn. Using ANOVA there was significant correlation between severity of anaemia and serum iron levels (Table 4).

Twenty four (88.9%) of the patients with low serum iron had decreased transferrin saturation. The low values are accepted as diagnostic of iron deficiency anaemia.

Low serum ferritin was seen in thirty two (21.3%) of anaemic subjects, fourteen (51.9%) of them also had low serum iron as shown in table 5.One hundred and fifteen (76.7%) had normal ferritin levels. High ferritin was seen in only three (2.0%) subjects.

Table 6 shows 6 (16.7%) patients being folate deficient and 3 (8.3%) borderline; 23 (63.9%) were normal. In all, 36 patients had MCV more than 90 and thus serum folate and B_{12} were done. Unfortunately serum folate was done for only 32 patients due to insufficient sample.

Sickling test and haemoglobin electrophoresis was done to exclude subjects who had sickle cell anaemia from the study. Out of the one hundred and fifty anaemic subjects nineteen (19) had haemoglobin genotype AS. None of the subjects had sickle cell anaemia. Only two (2) subjects with Hb AS had low serum iron levels.

Results of other Tests done

Plasmodium falciparum parasitaemia was present in only one of the anaemic subjects. Stool examination for hookworm and other helminthic infestations were negative in all the anaemic subjects.

Table 1: Summary of Full Blood Count Indices for Anaemic Group

	N	Minimum	Maximum	Mean	Standard Deviation
Hb (g/dl)	150	6.1	10.9	9.9	1.0
MCV (fl)	150	59.6	99.4	83.1	8.4
RBC ($x10^{12}$/L)	148	2.7	3.30	3.9	2.4
MCH (pg)	150	18.5	35.5	27.9	3.5
WBC ($x10^9$/L)	150	2.0	15.7	7.0	2.2
Neutrophils ($x10^9$/L)	136	0.2	10.9	4.1	2.0
Lymphocytes ($x10^9$/L)	136	0.8	4.3	2.0	0.6
Eosinophils ($x10^9$/L)	129	0.0	2.1	0.7	0.6
Platelets ($x10^9$/L)	150	74.0	442.0	223.3	67.2

Table 2: Serum Iron Levels Compared with Red Cell Morphology

		Red Cell Morphology			
		Normocytic Normochromic (%)	Microcytic Hypochromic (%)	Macrocytosis (%)	Total (%)
Serum Iron (μmol/L)	Low	11(40.7)	16(59.3)	0(0.0)	27(100.0)
	Normal	81(70.4)	30(26.1)	4(3.5)	115(100.0)
	High	6(75.0)	2(25.0)	0(0.0)	8(100.0)
Total		**98(65.3)**	**48(32.0)**	**4(2.7)**	**150(100.0)**

Table 3: Serum Iron compared with Serum Ferritin

		Serum Ferritin			
		Low(%)	Normal(%)	High(%)	Total(%)
Serum Iron (Umol/L)	Low	14(51.9)	12(44.4)	1(3.7)	27(100.0)
	Normal	17(14.8)	96(83.5)	2(1.7)	115(100.0)
	High	1(12.5)	7(87.5)	0(0.0)	8(100.0)
Total		**32(21.3)**	**115(76.7)**	**3(2.0)**	**150(100.0)**

Table 4: Mean Serum Iron and Serum Ferritin Levels for the Severity of Anaemia

Severity of Anaemia	Serum Iron («mol/L)			Serum Ferritin (pmol/L)		
	Mean	N	Std. Deviation	Mean	N	Std. Deviation
Mild	19.4	81.0	6.8	39.8	81.0	39.0
Moderate	14.9	66.0	6.1	32.2	66.0	36.8
Severe	7.5	3.0	2.4	5.1	3.0	0.8
Total	**17.2**	**150.0**	**6.9**	**35.7**	**150.0**	**38.0**
		p=0.0001			p=0.180	

Table 5: Serum Iron compared with Transferrin Saturation

		Transferrin Saturation			
		Low(%)	Normal(%)	High(%)	Total(%)
Serum Iron	Low	24(88.9)	3(11.1)	0(0.0)	27(100.0)
	Normal	15(13.0)	92(80.0)	8(7.0)	115(100.0)
	High	0(0.0)	1(12.5)	7(87.5)	8(100.0)
Total		**39(26.0)**	**96(64.0)**	**15(10.0)**	**150(100.0)**

Table 6: Levels of Serum Folate and B12 in Subjects

	Folate		B12	
	n	%	n	%
Borderline	3	8.33	0	0
Deficient	6	16.67	0	0
Normal	23	63.89	36	100
No results	4	11.11		
Total	**36**	**100.0**	**36**	**100**

DISCUSSION

Anaemia is recognised as widespread in the female, especially during pregnancy when the need for iron by the foetus, the placenta and the mother's expanding blood volume is substantial.[16]

The prevalence of anaemia in pregnancy was found to be 70%. It decreased with age, with the lowest rate seen in subjects >35 years and the highest seen in young adults (20–35 years) and teenagers. A study done in southern Malawi showed an increased risk of anaemia in pregnancy in adolescents,[17] however when age was corrected for gravidity and trimester at booking there was no significant increased risk for anaemia.[17] In this study anaemia was more prevalent in the teenagers and young adults. This compares with results obtained by the demographic health survey in which prevalence of anaemia was found to be 65%.[18]

Consumption of vitamin C-rich foods like fresh fruits is very important in the absorption of non-haem iron. In most African countries, especially where the staples are millet, rice, sorghum, maize, and wheat, diets are low in bioavailable iron, and nutritional deficiency has been found to be common.[19] Some African taboos during pregnancy restrict even further the intake of ligands which enhance the absorption of iron.[19,21] From this study dietary intake was adequate but perhaps they took in more meals which were low in bioavailable iron.

The anaemia of iron deficiency has for a long time been associated with microcytic hypochromic red blood cells. A significant number of subjects in this study had normocytic normochromic anaemia which most likely is dilutional anaemia of pregnancy. The examination of blood films may not always be useful in the diagnosis of anaemia and this has been proven by O. Ogunbode *et al*[22]. In this study it was also not useful in those who had low folate levels. Most patients had indices within normal limits, and therefore it was difficult to determine the aetiology of the anaemia using red cell indices only. This study therefore compares with Carr[23] and Fairbanks[24] that the red cell morphology and indices are very unreliable in the diagnosis of iron deficiency anaemia seen during pregnancy.

The measurement of blood ferritin levels has proven to be a reliable indicator of level of body iron stores, and its usefulness has been established by a number of researchers.[25–27] The only known cause of a significantly low ferritin value is iron deficiency. A significantly low ferritin level is therefore said to be specific for iron deficiency.[25]

The findings from this study have demonstrated that, the prevalence of anaemia in pregnancy is still high (70%) in Ghana. Iron deficiency anaemia seems to be the commonest cause and most likely due to intake of food low in

bioavailable iron. Folate deficiency is not a major cause of anaemia in Ghana. Vitamin B_{12} deficiency is not a cause of anaemia in pregnant Ghanaians. Malaria, and hookworm infestation did not contribute to anaemia in this study.

There were a number of limitations in this study. Out of the 36 patients with MCV>90fl, folate assay for four patients could not be done due to inadequate sample. The increase in ferritin levels seen in some subjects may have been consequent to an acute phase reaction, which could not be ruled out. This study was done during the dry season and that can account for malaria not being a cause of anaemia. It would have been worth looking at the role of thalassaemia trait, and HIV as causes of anaemia in pregnancy.

In summary, this study provides prevalence data and aetiology of anaemia in pregnant Ghanaians attending an urban antenatal clinic. Anaemia remains a significant problem, this unfortunately has not changed over the years.

Conflicts of interest: We declare no conflicts of interest.

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