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Impact of Maternal Iron Deficiency and Anaemia on Pregnancy and its outcomes in a Nigerian Population

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Abstract

BACKGROUND: Iron deficiency and anaemia during pregnancy, two nutritional disorders of public health importance, are common in developing countries. This study was conducted to investigate the possible contribution and impact of anaemia and iron status on pregnancy and its outcomes in a Nigerian population.METHODS: Three hundred and forty nine (349) pregnant women aged 15-40 years (mean; 27. 04 ± 4. 75 years) at gestational age = 25 week (mean 21.77 ± 3.14 wks) were analysed for plasma iron and haemoglobin using flame atomic absorption spectrophotometer and Cyanmethaemoglobin method, respectively. The women were followed-up weekly till delivery after which neonatal anthropometrics and other birth outcomes were recorded. RESULTS: Anaemia and iron deficiency were recorded in 252 (72.2%) and 222 (63.6%) of the women, respectively, with 0.3% severely anaemic while 38.4% and 33.5% were moderately and mildly anaemic respectively. An inverse relationship was observed between anaemia and iron deficiency with lower prevalence of iron deficiency found among groups with high prevalence of anaemia. Parity and antenatal attendance have significant ($p < 0.05$) effect on maternal haemoglobin with multiparous women having higher prevalence of anaemia and more than 10 antenatal attendance being associated with lower anaemia prevalence. On the pregnancy outcomes, neither maternal iron status nor anaemia was related to birth weight. However, higher foetal head circumferences (34.09 ± 2.61 vs. 33.41± 2. 68cm, $p < 0.05$) and more preterm deliveries (< 37wk) were found in anaemic than non-anaemic women (19 vs. 3, $p = 0.001$). Although no significant difference in maternal concomitant illnesses during pregnancy was found either in the iron or the anaemia groups, surgically delivered babies were significantly ($p < 0.05$) more in iron deficient than in the iron adequate group (16 vs. 1, $p = 0.021$). CONCLUSSION: Maternal anaemia was associated with premature delivery, delivery through caesarean section, and infants with lower head circumference. Thus, there is indication that apart from iron deficiency, other factors that predispose pregnant women to the development of anaemia may play important role in determining pregnancy outcomes.

BACKGROUND

Anaemia, defined as haemoglobin concentration below 110g/l [1] has been recognised as an important public health problem globally, with high prevalence, especially among children and women of childbearing age in developing countries [2]. Specifically, studies of anaemia prevalence during pregnancy have recorded the following prevalence: 87% (India), 77% (Bangladesh), 59% (Bhutar), 65% (Nepal), 60% (Sri Lanka) and 87.6% (India) with haemoglobin less than 11.0g/dl [3, 4]. In Nigeria anaemia prevalence in pregnancy vary across the region with a prevalence of 76.5% in Abeokuta, South Western region [5], and 40.4% in Enugu, South Eastern region [6], and prevalence higher among the primigravidae than multiparous women. It has been suggested that the prevalence of anaemia may depend on the season, increasing in relation to malaria transmission in wet season and in relation to increased food shortage at the end of dry season [7].

Iron deficiency (believed to be the most common cause of anaemia in pregnancy) like its anaemia has been recognised as the number one nutritional disorder in the world [8] affecting pregnant women in both the developing and the developed countries [9, 10]. According to the National Food Consumption and Nutrition Survey in 2003 [11] 43.7% of pregnant women in Nigeria are iron deficient. Animal and human studies have shown that iron deficiency, anaemia as well as high haemoglobin concentration during pregnancy is associated with adverse pregnancy outcomes [12-15].

In developing countries, maternal iron deficiency and anaemia during pregnancy is a product of many factors, such as maternal malaria, intestinal parasitic infection, recurrent infection, reduced dietary intakes, just to name but few [16]. Although in our previous study [17] in this population, we found maternal malaria parasitaemia to be a major factor for low birth weight deliveries with haematological parameters playing a secondary role, the influence of maternal iron status and haemoglobin concentration on pregnancy have not been fully established. Therefore, the present study is aimed at investigating the possible contribution and impact of maternal anaemia and iron status on pregnancy and its outcomes.

METHODS

The study was carried out among pregnant women attending antenatal clinic of the Department of Obstetrics and Gynaecology of the Federal Medical Centre, Abakaliki, one of the referral tertiary health institutions in the South Eastern part of Nigeria. The main occupation of the people is subsistence farming (mainly yam and cassava) with some animal husbandry. Other professions and/or activities such as civil service, trading, artisan and stone quarrying are practiced also. Malaria transmission is intense and occurs throughout the year (perennial).

Three hundred and fifty-one (351) women, aged 15-40 years (Gestational age = 25 weeks), who gave their consent to participate in the study, were recruited between July 2007 and September 2008. Gestational age was determined by date of last menstruation and confirmed by ultrasonography and where there is disagreement between the two methods that of ultrasonography was used. Those excluded from the study were women with chronic disease, women that were HIV-seropositive and those with multiple pregnancies. The protocol for this study was approved by the Ethics and Research Committee of the Federal Medical Centre Abakaliki. The sociodemographic and dietary data of the participants were collected by structured questionnaires. Maternal anthropometry; height and weight were measured with the subject in light clothes without shoes, and BMI (Kg/m2) calculated. Five millilitres (5.0 ml) of non-fasting venous blood collected between 08.00-10.00 hours were dispensed into trace element-free heparinised plastic bottles (3.0ml) and EDTA bottle (2.0 ml) for analysis of biochemical and haematological parameters respectively. The blood samples in the trace element-free bottles were centrifuged at 2000g for five minute for the isolation of plasma. The plasma samples were frozen until they were analysed.

Participants were followed-up weekly till delivery. At every follow-up, participants were evaluated by the attending Obstetricians for concomitant illness such as diabetes and hypertension. At delivery baby's birth outcomes such as weight, length, head circumference as well as still birth, mode of delivery, gestation age at delivery were recorded by the attending midwives. Birth weight was determined using electronic weighing balance and recorded to the nearest 0.05Kg with the scale checked periodically throughout the study for accuracy while birth length and head circumference was determined by a measuring tape to the nearest 0.1cm.

Plasma iron was determined in duplicates using flame atomic absorption spectrophotometer and the mean was recorded as the absolute value of the elements. Iron deficiency was defined as plasma iron < 10.0µmol.l [18].

Haemoglobin concentration was determined by Cyanmethaemoglobin method as described previously [19]. The World Health Organisation [1] criteria for typing anaemia in pregnancy were adopted in this study.

Basic statistical analyses were done employing student's t-test, one-way analysis of variance (ANOVA), and Chi square. Maternal concomitant illnesses and infants birth weight, length, head circumference, preterm delivery, still births, babies' sex were the maternal and foetal outcomes evaluated in relationship with maternal anaemia and iron status at = 25 weeks gestational age. All statistical analyses were performed with SPSS version 10 and p values = 0.05 were considered significant.

RESULTS

Out of the three hundred and fifty-one (351) pregnant women recruited at the beginning of the study, sample could not be collected from one and one died during the study. Three hundred and forty nine (349) pregnant women completed the study eventually. Their age ranged 15- 40 years (mean = 27. 04 ± 4. 75 years), with mean gestational age of 21.77±3. 14 wks and mean parity of 1.41 ± 1.46.

Figure 1

Table 1: Maternal anaemia and iron deficiency in relation to sociodemographic /obstetrics data at = 25 weeks gestational age

Maternal variables	No. Examined	Anaemia		Iron deficiency	
		No. deficient (%)	95% CI	No. Iron deficient (%)	95% CI
Age-groups (yrs) [a]					
≤ 19	16	14 (87.5)	71.3-103.7	9 (56.3)	31.7-80.3
20-24	85	59 (69.4)	59.6-79.2	60 (71.4)	60.9-80.3
25-29	136	95 (69.9)	62.2-77.6	84 (61.8)	53.5-70.0
30-35	107	80 (74.8)	66.6-83.0	66 (61.7)	52.4-71.0
> 35	5	4 (80.0)	44.9-115.6	3 (60.0)	17.1-102.9
Total	349	252 (72.2)	67.4-77.0	222 (63.6)	58.5-68.8
Educational level					
None	8	8 (100)	-	2 (25)	-0.05-55.0
Primary	42	33 (78.6)	66.3-90.9	24 (58.5)	42.2-72.1
Secondary	171	114 (66.7)	59.6-73.7	111 (64.9)	58.8-72.1
Tertiary	120	89(74.2)	66.0-82.4	80 (66.7)	58.2-75.1
Total	341	244 (71.6)	66.7-76.4	217 (63.6)	58.468.8

Figure 2

Occupation					
H/W	53	34 (64.2)	51.2-77.1	32 (60.4)	47.2-73.6
Student	61	44 (72.1)	60.6-83.6	40 (65.6)	53.6-77.5
C/S	143	109 (76.2)	69.2-83.2	92 (64.3)	56.3-72.4
Artisan	87	60 (69.0)	59.1-78.9	56 (64.4)	54.3-74.5
Farming	5	5 (100)	-	2 (40.0)	-2.9-82.9
Total	349	252 (72.2)	67.4-77.0	22 (63.6)	58.8-69.0
Parity [b]					
0	140	95 (67.9)	60.1-75.6	88 (62.8)	54.7-71.0
1	66	44 (66.7)	55.4-78.0	47 (71.2)	60.2-82.3
2	53	34 (64.2)	51.2-77.1	35 (66.0)	53.3-78.8
3	40	38 (95.0)	88.3-101.8	23 (57.5)	42.2-72.8
>3	50	41 (82.0)	71.4-92.7	29 (58.0)	43.4-72.6
Total	349	252 (72.2)	67.4-77.0	222 (63.6)	58.5-68.8
Living accommodation					
Single room	189	135 (71.4)	64.9-78.0	123 (65.1)	58.3-71.9
Flat	135	98 (72.6)	65.1-80.0	82 (60.7)	52.4-69.0
Bungalow	24	19 (79.2)	62.9-95.5	16 (66.7)	54.9-78.5
Total	348	252 (72.4%)	67.7-77.1	221 (63.5)	58.4-68.6
Antenatal visit [c]					
< 5	48	36 (75.0)	62.8-87.3	27 (56.3)	42.3-70.3
5-7	162	122 (75.3)	68.6-82.0	100 (61.7)	54.2-69.2
8-10	96	73 (76.0)	67.5-84.6	66 (68.8)	59.5-78.0
>10	36	14 (38.9)	23.0-54.8	24 (66.7)	51.3-82.1
Total	342	245 (71.6)	66.1-77.2	217 (63.5)	58.3-68.6

a,b,c represent variables showing significant differences ($p < 0.05$).

Table 1 shows the prevalence of anaemia and iron deficiency in relation to maternal demographic and obstetrics data. 252 (72.2%) and 222 (63.6%) of these women were anaemic and iron deficient respectively. For anaemic women, 0.3% was severely anaemic while 38.4% and 33.5% moderately and mildly anaemic, respectively. While anaemia was found among higher proportion of individuals in the age group =< 19 and > 35 years (87.5% and 80% respectively) with the same age groups recording lower prevalence of iron deficiency (56.3% and 60.0% respectively), highest prevalence of iron deficiency was recorded in the age group 21-24 years {60/85, 95% CI; 60.9-80.3}, the group that had least prevalence of anaemia, although these were not statistically significant ($X^2 = 12.873$, df = 12, $p > 0.05$). Although not statistically significant ($P > 0.05$), prevalence of anaemia decreased with maternal education al level, while maternal iron status decreased as maternal educational level increased. All participant without formal education were anaemic, while only 25% (2/8, 95% CI: -0.05-55.0) was iron deficient.

The prevalence of anaemia and iron deficiency were comparable in the occupation groups except farming where all the women were anaemic, although only 60% (95% CI: -2.9-82.9) was iron deficient.

Among the parity groups, although women who have had 3 deliveries had highest prevalence (38/40, 95.0%: 88.3-101.8) of anaemia, the group also had the least prevalence of iron deficiency (23/40, 95% CI: 42.2-72.8), which showed statistical significant difference in trend ($X^2 = 23.365$, df = 12, $p < 0.05$). Women with parity 1 had the highest prevalence of 71.2% (47/66, 95% CI: 60.2-82.3).

For living accommodation, although the women showed comparable iron status, women who live in Bungalow recorded highest prevalence of anaemia and iron deficiency of 79.2 and 66.7% respectively, but no significant difference ($p > 0.05$) was observed in the trend. Antenatal booking and attendance showed significant effect on haemoglobin concentration as women who attended antenatal clinic more than 10 times had least prevalence of anaemia (38.9%, 95% CI; 23.0-54.8) even though the prevalence of iron deficiency was comparable between the groups.

Figure 3

Table 2: Impact of maternal iron status and anaemia at = 25 weeks gestational age on foetal anthropometrics and duration of pregnancy

Birth outcomes	Iron Deficiency (n = 119)	Iron Adequate (n = 199)	p-values	Anaemic (n = 199	Non-anaemic (n = 119)	p-value
Birth weight	3.06 ± .50	3.05 ± 0.49	0.760	3.02 ± 0.52	3.12 ± 0.46	0.806
Birth length	50. 94 ± 4.93	50. 98 ± 4.18	0.941	51.23 ± 5.39	50. 49 ± 3.02	0.171
Head circumference	33.64 ± 2.72	33.71 ± 2.61	0.806	33.41 ± 2.68	34. 09 ± 2. 61	0.028*
Gestation age at delivery	39.19 ± 1.70	39.04 ± 1.79	0.459	38.96 ± 1.79	39.42 ± 1.59	0.023*

$p < 0.05$ is considered statistically significant.

Maternal iron status and anaemia were found not to be related to foetal birth weight and length as both parameters were comparable between iron deficient and iron adequate and between anaemic and non-anaemic women (table 2). However foetal head circumference while comparable ($p > 0.05$) between iron deficient and iron adequate groups was significantly ($p < 0.05$) higher (34.09 2.61 vs. 33.41 2.68cm) in non-anaemic than anaemic women. Similarly, while there was no significant difference ($p > 0.05$) in duration of pregnancy in the iron groups (table 2), women that were anaemic had significantly ($p < 0.05$) shorter duration of gestation when compared to the non-anaemic groups (38.42 ± 1.79 vs. 39.42 ± 1.59).

Figure 4

Table 3: Maternal and foetal outcomes in relation to maternal anaemia and iron status at = 25 weeks gestational age

Parameters	Anaemic (n = 199)	Non-anaemic (N = 119	Iron deficient (N = 199)	Iron adequate (N = 119)
Baby sex				
Male	122	61	115	68
Female	77	58	84	51
		P = 0.079		P = 0.910
History of DM				
No	207	118	205	120
Yes	9	4	8	5
		P = 0.683		P = 0.910
History of convulsion				
No	215	123	213	125
Yes	2	2	3	1
		P = 0.574		P = 0.621
Concomitant illness				
Malaria	44	30	47	27
UTI	34	19	31	22
Dyspepsia	15	13	16	12
URTI	7	1	5	3
UTI & Malaria	14	10	15	9
Others	18	5	15	8
None	46	48	88	46
		P = 0.405		P = 0.969
Mode of delivery				
SVD	165	108	176	97
Assisted	18	11	18	13
Surgical	16	1	8	9
		P = 0.021*		P = 0.241
Birth				
Live	190	116	192	114
Still	9	3	7	5
		P = 0.365		P = 0.757
Duration of gestation				
< 37 weeks	19	3	13	9
≥ 37 weeks	207	89	186	110
		P = 0.001		P = 0.726

UTI: Urinary tract infection; URTI: Upper respiratory tract infection; SVD: Spontaneous vaginal delivery

Table 3 shows the perinatal outcomes in relation to maternal iron status and anaemia. Although greater proportion of iron deficient and anaemic pregnant women had concomitant illnesses like urinary tract infection, malaria, URTI, dyspepsia, and DM than their iron adequate and non-anaemic counterparts, these were not statistically significant ($p > 0.05$). However, there was a significant difference between the anaemic groups in the mode of delivery. Surgically delivered babies were significantly more in anaemic than in non-anaemic group (16 vs. 1, $p = 0.021$) but comparable between the iron deficient and iron adequate group (8 vs. 9). Although more male babies and still births were recorded in anaemic and iron deficient mothers, these were not statistically significant ($p > 0.05$). While significantly more preterm deliveries were seen in anaemic than non anaemic mothers (19 vs. 3), the frequency of preterm deliveries were comparable between the iron deficient- and iron adequate group (13 vs. 9).

DISCUSSION

In the present study the prevalence of iron deficiency and anaemia among pregnant women at = 25 (mean; 21.77 ± 3.14 weeks) weeks gestation were 63.6% and 72.2% respectively. Although iron deficiency prevalence in a population has been reported to be difficult to estimate due to lack of sensitive indicator [20], plasma iron and haemoglobin concentration have been used in several studies to evaluate the iron status of pregnant women [9, 10]. Globally, the prevalence of iron deficiency and its anaemia is on the increase particularly in poorer countries [21]. Iron deficiency prevalence of 63.6% in pregnant women recorded in the present study is higher than 43.7% reported for Nigeria [11] in the National Food Consumption and Nutrition Survey of 2003. Also, anaemia prevalence of 72.2% in the present study, although higher than 40.4% recently reported by Dim and Onah [6] in Enugu, it is comparable to 67.4% reported in 1990 study in the same centre and 76.5% reported among pregnant women on Abeokuta, South Western, Nigeria [5]. Comparable anaemia prevalence had been reported in Bangladesh (77%), Nepal (65%), Sri Lanka (60%), but lower than 87.6% reported in India [3, 4] and 96.5% reported by Gautam et al. [22] among pregnant women in rural area of Delhi, India. This high prevalence of anaemia may be partly attributed to haemodilution as most women were recruited during the second trimester, a period associated with plasma volume expansion [5]. Most of the anaemia in this study is of the mild-moderate type with only 0.3% severely anaemic. This corroborates earlier finding among pregnant women in South Eastern Nigeria [6, 23, 24] except for the absence of severe anaemia in these studies and those of similar studies in Shagamu, Western Nigeria [25]. The finding of the present study however contradicts the general belief of iron deficiency being the most common cause of anaemia is pregnancy [26]. In this study there was an inverse relationship between anaemia and iron deficiency (i.e. high prevalence of anaemia was found in women with low prevalence of iron deficiency). The reason for this relationship is not known but anaemia in pregnant women may be a result of combination of factors including iron and folate deficiency, parasitic infections (malaria and hookworms), HIV/AIS and haemoglobinopathies [27]. Thus we may speculate that anaemia recorded in this population may be a result of combination of factors including, but not exclusively due to iron deficiency, a fact supported by the Sharma et al. [28] that anaemia in pregnancy is sometimes not corrected despite iron supplementation. It has been found that the more severe the anaemia, the more likely it is to have multiple causes and not be related solely to iron deficiency [29]. Deficiencies of copper, zinc and vitamin A may also be contributory factors for the high prevalence of anaemia recorded in this study as these micronutrients have been found to be involved in erythropoiesis and iron metabolism [30] and deficiencies of copper and zinc have been found in this population (Ugwuja, In press). Significantly higher prevalence of anaemia among multiparous contrasts the findings of other studies [5, 31]. The reason for this disparity is not obscure, but one possible explanation of the difference is that severe anaemia was considered in those earlier studies rather than anaemia as a whole. Another likely reason for the variation may be due to maternal depletion associated with multiparity and short inter-pregnancy intervals [32]. Multiparous women with short inter-pregnancy intervals may not have had sufficient time to replace nutrients used during previous pregnancy and thus may enter another pregnancy with compromised nutrition. Also higher prevalence of anaemia in women <19 years is in corroboration with the observations of earlier studies [5] but contrasts the findings of previous studies in South Eastern Nigeria [6, 33]. The difference may be attributable to the study design. While theirs were retrospective study with attendant documentation inadequacies, the present study was prospective. However, high prevalence of anaemia in age group > 35 years supports our speculation of maternal depletion syndrome as responsible for the anaemia in multiparous women in the present study. This study also highlighted the importance of antenatal booking and attendance in improving maternal health during pregnancy in corroboration with earlier study [5] as antennal attendance of >10 times was found to be associated with reduction in anaemia prevalence. Early antenatal booking and regular attendance at antenatal clinic (ANC) ensures better monitoring and early detection of anaemia and the institution of appropriate corrective measures.

The higher prevalence of anaemia recorded among women whose occupation was farming and among women with low education status, although not statistically significant, points to the role which maternal education plays in ensuring good nutrition and health. Enlightened mothers are more likely to maintain good hygiene and be able to eat balanced diet that may ultimately lead to the reduction of risk factors associated with anaemia.

For pregnancy outcomes, only foetal head circumference and duration of pregnancy were related to maternal anaemia with maternal iron lacking effect on the main outcome measures. The higher proportion of preterm delivery in anaemic than non-anaemic women in the present study is in concordance with several other findings [15, 34, 35]. Although low birth weight had been reported [36], 37] in pregnant women due to poor plasma volume expansion, we did not find such association. The only maternal outcome that was significantly ($p < 0.05$) associated with maternal anaemia, but not maternal iron status, was mode of delivery. The higher proportion of surgically delivered babies in anaemic than non- anaemic women may be partly attributed to maternal weakness [7] to undergo proper spontaneous vaginal delivery due to anaemia. Also, anaemia is associated with reduced transportation of oxygen and nutrients which may be injurious to both the mother and the foetus.

CONCLUSION

From this study, it is possible that apart from iron deficiency, other factors that predispose pregnant women to the development of anaemia may play important role in determining birth outcomes with more anaemic women delivering through caesarean section, having more preterm deliveries and infant with lower head circumference. However, we did not find any association between maternal anaemia and iron deficiency on birth weight or maternal concomitant illnesses during pregnancy.

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