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**Prevalence of Anaemia and Iron Deficiency Anaemia among Pregnant Women in a Nigerian Rural Community***Okafor, I.M.\*<sup>1</sup>, Ibanga, I.A.<sup>2</sup> and Asuquo, J. I.<sup>1</sup>**Department of Medical Lab. Science, Haematology Unit, College of Medical Sciences University of Calabar, Calabar, Nigeria<sup>1</sup>, Haematology Department, College of Medical Sciences University of Calabar, Calabar, Nigeria<sup>2</sup>.**Author for Correspondence\*: okaforify12@gmail.com/okaforify@unical.edu.ng/+234-808-068-0620***Abstract**

Anaemia, especially iron deficiency anaemia, is one of the most common nutritional deficiency diseases observed globally and affects more than a quarter of the world's population. It is a major public health problem affecting all ages of the population with its highest prevalence among children under five years of age and pregnant women. This research examined the iron status of pregnant women in Akpabuyo, Cross River State. Fifty pregnant women within the age range of 15-45 years from St. Joseph's Hospital, Ikot Ene in Akpabuyo Local Government Area of Cross River State were recruited as subjects in this study. The control consisted of fifty age-matched apparently healthy non-pregnant women. The tests that were carried out using standard method include full blood count (packed cell volume, haemoglobin, mean cell haemoglobin, mean cell haemoglobin concentration and red cell count), serum iron, total iron binding capacity, transferrin saturation, serum ferritin, soluble transferrin receptor and soluble transferrin receptor/ferritin ratio. The prevalence of anaemia and iron deficiency anaemia were found to be significantly higher ( $p < 0.05$ ) among pregnant women (76.0%, 32.0%) when compared to non-pregnant women (16.0%, 3.0%). The mean haemoglobin, haematocrit, serum iron, serum ferritin and transferrin saturation were significantly reduced ( $p < 0.01$ ) in pregnant than non-pregnant women while total iron binding capacity and soluble transferrin receptor were significantly higher among the pregnant subjects compared to the non-pregnant controls ( $p < 0.01$ ). It was also shown that pregnant women in their third trimesters and multigravidae had the highest prevalence of anaemia and iron deficiency anaemia while prevalence of anaemia was significantly higher among the pregnant women in their second trimester. In conclusion the study has shown that the prevalence of anaemia and iron deficiency anaemia among pregnant women in the

studied area is indeed very high and can be considered a public health problem.

**Keywords:** Anaemia, Iron deficiency, soluble transferrin receptor

**Introduction**

Iron requirements are greater in pregnancy than in the non-pregnant state. Although iron requirements are increased in the first trimester because of the absence of menstruation, they decrease steadily thereafter; the total requirement of a 55-kg woman is approximately 1000 mg (Bothwell, 2000). Translated into daily needs, the requirement is approximately 0.8 mg Fe in the first trimester, between 4 and 5 mg in the second trimester, and  $>6$  mg in the third trimester (Bothwell, 2000). The amounts that can be absorbed from even an optimal diet, however, are less than the iron requirements in later pregnancy and a woman must enter pregnancy with iron stores of  $\geq 300$  mg if she is to meet her requirements fully (Armstrong, 2011; Hallberg, 1991). This is more than most women possess, especially in developing countries. The overall iron requirement during pregnancy is significantly greater than that in the non-pregnant state despite the temporary respite from iron losses incurred during menstruation. Iron requirements increase notably during the second half of pregnancy because of the expansion of the red blood cell mass and the transfer of increasing amounts of iron to both the growing foetus and the placental structures (Kaufer *et al.*, 1990). Iron is also lost in maternal blood and lochia at parturition. The degree to which these increased requirements can be met depends on the size of iron stores at the start of pregnancy and on the amounts of dietary iron that can be absorbed during pregnancy. The fact that iron deficiency anaemia frequently develops in pregnancy indicates that the physiologic adaptations are often insufficient to meet the increased requirements. As a result, iron

supplementation during pregnancy is a common practice throughout the world. In developing countries, the causes of anaemia during pregnancy are multifactorial and include nutritional deficiencies of iron, folate, and vitamin B12 and also parasitic diseases, such as malaria and hookworm (Ketyalew and Abhudulahi, 2014). The relative contribution of each of these factors to anaemia during pregnancy varies greatly by geographical location, season, and dietary practice. In Sub-Saharan Africa, iron and folate deficiencies are the most common causes of anaemia in pregnant women (Ketyalew and Abhudulahi, 2014). Anaemia, especially iron-deficiency anaemia, is the most common nutritional deficiency worldwide and remains a major contributing factor to maternal morbidity and mortality (Kumar *et al.*, 2014). In developing countries, where the prevalence of iron deficiency is high and the severity of anaemia is marked (Okafor *et al.*, 2014). Studies on prevalence of anaemia and iron deficiency anaemia in different population groups can provide important information as a valuable basis for action programmes. The aim of this study is study is to assess the prevalence of iron deficiency anaemia in a rural community in Cross River State, Nigeria.

## Materials and method

### Study setting and design

This study is a community based cross-sectional case-control study conducted in Ikot Ene, Akpabuyo Local Government Area of Cross River State.

### Study Population

The study population consisted of a cohort of pregnant women who were residing in the town during the study period and who came for booking at the antenatal clinic of St. Joseph's Hospital, Ikot Ene in Akpabuyo Local Government Area, Cross River State. Fifty pregnant women within the age range of 15-45 years were recruited as subjects in this study. Fifty age-matched apparently healthy non-pregnant women were monitored as controls.

### Data Collection

Data were collected using a pre-tested interviewer administered questionnaire, which contains sociodemographic characteristics (age, education, occupation, marital status), obstetric and gynaecological history (trimester, gravidity, parity, ANC follow up, iron supplementation). Full blood count was carried out using the PCE-210 version 5.10 3-part differential fully automated haematology analyser (ERMA Inc., Tokyo). Serum iron and TIBC were determined using the Teco Diagnostics serum iron kit (Teco Diagnostics Anaheim, U.S.A) while the

transferrin saturation was determined using this formula-

$$TS = \frac{\text{Serum Iron concentration} \times 100}{\text{TIBC}}$$

Ferritin was determined using the Diagnostic Automation (Diagnostic Automation, Inc. Calabasas USA) human ferritin enzyme immunoassay test kit. Soluble Transferrin Receptor was measured using human soluble transferrin receptor ELISA Kit (Biovendor Diagnostics, USA). The manufacturer instruction was obeyed when using all the kits.

### Data Processing and Analyses

Data obtained were analysed using Statistical Package for the Social Sciences (SPSS version 16.0, SPSS Inc., Chicago, USA). Independent sample *t*-test, Chi square and one-way analysis of variance was used. A *p*-value of  $\leq 0.05$  was considered statistically significant.

### Ethical Consideration

Ethical clearance was obtained from the Cross-River State Ministry of health ethical committee. Written informed consent was obtained from each study participant after they were introduced to the purpose of the study and informed about their rights to interrupt the interview at any time. Confidentiality was maintained at all levels of the study. Mothers found to be anaemic were referred to an obstetrician for management.

### Result

#### Demographic characteristics of the study groups

are presented in table 1. The result shows that 75.0% of pregnant women were house wives and the rest were mostly students or teachers. Sixty (60.0%) and 8.00% of the study groups had secondary and tertiary education respectively while thirty-four (34.0%) of the pregnant women involved in this study were on iron supplementation. The mean haemoglobin (10.03±0.24), haematocrit (0.31±0.08), serum iron (93.04±5.7), serum ferritin (30.11±4.8) and transferrin saturation with iron (25.61±1.77) were significantly reduced ( $p < 0.01$ ) in pregnant than non-pregnant women while total iron binding capacity (410.25±18.97) and soluble transferrin receptor (3.38±0.41) significantly ( $p < 0.01$ ) increased in pregnant than non-pregnant women (Table 2). Anaemia was defined as  $11 < 11 \text{ g/dl}$  in pregnancy and  $\text{Hb} < 12 \text{ g/dl}$  in non-pregnant women. Severe anaemia was defined as  $\text{Hb} < 7 \text{ g/dl}$  (WHO, 2005), Iron deficiency anaemia was defined using  $\text{sTfR} > 2.4 \mu\text{g/ml}$  and  $\text{Hb} < 11 \text{ g/dl}$  in pregnant women or  $\text{Hb} < 12 \text{ g/dl}$  in non-pregnant women while anaemia of

infection was defined using sTfR < 2.4ug/ml and Hb>11g/dl in pregnant women or Hb >12g/dl in non-pregnant women (Okafor et al., 2017). The prevalence of anaemia and iron deficiency anaemia among the pregnant subjects is shown in table 3. Severe anaemia was defined as Hb <7g/dl (WHO, 2005), Iron deficiency anaemia was defined using sTfR >2.4ug/ml and Hb <11g/dl in pregnant women or Hb <12g/dl in non-pregnant women while anaemia of infection was defined using sTfR < 2.4ug/ml and Hb>11g/dl in pregnant women or Hb >12g/dl in non-pregnant women. The prevalence of anaemia, anaemia of infection and iron deficiency anaemia was 76.00%, 44.00%, 32.00% respectively. The prevalence anaemia, anaemia of infection and iron deficiency anaemia was significantly higher among pregnant women when compared to non-pregnant women (p<0.05). Normocytic normochromic

anaemia and microcytic hypochromic anaemia are significantly higher (p<0.05) among the pregnant subjects [27(54.0%) and 8(16.0%)] respectively when compared to non-pregnant controls [3(6.0%), 4(8.0%)] respectively as shown in table 4. The table also shows that normocytic normochromic anaemia and microcytic hypochromic anaemia are the most prevalent form of morphologic anaemia observed among the pregnant women. Pregnant women in their third trimester had the highest prevalence of iron depletion, iron deficiency and iron deficiency anaemia while multigravidae and the pregnant women in their second trimester recorded highest prevalence of anaemia. When the pregnant women were grouped according to age (Table 5), those within the age range of 15-30 years had the highest prevalence of iron depletion, anaemia, iron deficiency and iron deficiency anaemia.

**Table 1: Demographic characteristics of the study groups**

Variables	Pregnant women (n=50)	Non- Pregnant women (n=50)
-	-	28.50 ± 13.30
Occupation		
House wife	75(75.0%)	19(38.00%)
Others	25(25.0%)	31 (62.00%)
Level of Education		
Primary	32(32.0%)	7(14.00%)
Secondary	60(60.0%)	15 (30.00%)
University	8(8.00%)	28(56.00%)
Number on iron Supplementation	34(34.0%)	-

**Table 2: Haematological and biochemical parameters of pregnant subjects and non-pregnant controls**

Parameters	Non-pregnant women (n=50) Mean ± SEM	pregnant women(n=50) Mean ± SEM
Hb (g/dl)	12.32±0.20	10.03±0.24*
Hct (l/l)	0.37±0.07	0.31±0.08*
MCV (fl)	80.94±1.40	80.73±0.91
MCHC (g/dl)	32.96±0.54	30.84±0.17
MCH (pg)	27.11±0.54	25.62±0.37
RBC (g/l)	4.51±0.11	4.17±0.03
SI (ug/dl)	106.46±7.68	93.04±5.7**
SF (ng/ml)	54.64±7.76	30.11±4.88**
TIBC (ug/dl)	355.3±11.14	410.25±18.97*
TS (%)	29.66±2.0	25.61±1.77**
STfR (ug/ml)	1.39±0.12	2.46±0.41**

**Key:**

\*\*means significantly different when compared to corresponding non-pregnant women values ( $p < 0.01$ )

\*means significantly different when compared to corresponding non-pregnant women values ( $p < 0.05$ ).

**Table 3: Prevalence of Anaemia and Iron deficiency Anaemia among the pregnant subjects and non-pregnant controls.**

	Non-pregnant women (n= 50)	Pregnant women (n=50)
<b>Anaemia</b>		
Prevalence of anaemia	16(16.0%)	38(76.0%)*
Severe anaemia	0	0
Prevalence of Anaemia of infection	13(13.00%)	22(44.00%)*
Prevalence of Iron deficiency anaemia	3(3.00%)	16(32.00%)*

**Key**

\*These values are significantly different from the corresponding values of non-pregnant women ( $p < 0.05$ ).

**Table 4: Morphological classification of anaemia among pregnant women**

Morphologic type of anaemia	Non-pregnant women (n=50)	Pregnant women (n=50)
Microcytic hypochromic anaemia (MCV <78fl , MCH < 26pg and Hb<11g/dl)	5(5.00%)	8(16.00%)*
Microcytic normochromic anaemia (MCV <78fl, MCH > 26pg and Hb<11g/dl)	2(2.00%)	3(6.00%)*
Normocytic normochromic anaemia (MCV >78fl but <95fl, MCH>26pg and Hb<11g/dl)	9(9.00%)	27(54.00%)*
Macrocytic normochromic anaemia ( MCV > 95fl , MCH > 26pg and Hb<11g/dl)	0	0

**Key**

\*These values are significantly different from the corresponding values of non-pregnant women ( $p < 0.05$ ).

**Table 5: Classification of Iron Status of Pregnant Subjects based on Trimester, Age and Gravidity**

Index	Anaemia	Iron Deficiency	Iron Deficiency Anaemia	Iron Depletion
(n=50)	38(76.00%)	20(40.00%)	16(32.00%)	23(46.00%)
1st Trimester(n=18)	14(77.70%)	5(27.70%)	4(22.20%)	8(44.40%)
2nd Trimester(n=15)	13(86.60%)*	7(46.60%)	5(33.30%)	6(40.00%)
3rd Trimester(n=17)	11(64.70%)	8(47.10%)*	7(41.20%)*	9(52.90%)*
Primigravidae(n=14)	9(64.20%)	6(42.90%)	3(21.40%)	8(57.40%)#
Multigravidae(n=36)	27(75.00%)#	14(38.90%)	13(36.10%)#	15(41.70%)
15-30years(n=27)	21(77.80%)**	12(44.40%)**	10(37.30%)*	14(51.90%)**
31-35years(n=23)	17(73.90%)	8(33.30%)	6(26.10%)	9(39.10%)



### Key

\*These values are significantly higher when compared to other trimesters ( $p < 0.05$ )

#These values are significantly higher when compared to the other gravidae ( $p < 0.05$ )

\*\*These values are significantly higher when compared to the other age group ( $p < 0.05$ )

### Discussion

More than half (76.0%) of the pregnant women studied were anaemic. The prevalence of anaemia recorded in this study is higher than that recorded in some parts of Nigeria; Abeokuta Nigeria (20.7%) (Ogbeide *et al.*, 1994) and Calabar Nigeria (20.0%) (Okafor *et al.*, 2013). Our observed prevalence of anaemia is also higher than prevalence observed in Ethiopia (56.8%) (Ketyalew and Abhudulahi, 2014). This variance may be attributable to the differences in the geographical location of the study population. Our finding is however consistent with the result (76.8%) obtained by Idowu *et al.* (2005) in Benin Nigeria as well as that obtained in some other developing countries such as India and Pakistan (Esmat *et al.*, 2010; Toteja *et al.*, 2006). The similarity may be due to the inclusion of more rural villages in their studies, which were similar to this study.

The high incidence of anaemia (76.0%), iron depletion (46.0%), iron deficiency (40.0%) and iron deficiency anaemia (32.0%) recorded among the pregnant women from this rural community may be attributed to their diets which is mostly vegetarian. The more bioavailable haem iron is present only in meat products and is therefore not present in vegetarian diets. It has been shown that vegetarians have lower serum ferritin (Armstrong, 2011; Singh *et al.*, 1998) and that meat intake specifically increases serum ferritin. It may also be attributed to the level of education of the pregnant women that were involved in this study. Majority of them had only primary and secondary education and they were also predominantly housewives which may impact negatively on the economic situation of their family. This finding is consistent with the findings from other studies in low and middle-income countries, which found that the risk of anaemia among women living in the lowest wealth quintile was increased when compared with those living in the fourth and fifth wealth quintiles (Ketyalew and Abhudulahi, 2014). A study done in India showed that pregnant women from lower socioeconomic classes were at increased risk of developing anaemia compared with those in higher socioeconomic classes (Vivek *et al.*, 2012; Balarajan *et al.*, 2011). This could be due to the fact that those from lower socioeconomic status lack the ability to purchase the quality or quantity of foods compared with those from higher socioeconomic status.

Gravidity and age of current pregnancy (trimester) were important variables, which have shown a significant association with anaemia, iron deficiency, iron deficiency anaemia and iron depletion in the current study. The risk of developing anaemia increases with the age of pregnancy (trimester). The prevalence of anaemia was higher in the second trimester while iron deficiency, iron deficiency anaemia and iron depletion were higher in the third trimester when compared with those in the first trimester. This finding is consistent with a study done in Saudi Arabia, which found that the prevalence of anaemia is higher in the third trimester in comparison with first trimester (Elzahrani, 2012). Similarly, another study conducted in India indicated that the prevalence of anaemia was higher in pregnant women in the third and second trimesters (Vivek *et al.*, 2012). Additionally, studies conducted in Malaysia, Vietnam and Nepal found that increased gestational age is significantly associated with the risk of developing anaemia (Ketyalew and Abhudulahi, 2014; Makhoul *et al.*, 2012; Aikawa *et al.*, 2006). This could be due to the fact that when the gestational age increases the mother becomes weak and the iron in the blood is shared with the foetus in the womb therefore decreasing the iron binding capacity of the mother's blood. Secondly the peak of anaemia recorded in this study (2<sup>nd</sup> trimester) coincides with the period when haemodilution is at its peak. This may have contributed to the high prevalence recorded in the second trimester, indicating that anaemia is further aggravated by haemodilution in pregnancy.

The other important variable significantly associated with anaemia is number of pregnancies (gravidity). Our study recorded higher prevalence of anaemia and iron deficiency anaemia in pregnant women with more than one pregnancies (multigravidae) compared to those who had one pregnancy (primigravidae). This finding is consistent with studies conducted in another part of Nigeria, Saudi Arabia and India, which found that increased number of pregnancies and deliveries is positively associated with the risk of developing anaemia (Okafor *et al.*, 2016; Elzahrani, 2012; Vivek *et al.*, 2012). This could be due to the loss of iron and other nutrients during increased and repeated pregnancies and there is also the possibility of sharing of resources with the foetus. However, other studies conducted in Ethiopia and Nepal did not find association between gravidity and

anaemia (Makhoul *et al.*, 2012; Haider, 2010). This could be due to the difference in sociocultural characteristics of the study populations. In the current study, it was found that anaemia, iron deficiency anaemia and iron depletion were significantly higher among the lower age group. In the Dugdale (2006) study, haemoglobin levels were negatively and significantly correlated with increasing age.

Morphologically, most of the anaemia were normocytic-normochromic (54.0%) and 16.0% were microcytic-hypochromic. Despite the high proportions of folate deficiency commonly reported in anaemic pregnant women, macrocytic anaemia was not found in this study. Leyla *et al.* (2010) stated in their work that concurrent presence of iron deficiency and folate deficiency result in normocytic anaemia. The mean haematological values for the anaemic women in our study confirmed this inference. In anaemic women, iron and folate deficiencies are always common (Okafor *et al.*, 2017), in this study the mean MCV value was close to the lower limit, mean Hb value were 10.03g/dl and anaemia of infection was 13.0% showing that there was a mixed anaemia with the dominant cause being iron deficiency.

In conclusion, this study has shown that the iron status of pregnant women in the studied area needs to be improved. The 76.0% and 32.0% prevalence of anaemia and iron deficiency anaemia recorded among pregnant women in this rural community is indeed very high and should be considered a public health problem. Iron supplementation and public health advocacy on the need for pregnant women to attend antenatal right from first trimester especially in our rural communities should be encouraged.

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