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Nutritional Anemia Screening in Pregnant Women in Umuahia North Local Government Area, Abia State, Nigeria

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ABSTRACT

This study was designed to evaluating these critical nutritional anemia indices associated with causal link within the semi-urban and urban areas of Umuahia North Local Government area of Abia State. Nigeria. One hundred (100) consenting pregnant women were used for the study. A semi-structured interviewer administered questionnaire was used to obtain information on sociodemographic, socioeconomic characteristics. Blood samples were collected under sterile condition and haemoglobin concentrations, packed cell volume, red blood cell, selenium, iron, folate, and some vitamins were determined. Results showed that iron and selenium concentrations of pregnant women who attended semi-urban hospital was significantly ($p<0.05$) higher than those who attended urban. The vitamin B_{12} concentration was significantly ($p <0.05$) lower for pregnant women who attended semi-urban hospital compared to those who attended urban. However, Vitamin A and Vitamin B_9 concentrations of pregnant women who attended semi-urban hospital were not significantly ($p>0.05$) different. Red blood cell showed that pregnant women who attended urban hospital was significantly ($p<0.05$) higher than those who attended semi-urban hospital while there was no significant ($p>0.05$) difference was observed for Hb and PCV. The evaluation of blood samples for malaria revealed 10% and 22% prevalence for both urban and semi-urban hospitals respectively. Overall prevalence of anemia observed among all pregnant women was 14%. Severe anemia was not found in any of the participants. The study established that presence of anemic pregnant mothers that showed better awareness in the urban areas than the semi-urban areas. However, continuous education of women of reproductive age on early antenatal booking and compliance with the use of prescribed medications (iron supplements, folate and antimalarial) should also be emphasized to reduce to the barest minimum, the problem of anemia in pregnancy in the studied area and Nigeria at large.

KEYWORDS

Anemia*;* Pregnant women; Haemoglobin

INTRODUCTION

Anaemia remains a widespread public health problem. Anaemia is characterized by low haemoglobin concentration with subsequent impairment in meeting the oxygen delivery demands of tissues. When the haemoglobin concentration decreases, the capacity of the

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blood to carry oxygen to tissues is compromised, resulting in symptoms such as fatigue, reduced physical work capacity, and shortness of breath, among others. Anaemia accounts for nearly 9% of the world's total disability and results in important health and economic consequences, including impaired immune response, maternal mortality, cognitive and developmental delays, and decreased productivity [1,2]. Anaemia's are frequently classified by their cause (e.g. nutritional anaemia's or haemolytic anaemia's), but can also be distinguished by the size, shape and colour of the red blood cells. "Nutritional anaemia's" result when the intake of certain nutrients is insufficient to meet the demands for synthesis of haemoglobin and erythrocytes [2]. Deficiencies of vitamins A, B_2 (riboflavin), B_6 (pyridoxine), B_{12} (cobalamin), C, D and E, folate and copper can also result in anaemia, owing to their specific roles in production of haemoglobin or erythrocytes.

Anaemia during pregnancy has been associated with poor maternal and birth outcomes, including premature birth, low birth weight and maternal, perinatal and neonatal mortality [3]. Anaemia is a particularly important complication of malaria in pregnant women, especially those who are pregnant for the first time, who are susceptible to severe anaemia. Nevertheless, a 10 g/L increase in haemoglobin has been estimated to decrease the risk of maternal mortality by 29%, and perinatal mortality by 28% [4,5]. In pregnant women, global prevalence has decreased only slightly from 41.6% in 2000 to 40.1% in 2016. Among women who are not pregnant, it has risen slightly from 31.1% to 32.5% over the same time. Anaemia in the first or second trimester significantly increases the risk of low birth weight and preterm birth [6]. Prenatal iron supplementation increases birth weight and significantly reduces the risk of low birth weight, but not preterm birth [6,7]. However, despite strong biological plausibility for a causal link between maternal haemoglobin concentration and adverse maternal and birth outcomes, a causal relationship has not been established for all outcomes, and results are inconsistent. Thus, essence of evaluating these critical nutritional anaemia deficient indices associated with causal link within the semi-urban and urban areas of Umuahia North Local Government area of Abia State, Nigeria.

MATERIAL AND METHODS

The Study Area

The study was carried out in Umuahia North, Abia State. Two (2) hospitals namely; Urban, Umuahia (urban) and Semi-Urban Hospital Umuahia (Semi-urban) were randomly selected from the Local Government area of the study (Figure 1).

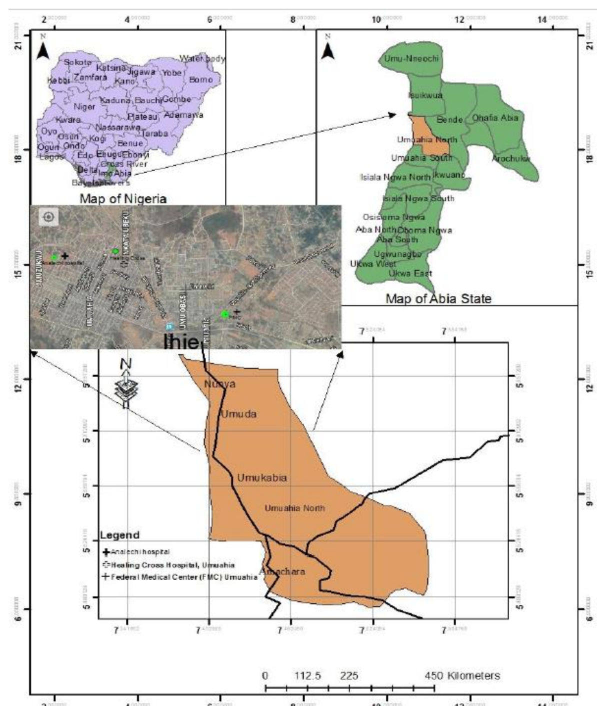

Figure 1: Map of the study locations.

Method of Data Collection

The research method adopted an independent random sampling and information on the participants through administered 50 copies of questionnaires each to the respondents (pregnant women) in the urban location. Another, 50 copies of questionnaires each to the respondents (pregnant women) in the semi-urban location, with the assistance of laboratory technicians across the designated hospitals were the study was carried out. The laboratory technicians helped immensely in fast-tracking the administration and collection of questionnaires and blood samples.

Sample Collection and Processing

Venous blood samples were collected from the respondents (pregnant women) using syringe and needle, into bottles containing anticoagulant (EDTA) for haematological assay. The blood samples for other biochemical studies were collected in plain bottles. The blood samples were allowed to clot for 25 minutes and then centrifuging at 3000 rpm for 10 minutes. The serum was aspirated using a Pasteur pipette into clean dry sample bottles.

Biochemical Analyses

Determination of haematological parameters

This was determined using automated hemolyzer using manufacturer's operational guidelines. The automated hemolyzer counted and sized red blood cells (RBC) and platelets (PLT) using electronic resistance detection. Haemoglobin (HGB) is converted to methaemoglobin and read photometrically at 555 nm.

Determination of selenium concentration

Selenium concentration in blood was determined using the method of Jacobson and Lockitch. Selenium was measured by electrothermal atomic absorption spectrometry (ET-AAS) using a pyrolytic tube. Samples were analysed without digestion by use of palladium matrix modification. The matrix modifier contained palladium nitrate (1 g/L), hydrochloric acid (32 ml/L), magnesium nitrate (1 g/L) and triton x (0.1 ml/L) in water.

Determination of folate

Folate concentration was determined by plasma microplate enzyme immunoassay, as described by Tietz [8]. The folic acid ELISA kit is a competitive ELISA for the quantitative measurement of folic acid. The unknown folic acid samples or folic acid standards are first added to a folic acid Conjugate pre absorbed microplate. After a brief incubation, an anti-folic acid polyclonal antibody is added, followed by an HRP conjugated secondary antibody. The folic acid content in unknown samples is determined by comparison with a predetermined folic acid standard curve.

Determination of vitamin B_{12}

Vitamin B_{12} concentration was determined by plasma microplate enzyme immunoassay, as described by Tietz [8]. Vitamin B_{12} determination is based on competitive ELISA for its quantitative measurement.

Determination of iron

Serum iron concentration was estimated spectrophotometrically using the Tulip diagnostic kit as described by Siedel. Iron bound to transferrin is released in an acidic medium and the ferric ions are reduced to ferrous ions. The Fe(III) ions react with ferrozine to form a violet colored complex. Intensity of the complex formed is directly proportional to the amount of iron present in the sample.

Determination of vitamin A (retinol)

Vitamin was determined by the method described by Balmer and Blomhoff. Vitamin A determination was based on Reverse-Phase HPLC method of retinol analysis.

Presence of malaria parasite (using rapid diagnostic test)

Malarial parasite was determined by the method described by Obeagu et al. [9]. The rapid diagnostic test works based on immunochromatographic principle, with the formation of antigen-antibody complexes with the specific malaria antigen released from lysed blood. The specific malaria antigen is identified by its binding to dye-labeled antibodies bound to the strip to produce a visible band on the strip of nitro-cellulose, often encased in plastic housing, referred to as cassettes.

Statistical Analysis

In this study, the descriptive analysis (frequency, simple percentage) was used to analyze the response of the respondents. Data from biochemical analysis were analysed using independent sample t-test with $p < 0.05$ considered as statistically significant.

Characteristics	Urban Hospital		Semi-Urban Hospital	
	Frequency	Percentage	Frequency	Percentage
Gender				
Male	-	-	-	-
Female	50	100	50	100
Total	50	100	50	100
Age				
15-22 years	4	8	9	18
23-30 years	19	38	23	46
31-38 years	23	46	16	32
39-46 years	4	8	1	2
Total	50	100	50	100
Marital Status				
Married	50	10	46	92
Single	-	-	2	4
Divorced	-	-	2	4
Total	50	100	50	100
Number of Children				
0	14	28	21	42
1 to 2	22	44	11	22
3 to 4	14	28	10	20
4 and above	-	-	8	16
Total	50	100	50	100
Academic Qualification				
SSCE	12	24	14	28
NCE/OND	10	20	18	36
HND/BSC	25	50	13	26
MSC	3	6	4	8
PhD	-	-	1	2
Total	50	100	50	100
Employment Status				
Self employed	9	18	13	26
Public servant	23	46	17	34
Private sector	11	22	7	14
NGO	-	-	4	8
Unemployed	7	14	9	18
Total	50	100	50	100
Work Experience				
0 to 4	18	36	37	74
5 to 9	13	26	12	24
>10	17	34	1	2
Total	50	100	50	100

Table 1: Socio-demographic and socioeconomic characteristics of respondents.

RESULTS

Socio-Demographic and Socioeconomic Characteristics of Respondents

A total of 100 respondents participated in the study, among which are 50 respondents from the hospital situated in an urban area and another 50 respondents from hospital in a location considered to be semi-urban. All the respondents are women, majority of the women 23(46.0%) from URBAN were in the age range of 31 years - 38 years, while 23 (46.0%) from Semi-urban hospital were in the age range of 23 years - 30 years. All the respondents from urban are married, while 46(92.0%) married, 2(2.0%) single, and 2(2.0%) divorced were observed for semi-urban hospital. The respondents cut across several ethnic groups, but Igbo as a single ethnic group had the highest number of respondents 84(20.7%). Among the respondents from urban area, 22(44.0%) already had children in the range of 1-2, while in semi-urban hospital, majority 21(42.0%) had no child yet. Most of the respondents 25(50%) from urban area are HND/Bachelor's degree holders and majority 18(36.0%) from semi-urban hospital are NCE/OND holders. A larger proportion (46% and 34%) of the respondents were public servants from both urban and semi-urban hospitals respectively (Appendix 1).

Haemoglobin (g/dl)	Frequency	Prevalence (%)
10.00 - 10.99	2	4
11.00 - 11.99	2	4
12.00 - 12.99	5	10
13.00 - 13.99	9	18
14.00 - 14.99	14	28
15.00 - 15.99	8	16
16.00 - 16.99	7	14
17.00 - 17.99	2	4
18.00+	1	2
Total	**50**	**100**

Table 1A: Prevalence of anemia among pregnant women attending urban hospitals.
Note: Hb level <11 g/dl is considered anemic using World Health Organization criteria.

Haemoglobin (g/dl)	Frequency	Prevalence (%)
7.00 - 7.99	2	4
9.00 - 9.99	1	2
10.00 - 10.99	2	4
11.00 - 11.99	4	8
12.00 - 12.99	4	8
13.00 - 13.99	9	18
14.00 - 14.99	9	18
15.00 - 15.99	6	12
16.00 - 16.99	7	14
17.00 - 17.99	3	6
18.00 - 18.99	2	4
20.00 - 20.99	1	2
Total	**50**	**100**

Table 1B: Prevalence of anemia among pregnant women attending semi-urban hospital.
Note: Hb level <11g/dl is considered anemic using World Health Organization criteria.

Anemia in the Sampled Population

Clinically, anemia is considered for haemoglobin levels below 11.0 (g/dl). The (Table 1A and Table 1B) indicate the distribution frequency and prevalence of anemia in the urban and semi-urban sampled populations.

Micronutrient Distributions of Urban and Semi-urban Respondents

An obvious outcome of inadequate intake of micronutrients is a reduction in hemoglobin biosynthesis, present as nutritional anemia. However, Table 2 below indicates a significant ($p < 0.05$) increase in iron and selenium in semi-urban respondents compared to those for urban respondents. This could suggest that although the respondents consumed both iron and selenium rich foods and supplements, parasitic infestations (parasitaemia) observed for the semi-urban respondents, as well as other possible factors may have contributed to their anemia through depletion of red blood cells considering that even vitamin B_{12} concentration was significantly ($p < 0.05$) lower for pregnant women who attended semi-urban Hospital compared to those who attended urban.

	Vitamin A (µg/dl)	Vitamin B9 (µg/dl)	Vitamin B12 (pg/ml)	Iron (µg/dl)	Selenium (µg/dl)
Semi-Urban	46.74 ± 12.80	7.42 ± 2.81	349.20 ± 121.71	60.00 ± 21.24	7.48 ± 2.74
Urban	46.87 ± 11.07	22.40 ± 92.47	398.66 ± 87.68	20.48 ± 2.90	6.59 ± 2.68
p-value	0.959	0.258	0.022	0.016	0.047

Table 2: Vitamin and mineral status assay for pregnant women.
Note: Data expressed as Mean ± SD. The *p*-value is analyzed using the t-test and considered significantly different at $p < 0.05$.

	Hb (g/dl)	PCV (%)	RBC × 10^6 mm^3
Semi-Urban	14.00 ± 2.62	35.36 ± 6.69	4.31 ± 0.76
Urban	14.32 ± 1.71	36.50 ± 4.18	4.46 ± 0.44
p-value	0.472	0.31	0.04

Table 3: Result for haematological status assay for pregnant women.
Note: Data expressed as mean ± SD. The *p*-value is analyzed using the t-test and considered significantly different at $p < 0.05$.

Haematological Indices of Urban and Semi-urban Respondent

Table 3 below showed that the red blood cell of the pregnant women who attended urban was significantly ($p < 0.05$) higher than those who attended semi-urban hospital. Also, there was no significant ($p > 0.05$) difference was observed for Hb and PCV.

Presence of Malaria Parasite among Urban and Semi-Urban Respondents

Qualitative assay of the malaria parasite (*Plasmodium falciparum*) presence in the blood of the respondents indicates the below distribution among the respondents. Ten percent (10.0%) of the pregnant women examined at urban were infected with *Plasmodium falciparum* while twenty-two percent (22.0%) of the pregnant women from semi-urban Hospital were also found infected with the same pathogen.

	Urban	Semi-urban Hospital
Negative	45	39
Positive	5	11
Total	50	50
% Prevalence	**10**	**22**

Table 4: Prevalence of Parasitaemia.

DISCUSSION

The socio-demographic characteristics of the study population in Umuahia North LGA revealed that out of the total respondents, majority of the women 23(46.0%) from urban were in the age range of 31 years - 38 years, while 23(46.0%) from Semi-urban hospital were in the age range of 23 years - 30 years. This corroborates with the fact that women mostly get into marriages at about their twenties and thirties. The results of this study showed that women who were educated were most likely to be more informed. This suggests that lack of maternal education was associated with observed anaemia. This agrees with the report of Yang that some disadvantageous socio-demographic characteristics such as lower maternal education, poor household, and crowded living conditions were significantly associated with anaemia.

In Table 4, the increased malaria prevalence in the semi-urban shows consistent decrease with haematological (Hb, RBC and PCV) status of pregnant women.

According to Viana [10] there is an association between anaemia and acute/chronic infection. When anaemia exists in acute infections, it is due to several factors. Malaria parasite (*Plasmodium falciparum)* contributes to the etiology and severity of anaemia through several mechanisms including destruction of red blood cells. Clearly, in a patient with malaria the main reason for anaemia is the destruction of red blood cells by the parasite. According to Zimmermann [11], humans acquire parasites of the genus *Plasmodium* through a mosquito "bite". The parasite passes through a series of asexual stages, which occur successively in the cells of the liver, in the erythrocytes, and transiently free in the plasma. Maturation of the parasite within the red cell is followed by its rupture and is associated with fever and sweating and the liberation of new merozoites that infect new red cells. Sexual forms are eventually formed in the human host but transfer to another human host must take place through the medium of the mosquito. Therefore, both malaria and anaemia in pregnancy pose a serious public health challenge [12].

Out of the 100 women that were screened at urban (50) and Semi-urban hospital (50), showed a prevalence of malaria parasite 10% and 22% respectively. This correlates relatively with reports of the respondents, and could be attributed to the lack of awareness of program for intermittent (IPTp) of malaria for pregnant women, lack of awareness of distribution of insecticide treated nets for prevention of malaria, lack of use of insecticide treated nets, inactive case management of malaria, and poor drainage system in their locations. Also, the results of this present study is indicative that the anaemia in the pregnant women who had no malaria parasite is likely to be from other possible causes of anaemia other than malaria infection. In Africa, it was noted that malaria and anaemia accounts for majority of visits to health centres.

According to Akomas [13], the rich iron content of most green leafy plants makes them readily available sources of iron required in the process of erythropoiesis. In this present study, the red blood cell of the pregnant women who attended urban was significantly ($p < 0.05$) higher than those who attended Semi-urban hospital while no significant ($p > 0.05$) difference was observed for Hb and PCV. This agrees with the response of the pregnant women who attended urban, who opined they were aware of the iron and folic acid supplementation to pregnant women of which majority had access to these supplements during pregnancy. Reduction in the percentage of haemoglobin results in poor transportation of oxygen from the respiratory organs to the peripheral tissues and carbon dioxide protons for subsequent excretion [14].

Folic acid concentrations of pregnant women who attended semi-urban hospital was not significantly ($p > 0.05$) different from those who attended urban. However, these levels of folic acid are about the reference range of plasma levels of folate (2 µg - 20 µg) in adults. Folic acid is largely a source of methyl group (one carbon compound) involved in DNA synthesis and also known to reduce the risk of neural tube defects [15]. The presence of adequate folic acid in the blood of the respondents examined at both clinics suggests largely an association with the compliance of regular intake of food sources rich in folic acid, as well as, folic acid supplementation during pregnancy. Reference values may vary significantly among populations and cultures for which dietary intakes may be different. However, the findings of folic acid levels in blood samples of the pregnant women is comparable to 20 ng/ml established reference serum levels of folic acid in a young Ugandan youth as established by Galukande et al. [16]. Folic acid supplementation before pregnancy and throughout the first trimester is a standard practice recommended in the UK [15]. Folate deficiency has also been documented in pregnancy, often leading to combined iron-folate deficiency anaemia. This is common among lower socioeconomic groups who consume mostly cereal-based diets (poor in folate) aggravated by prolonged cooking and reheating. Folate requirements double in the second half of pregnancy and are markedly increased by processes that involve haemolysis, such as malaria and haemoglobinopathies [12].

The vitamin B_{12} concentration was significantly ($p < 0.05$) lower for pregnant women who attended Semi-urban Hospital compared to those who attended urban. However, this does not correlate to vitamin B_{12} deficiency. Mild vitamin B_{12} deficiency is common in pregnancy and due to increased foetal demand over gestation, 38% of women have low vitamin B_{12} levels by the time of delivery [13]. Early recognition is critical because low vitamin B_{12} levels in pregnancy have been associated with neural tube defects, preterm birth and low neonatal birth weight [18,19]. Also, in pregnancy, vitamin B_{12} may go unrecognized if anaemia is mistakenly attributed to other causes such as iron deficiency or physiologic hemodilution [20]. When severe B_{12} deficiency goes untreated, it can have profound effects including severe anaemia, peripheral neuropathy, and cognitive decline [17].

The vitamin A levels of the pregnant women were not significantly ($p > 0.05$) different while that of infants showed significant ($p < 0.05$) difference between infants who attended the three different hospitals. Vitamin A requirements vary during different stages of pregnancy. In a similar study carried out by Chen et al. [21], Serum vitamin A level in pregnancy was 360 ± 0.10 μg/l which is very high compared to 14.00 ± 2.62 μg/dl and 14.32 ± 1.71 μg/dl reported in the present study. Vitamin A is an essential micronutrient in human body and play very important roles in maternal health and foetal development [22]. In addition to being essential for morphological and functional development and for ocular integrity, vitamin A exerts systemic effects on several foetal organs and on the foetal skeleton. In pregnancy, extra vitamin A is required for growth and tissue maintenance in the foetus, for providing it with some reserves and for maternal metabolism. Pregnant women have a basal requirement of 370 μg/day, maximum dose of 3,000 μg/day and recommended daily allowance (RDA) of 770 μg/day [21].

Variables	Urban Hospital		Semi-Urban Hospital	
	Frequency	Percentage	Frequency	Percentage
Awareness of Iron Folic Acid Supplementation to Pregnant Women				
Yes	32	64	33	66
No	18	36	17	34
Total	50	100	50	100
Whether Expectant Mothers get Drugs like Iron Folic Acid during Pregnancy when they Visit Clinic				
Yes	40	80	33	66
No	10	20	17	34
Total	50	100	50	100
Whether they pay after the iron folic acid is issued by the clinic				
Yes	40	80	33	66
No	10	20	17	34
Total	50	100	50	100
Awareness of Iron Folic Acid Supplementation to Women of Reproductive Age (including Adolescent Girls)				
Yes	31	62	27	54
No	19	38	23	46
Total	50	100	50	100

Table 2: Awareness of Respondents to supplementation programs.

According to Fairweather-Tait et al. [23], although most dietary selenium is absorbed efficiently, the retention of organic forms is higher than the inorganic forms. Selenium is a trace element essential for the appropriate course of vital processes in the body. Selenium plays a vital role in the undisturbed functioning of the reproductive system. Many studies have addressed correlations between its intake and fertility, as well as, disorders of procreation [24]. Selenium deficiencies may lead to gestational complications, miscarriages and the damaging of the nervous and immune systems of the foetus. A low concentration of selenium in blood serum in the early stage of pregnancy has been proved to be a predictor of low birth weight of a new-born [24]. For this reason, supplementation of selenium is highly recommended, especially during pregnancy. Selenium concentrations of the pregnant women for both urban and Semi-urban hospital were 6.59 ± 2.68 μg/dl and 7.48 ± 2.74 μg/dl respectively. The selenium concentration of the pregnant women who attended antenatal in semi-urban hospital was significantly ($p < 0.05$) higher when compared to those who attended urban. It is highly probable that the pregnant women whose settlements are around semi-urban area consumed foods richer in selenium than the pregnant women whose settlements are in the urban area. However, regardless of where you live, certain factors such as human immunodeficiency virus infection, gastrointestinal condition (Crohn's disease) etc. can affect the bioavailability of selenium (Appendix 2 and Appendix 3).

Characteristics	Federal Medical Centre		Anelechi Hospital	
	Frequency	Percentage	Frequency	Percentage
Awareness of Program for Intermittent Treatment (IPTp) of Malaria for Pregnant Women				
Yes	42	84	34	68
No	8	16	16	32
Total	50	100	50	100
Awareness of Distribution of Insecticide treated Nets for Prevention of Malaria				
Yes	41	82	34	68
No	9	18	16	32
Total	50	100	50	100
Whether there is Active Case Management of Malaria				
Yes	41	82	24	48
No	9	18	26	52
Total	50	100	50	100
Whether there is Proper Drainage System in their Locations				
Yes	35	70	30	60
No	15	30	20	40
Total	50	100	50	100
Whether they use Insecticide treated Nets to Sleep at Home				
Yes	32	64	24	48
No	18	36	26	52
Total	50	100	50	100
Whether they know the Medication to use without going to see a Doctor				
Yes	38	76	30	60
No	12	24	20	40
Total	50	100	50	100

Table 3: Awareness of Respondents to prevention and treatment for malaria.

Anaemia in pregnancy is defined by the World Health Organization (WHO) as a haemoglobin concentration of <11 g/dl in a pregnant woman with 10 g/dl - 10.9 g/dl, 7 g/dl - 9.9 g/dl, and <7 g/dl classified as mild, moderate, and severe anaemia, respectively [25]. Using the World Health Organization criterion of 11 g/dl to define anaemia in pregnancy, few of our pregnant women were anaemic.

Out of the 50 pregnant women examined during this study in urban area, only 2 had Hb level less than 11 g/dl indicating anaemia prevalence of 4%, whereas a total of 48 pregnant women whose Hb level were above the limit were considered non anaemic. The findings of this study disagree with the report of Esike et al. [26] in a similar study carried out in Abakiliki where a prevalence of 56% was recorded. The low prevalence of anaemia for pregnant women who attended urban may be attributed to the socio-economic status of the women as majority of them were observed to the educated. Also, the low prevalence corroborates with their level of awareness of medications to use for active malaria treatment when infected with malaria, use of insecticide treated nets to sleep for prevention of malaria. However, 10% prevalence was echoed for pregnant women who attended semi-urban hospital. This prevalence of anaemia across these two clinics (urban and semi-urban hospitals) are lower compared to the reports of Ukibe et al. [27] who reported 75% anaemia prevalence in a similar study conducted on prevalence of anaemia in pregnant women attending antenatal clinics in Anambra State South-Eastern Nigeria, the findings of Dim et al. [28], who reported 40% prevalence of anaemia in a similar study carried out in Enugu State, and 63% in a study conducted in India where factors such as level of education and socio-economic status were found to be significantly associated with prevalence of anaemia [29].

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