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Anaemia, Body Mass Index and Risk Factors Association with Malarious Pregnant Women in Ebonyi State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Authors CAI designed the study, carried out the hospital and the laboratory analyses of the study. Author JCO performed the statistical analysis; wrote and proof-read the manuscript. Authors OPO, GUA and SCE managed the literature searches and wrote the protocols. All authors thoroughly proof read and approved the final manuscript.

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ABSTRACT

Aims: Malaria in pregnancy is a weighty health problem in sub-Saharan Africa where 90% of the global malaria burden occurs, therefore there is urgent need for more researches on malaria in pregnancy to reduce its mortality and morbidity. Anaemia, body mass index and risk factors association with malarious pregnant women in Ebonyi State was investigated in this study.
Study Design: A cross-sectional study on malaria infection among pregnant women in Ebonyi State, Nigeria was carried out from April 2011 to March 2012 from two selected hospitals.
Methodology: Venous blood samples were collected for thick and thin films blood smears for microscopic examinations. Presence or absence of anaemia was determined by measuring haemoglobin concentration spectrophotometrically using the cyanmethemoglobin method. Chi-square ($\chi 2$) was used to analyse the data collected. Statistical significance was set at $P < 0.05$.

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Results: The result showed that out of 360 pregnant women sampled with average age of (26.54 ± 4.61), infection rate of 150 (41.7%) was observed. The prevalence of anaemia was 202(56.1%) and it was highly associated with malaria, infection was higher among pregnant women who were anaemic than those who were not. Also, body mass index is associated with malaria as it showed its highest prevalence amongst overweight pregnant women. The risk factors associated with malaria in this study were rainy season, primigravidae and primary education.
Conclusion: Increased awareness about anaemia, body mass index and risk factors such as rainy season, primigravidae and primary education association with malaria as established in this study could help in the reduction of the burden of malaria among pregnant women.

Keywords: Anaemia; body mass index; risk factor; malaria; pregnant women; Ebonyi State; Nigeria.

1. INTRODUCTION

Malaria in pregnancy is a weighty health problem in sub-saharan Africa where 90% of the global malaria problem occurs [1-4]**.** It is often more dangerous particularly with an infection of *P. falciparum* during pregnancy which can run a raging and dramatic course in pregnant women and seems to affect the immune processes [5]. The physiological variations of pregnancy and the pathological changes due to malaria have synergistic effects on each other, thus making life hard for both the mother and the child [1,6]**.** In pregnancy, malaria inclines to be more atypical in its presentations, this may be because of hormonal, immunological and haematological fluctuations during pregnancy [7]. In extremely endemic malarious areas such as Nigeria, where semi-immune adults generally have considerably acquired resistance to local strains of *Plasmodia*, the prevalence of clinical malaria is more and its sternness is greater in pregnant women than in non-pregnant women [8-10]. Pregnant women with *P*. *falciparum* malaria are meaningfully more anaemic than non-infected pregnant women or infected non-pregnant women [11,8]. At pregnancy, immunity has been transformed; hence, with malaria 70 - 80% of pregnant women in malarious areas are prone to anaemia [8,12]. *P. falciparum* infection is more during pregnancy, particularly in primigravidae and is typically connected with anaemia or reduced haemoglobin levels [11,8]. *P. falciparum* malaria is a foremost cause of fever and anaemia in pregnant women resident in hyper endemic areas of Africa and this is as a result of decreased immunity in pregnancy [13] making the pregnant women predisposed to serious malaria infection and anaemia afterwards. It has been revealed that serious anaemia was found to be more common in women with peripheral parasitaemia than those without parasitaemia [8]. Undeniably, malaria can cause several perinatal and maternal complications including abortion, stillbirth, low birth weight and even abortion [13-16]. Incidentally malaria infection is more widespread among the primigravidae and secundigravidae than the multigravidae [6]. The better vulnerability of these sets of pregnant women may be linked to some evidence that immuno-suppression associated with pregnancy happens more in the first than succeeding pregnancies [17]. Age has also been a strong factor as epidemiological studies have shown that malaria in pregnancy is more prevalent in younger than older age groups [6]. Presently, vulnerability of *P. falciparum* parasitaemia has been linked to the level of antibodies to sequestrated parasites [18]. Anaemia, body mass index and risk factors association with pregnant malarious women attending antenatal clinic in Ebonyi State, Nigeria was investigated in this present study.

2. MATERIALS AND METHODS

2.1 Study Area, Design and Population

The study area, Ebonyi State is one of thirty-six states of Nigeria. It is in the South-Eastern part of the country. Ebonyi State is made up of thirteen Local Government Areas. Ebonyi State has a projected population of about 2.3 million. Like most parts of Nigeria, it has two main seasons; rainy and dry seasons. The rainy season which is the main farming season commences around late April and could last up to October [19].

The study was a cross-sectional, hospital-based study to investigate malaria parasite among pregnant woman attending antenatal clinic in Ebonyi State. The hospitals that were selected include Mile Four Hospital and Federal Medical Centre Abakaliki. The study lasted for twelve months, from April 2011 to March 2012. We employed such tools as informed conversation to raise awareness on the study, administration of questionnaire and parasitological examination of the parasite. Pregnant women attending

antenatal clinics in their different trimesters were selected for the research. Three hundred (360) pregnant women were selected from two hospitals.

All work was performed according to the international guideline for human experimentation clinical research [20].

2.2 Sampling Method

The hospitals used were purposively selected for the study based on the availability of active antenatal clinic. Random sampling through balloting was employed for the selection of pregnant women for the study. Pieces of papers written either 'yes' or 'no' were picked by the pregnant women attending antenatal clinics. Those that picked 'yes' were chosen for the study. One hundred and eighty (180) pregnant women were chosen for each hospital making a total of 360.

2.3 Administration of Questionnaire

A structured pre-tested questionnaire was administered to the randomly selected pregnant women through participatory approach. By this the researchers discussed each question and their options with the pregnant women in a manner that facilitates effective recall of experiences. The questionnaire sought information on age, gravidity and trimesters among others.

2.4 Collection of Blood Sample

Five ml of venepuncture sample was taken from the arm of each pregnant woman using syringe. After cleaning the volar surface of the arm with cotton wool moistened with methylated spirit, peripheral blood samples were collected into sterile EDTA (ethylenediamine tetra acetic acid) containers. The blood sample was immediately transported to laboratory for analysis.

2.5 Blood Smear Staining and Microscopy Procedure

Thin and thick blood films were prepared immediately upon blood collection on different slides. For thick films, 12µl of blood was spread in a diameter of 15 mm, while 2µl of blood was used for thin films as described by [21]. The films were allowed to dry for at least 45 minutes (thin) and 12 hours (thick) [22,23]. The thin films were fixed in absolute methanol for 2 seconds and air dried. The blood films were stained with 3% Giemsa stain solution. Each slide was examined under the x 100 objective oil immersion for the presence of characteristic stages of *Plasmodium*. Identification of species was done using the thin blood smear. The parasite density was estimated on the thick smear under oil immersion and viewed using x100 objective lens.

2.6 Malaria Parasite Intensity Determination

The thick film was use for detection and counting of malaria parasite density. The degree of parasitaemia was graded thus: 1 to 10 parasites per 100 thick film fields (+) as mild, 11 to 100 parasites per thick film fields (++) as moderate and above 100 parasites per 100 thick film fields (+++) as severe. A negative result was recorded after thorough examination of 100 fields without any parasite [24].

2.7 Determination of Haemoglobin Concentration (Hb)

Haemoglobin concentration was estimated spectrophotometrically using the cyamethaemoglobin method [23]. The World Health Organization definition of anaemia in pregnancy, that is, the haemoglobin concentration of less than 11g/dl in the first and third trimesters or haemoglobin concentration of less than 10.5g/dl in the second trimester was adopted in this study. The Hb was defined as normal and anaemic [23].

2.8 Body Mass Index

The height (m) and weight (kg) of pregnant woman were measured using a meter rule for height and weighing scale for weight. The body mass index (BMI) was calculated using the formula: BMI = weight (kg) ÷ height $(m)^2$. The BMI was graded as 18.5 - 24.9 as normal, 25.0 – 29.9, as overweight and ≥ 30 as obese [23,25].

2.9 Statistical Analysis

Preliminary information showing demographic profile of pregnant women was calculated as simple frequencies. Chi-square test was used to determine significant differences and the intensity of malaria parasite was categorized into light, moderate and severe. Significant difference in the prevalence of this categorized intensity in

relation to the above stated variable was also checked using chi-square test. Statistical significance was set at P < 0.05. Risk multivariate logistic regression was used to determine variable that are predictive of the prevalence of parasitic infections studied. All analysis were performed using statistical package for social sciences version 20.0.

3. RESULTS

Three hundred and sixty pregnant women were sampled during the study with average age of 26.54 ± 4.61. Table 1 showed prevalence of malaria in relation to the body mass index and haemoglobin concentration among pregnant women in Ebonyi State, Nigeria. Overweight pregnant women had the highest prevalence 68(45.6%) of malaria while the least prevalence was observed among obese 20(35.1%) pregnant women. There is significant association (P < 0.05) between malaria and BMI. Prevalence in relation to haemoglobin concentration showed that pregnant women who were anaemic 118(58.4%) had highest prevalence of malaria, while those who were normal 32(20.3%) had the least prevalence. There was high significant association between malaria and Anaemia (χ^2 = 53.12, P = 0.0001) but not with non-anaemic pregnant women (χ^2 =13.70, p =0.67).

In Table 2, light high intensities were observed in all Hb, while in moderate and severe intensities it was for those who were anaemic. No significant difference (P < 0.05) was observed in the Hb intensities. In body mass index, light intensity had the highest in all BMI. In moderate and severe intensities, it was seen in those pregnant women who are normal and overweight. No significant difference (P < 0.05) was observed in the BMI intensities.

3.1 Risk Factors among Pregnant Malarious Women in Ebonyi State, Nigeria Using Multivariate Logistic Regression

Using backward elimination in multivariate regression model the risk factors associated with malaria were: season (OR = 1.88, 95% = 1.20-2.94, P < 0.05), primigravidae (OR = 2.19, 95% CI = 1.35 – 3.55, P < 0.05), and just having primary education (OR = 2.08, 95% CI = 1.30 – 3.33, P < 0.05) among pregnant women in Ebonyi State, Nigeria (Table 3).

Table 1. Association of malaria with body mass index and haemoglobin concentration among pregnant woman in Ebonyi State, Nigeria

Variable	Number examined (360)	Number infected (%)	χ^2	P - value
Body mass index				
Normal	154	62 (40.3)	3.87	0.47
Over weight	149	68 (45.6)	4.61	0.61
Obesity	57	20 (35.1)	2.11	0.35
Anaemia	202	118 (58.4)	53.12	0.0001*
Normal	158	32 (20.3)	13.70	0.67
Total	360	150 (41.7%)		

*Figures in parentheses = %.; * Significant difference at P < 0.05*

Table 2. Malaria parasitaemia in relation to haemoglobin concentration and BMI among pregnant women in Ebonyi State

Variables	Category	Number examined	Number positive	Light (+)	Moderate (+)	Severe (+++)	P value
Haemoglobin	Anaemia	202	118	98(83.1)	16(13.6)	4(3.4)	0.15
Concentration	Normal	158	32	30(93.8)	1(3.1)	1(3.1)	0.25
Bodymass index	Normal	154	62	52(82.3)	10(16.1)	1(1.6)	
	Over weight	149	67	57(85.1)	6(9.0)	4(6.0)	0.25
	Obesity	57	21	20(95.2)	1(4.8)	0(0)	0.18

Table 3. Risk factors among pregnant malarious women in Ebonyi State, Nigeria Using multivariate regression

Variables	Odd Ration (OR)	95% CI	Significance
Season			
Rainy	1.88	1.20 - 2.94	0.006*
Gravidity			
Primigravidae	2.19	1.35 - 3.55	0.001*
Education			
Primary	2.08	1.30 - 3.33	0.002*

** Significant difference at P < 0.05, CI = confidence interval, OR = Odd ration*

4. DISCUSSION

The prevalence of anaemia among pregnant women in this study was found to be 202 (56.1%) which is high. Anaemia in pregnancy in developing countries are generally presumed to be as a result of malaria infection [26] and many studies also recorded high prevalence [27,6,8]. In this study majority of the pregnant women were anaemic and anaemic women were more likely to have malaria infection than non-anaemic women. This was consistent with reports from a number of sub-saharan Africans where it was indicated that the prevalence of anaemia was consistently higher among pregnant women infected with malaria parasite than those uninfected [28,8]. Furthermore, Hb showed a significant decrease with increasing parasite density. This is understandable as increasing parasite density ultimately leads to increase in red cell break down and consequently anaemia. This is aggravated by the poor socio-economic background of the pregnant women since they are predominately subsistent farmers. Moreover, we observed that malaria was associated with anaemia and the haemoglobin levels were different between infected and non-infected women. This agreed with [28,29] who found association between malaria and anaemia. In contrast, [28] showed no association between malaria and anaemia. With regards to body mass index (BMI), Malaria was associated with body mass index in this study since overweight pregnant women were most affected. This result contrasted with [30-33] but agreed with [34,35]. The risk factors associated with malaria among pregnant women in this study were rainy season, primigravidae and primary education and it is in agreement with the work done by [36].

5. CONCLUSION

Malaria is still a major public health issue among pregnant women in Ebonyi State and malaria infection is strongly associated with anaemia in pregnant women. Malaria was also associated with body mass index in this study as it showed the most prevalence amongst overweight pregnant women. Rainy season, primigravidae and primary education are risk factors in malaria among pregnant women in Ebonyi state, Nigeria. Increased awareness about anaemia, body mass index and risk factors such as rainy season, primigravidae and primary education association with malaria as established in this study can help in the reduction of the burden of malaria among pregnant women in Ebonyi state, Nigeria.

CONSENT AND ETHICAL APPROVAL

Ethical review and clearance was obtained from the Ministry of Health, Ebonyi State and University of Nigeria Nsukka Ethical Research Committee. Ethical consideration was also obtained from the two hospitals selected for the study from antenatal division and research department. The permission to use hospital facilities was also obtained from management. Informed consent was obtained from the pregnant women before collection of the samples. The approval was on the agreement that patient anonymity must be maintained, good laboratory practice and findings would be treated with utmost confidentiality and for research purpose only.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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