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Evaluation of full blood count among plasmodium parasatized pregnant women, in general hospital Sabo Kaduna state, Nigeria

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Abstract

Background: Malaria poses a significant public health challenge in sub-Saharan Africa, particularly among pregnant women, where it contributes to a high burden of infection and mortality. This study aimed to investigate the impact of malaria on haematological and biochemical parameters among pregnant women attending the Antenatal Clinic at General Hospital Sabo Kaduna State, North-Western Nigeria.

Methodology: A total of 70 pregnant women participated in the study, with subjects aged between 15 and 40 years. A total of 70 pregnant women participated in the study, 50 of which were malaria positive and 20 of which were malaria negative. Participants were recruited from Antenatal Clinic of General Hospital Sabo, Kaduna State. Socio-demographic characteristic and blood samples were collected and examine for malaria parasite, some haematological parameters (HCT, HGB, WBC, RBC and platelet count) were measured using the sysmex auto-haematology analyzer. Data generated was analyzed using SPSS 22.0 statistical package.

Results: Findings revealed that younger women, particularly those aged 21-25 years, constituted a significant proportion of the subjects, consistent with previous reports. Haematological analysis demonstrated a significant decrease in haematocrit (HCT), haemoglobin (HGB), red blood cell count (RBC), and platelet count among malaria parasitized pregnant women compared to controls ($p<0.05$). However, white blood cell (WBC) count remained within the normal reference range for both groups.

Conclusion: These findings corroborate previous research indicating that malaria infection leads to alterations in haematological parameters, primarily attributed to mechanical destruction of parasitized red blood cells and splenic clearance. Furthermore, there should be an enhanced efforts to implement malaria prevention and control strategies, promote sanitation practices to reduce mosquito breeding sites, and prioritize the inclusion of malaria parasite investigation as a routine test in antenatal care for pregnant women.

Keywords: Malaria; Pregnant women; Haematological parameters; Antenatal care; Nigeria

1. Introduction

Malaria remains a significant public health concern, especially in regions like sub-Saharan Africa, where an estimated 30 million women living in malaria-endemic areas become pregnant annually. Pregnant women face heightened

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vulnerability to malaria due to physiological changes that reduce immunity, increasing susceptibility to infection and severe complications. These complications include severe anaemia, acute pulmonary oedema, renal failure, puerperal sepsis, and postpartum haemorrhage, ultimately elevating the risk of maternal and neonatal mortality. Chronic anaemia resulting from malaria can further impact a child's growth and intellectual development, highlighting the far-reaching consequences of the disease (WHO, 2006).

Malaria, caused by protozoan parasites of the genus Plasmodium, poses a significant threat to pregnant women and children under five years old. Plasmodium falciparum, the most pathogenic species, is responsible for the majority of malaria-related deaths worldwide, particularly in sub-Saharan Africa (WHO Malaria Report, 2005). Transmission occurs through the bite of infected female Anopheles mosquitoes, introducing sporozoites into the bloodstream and initiating infection (Jawetz, 2013).

Clinical manifestations of malaria include severe chills, high fever, sweating, headache, muscle pain, and vomiting. In pregnant women, particularly with Plasmodium falciparum infection, malaria can progress to life-threatening complications such as coma and convulsions. Cerebral malaria, characterized by the adherence of parasitized red blood cells to brain capillary endothelium, contributes to severe anaemia and renal failure, among other complications (David et al., 2012).

Pregnancy further exacerbates the risk of malaria complications, as it interferes with immune processes already altered by the disease. In highly endemic areas, pregnant women experience higher prevalence and severity of clinical malaria compared to non-pregnant counterparts, underscoring the urgent need for targeted interventions (Bruce et al., 2006). Despite efforts to control malaria, its transmission continues to rise in Nigeria, attributed to factors like deforestation, poor environmental sanitation, and man-made breeding sites conducive to mosquito proliferation (Saidu et al., 2015).

A keystone in the diagnosis and management of malaria-related complications is the full blood count (FBC), a vital tool providing insights into haematological parameters. FBC analysis offers crucial information on red blood cell indices, haemoglobin levels, white blood cell counts, and platelet counts, aiding clinicians in assessing disease severity, monitoring response to treatment, and guiding clinical decision-making.

As such, integrating FBC assessment into routine antenatal care becomes imperative, especially in malaria-endemic regions where pregnant women face heightened risks of complications. By leveraging the power of FBC analysis alongside malaria testing, healthcare providers can enhance the early detection of adverse outcomes, tailor interventions to individual patient needs, and ultimately mitigate the impact of malaria on maternal and child health.

The intersection of malaria and pregnancy poses complex challenges for maternal and child health in Nigeria. To address these challenges effectively, a comprehensive understanding of the impact of malaria on maternal health outcomes, including its effects on haematological parameters, is essential. This study aims to evaluate the influence of malaria on haematological and biochemical parameters among pregnant women attending the antenatal clinic at Specialist Hospital Sokoto, North-Western Nigeria. By elucidating these relationships, the study seeks to inform evidence-based interventions and strategies for malaria prevention and control in antenatal care settings.

2. Materials and methods

2.1. Study design

The research was a case-control study to assess the level of haematological changes of malaria parasitized pregnant women parameters of 50 Plasmodium parasitized pregnant women and 20 age and gender-matched healthy non-parasitized pregnant women were monitored as controls visiting the Antenatal Clinic General Hospital Sabo Kaduna. Blood sample were collected (from both subjects and controls) and tested for complete blood count.

2.2. Study area

This study was carried out in the Antenatal Clinic of Baraudikko Specialist Hospital, North–Western Nigeria. Specialist Hospital Kaduna is a tertiary institution located within the Kaduna metropolis. Kaduna is the capital city of Kaduna State of Nigeria. The State is located in the Northwest of Nigeria, The State is in the dry Sahel, surrounded by sandy savannah and isolated hills, with an annual average temperature of 28.3^{o}c (82.9^{o}F). However, maximum daytime temperatures are for most of the year generally under 40^{o}c (104.0^{o}F) and the dryness makes the heat bearable. The warmest months are February to April when daytime temperature can exceed 45^{o}c (113.0 ^{o}F). The rainy season is from April to October during which shower are a daily occurrence. Kaduna city is a major commerce center in leather crafts and agricultural

products. As at 2006, the state has a population of 3.6 million (NPC/FGN, 2006). However, based on the population annual growth of 3%, the calculated projected population for kaduna State now stands at around 4.9 million.

2.3. Study population

The study population for this study includes 50 malaria- infected pregnant women (subject) and 20 age- matched healthy pregnant women without plasmodium infection, which were monitored as controls. Both subjects and controls ware recruited in the Antenatal Clinic Specialist Hospital, kaduna, North-Western Nigeria. However due to limitations caused by financial resources 500 malaria- infected pregnant women were use as subjects and 20 non-parasitized pregnant women were monitored as controls.

2.4. Selection criteria

- **Inclusion Criteria:** Pregnant women parasitized with plasmodium attending Antenatal Clinic Sabo general Hospital, kaduna; women who gave written informed consent in their clinic and agreed to be included in the study.
- **Exclusion Criteria:** Non-pregnant women parasitized with plasmodium; Healthy pregnant women that are not parasitized with plasmodium; Plasmodium parasitized pregnant women who did not offer an informed consent to be included in the study.

2.5. Sample size determination

The sample size was determined using the standard formula for calculation of minimum sample size:

$$(n = z^2 pq/d^2)$$

n = Minimum sample size
z = standard normal deviation and probability.
p = prevalence of value to be estimated from previous studies.
q = Proportion of failure (= 1 - p)
d = precision, tolerance limit, the minimum is 0.05.

$$\text{Therefore } n = z^2 pq/d^2$$

Where

Z = 95% (1.96)

P = 4.8% (0.048) (Aliyu *et al.,* 2011).

q = 1 - 0.048 (=0.952)

d = 5% (0.05)

$$\text{Therefore } n = (1.96)^2 (0.048) (0.952) / (0.05)^2$$

$$n = 50$$

2.6. Sample collection

Whole blood was collected via venipuncture, using BD vacutainer system into K_3 EDTA anticoagulated and plain tube under strict aseptic techniques. The EDTA anticoagulated blood sample was used to analyze complete blood count while sample from the plain tubes was allowed to clot. The clotted blood sample was centrifuged at 3000 rpm for ten minutes on a bench-top centrifuge. The serum obtain was transferred into sterile plastic tube and stored immediately until ready to be analyzed. These samples were tested in the Laboratory of general Hospital Sabo Kaduna state Nigeria. The following laboratory investigations were carried out on K^3EDTA anticoagulated blood.

3. Results

The findings of the study are presented and analyzed. The results provide insights into the impact of malaria parasitization on various haematological parameters among pregnant women, as well as a comparison between subjects (malaria parasitized pregnant women) and controls (non-parasitized pregnant women).

The table shows the distribution of subjects and controls across different age groups and indicates that there is no significant difference ($p>0.05$) in the age distribution between the two groups.

Table 1 The socio-demographic characteristics of subjects and controls

Variables	Patients (n=50)	Controls (n=20)	X^2	p-value
Age group				
15-20	7 (11.7%)	5 (16.7%)	t=1.2884	0.751
21-25	27 (45.0%)	10 (33.3%)		
26-30	14 (23.3%)	8 (26.7%)		
31-35	9 (15.0%)	4 (13.3%)		
36-40	3 (5.00%)	3 (10.0%)		

Key: t = t-test, x^2 = chi-square, * = statistically significant.

The table shows the difference in haematological parameters of the subjects and control, there is a statistically significant decrease in HCT, HGB and Platelet of the subject compared to the controls. However, the WBC count is within the normal reference range.

Table 2 Mean comparison of some Haematological parameters for the subjects and controls

Parameters	Patients	Controls	t-test	p-value
WBC ($\times10^9$/l)	7.403± 0.2650	6.630±0.3824	1.674	0.098
RBC ($\times10^9$/l)	3.5072±0.4082	3.7350 0.5410	-3.354	0.001*
HGB (g/dl)	9.370±0.1758	10.141±0.1035	-2.979	0.004*
HCT (%)	28.378±0.3146	29.840±0.2426	-3.060	0.003*
PLT ($\times10^9$/l)	194.137.722	288.50±7.103	-7.840	0.000*

Data are presented as mean ± SEM.

Key: RBC= Red Blood Cells, HCT = Haematocrit (Packed cell volume), HGB= Haemoglobin, WBC = white cell, PLT = platelet, * = statistically significant.

4. Discussion

Malaria is a major public health problem in sub-Sahara Africa including Nigeria, where it accounts for more cases of infection and death than other countries in the world. The aim of this study was to investigate the effect of malaria on some haematological and biochemical parameters in pregnant women attending antenatal clinic in Specialist Hospital Sokoto. A total of 90 pregnant women participated in this study. The subjects were aged 15-40 years. Our finding is consistent with a previous report (Sa'idu *et al,* 2015) in Sokoto which indicated that, young maternal age contributed to the seroprevalence of malaria parasitaemia among pregnant women.

We observed that younger women in the age group 21-25 years constituted a significant number of the subjects (45%) compared to older age group 36-40 (6%). This finding is consistent with a previous report of Panti and Colleagues (2010) who reported that majority of the asymptomatic malaria positive pregnant women (84%) were aged between 20 and 34 years. Uneke and Colleagues (2007) in Southern Nigeria also reported that individuals of age group 20-24 has the highest prevalence of maternal malaria (52%) while the least was recorded among those > 40 years. Similarly, Dolo *et al.* (2005) also reported that the pregnant women that are in the age range 21-25 years followed by 26-30 years

and 31-35 years recorded high number of malaria parasitemia (28%). Susceptibility to plasmodium parasitaemia has been linked to the level of antibodies to placental sequestrated parasites (Elliot *et al.,* 2005). This may be attributed to the fact that majority of the younger women are likely to be primigravidae and are expected to have higher malaria parasitaemia. This also supports the existing knowledge that high prevalence at lower age is due to the existence of low natural immunity to infectious diseases including malaria at that age.

This study indicated that the HGB, HCT, RBC and Platelet count was significantly lower ($p<0.05$) in malaria parasitized pregnant women. This finding is consistent with previous reports (Udomah *et al.,* 2014) which indicated that infected patients tended to have significantly lower platelets, haemoglobin and red blood cell count. Maina *et al. (2010)* further reported that children infected with *Plasmodium falciparum* malaria exhibit important changes in some haematological parameters with low platelet count and haemoglobin concentration being the two most important predictors of malaria infection. The lower HCT HGB and RBC may reflect anaemia which is mainly due to mechanical destruction of parasitized red blood cells as well as splenic clearance of parasitized and defected red cells. The reduced platelet count in malaria is said to be due to platelet activation, splenic pooling and decrease platelet life span (Abdull, 2004; Beale *et al.,* 1972).

The mean values of WBC count in both infected and non-infected women were within normal reference range. Whereas during labour and puerperium, WBC may be more markedly elevated (Onwukeme, 1992). Nevertheless, this compared favorably well with the findings of other workers in Jos and Ibadan, Nigeria (Onwukeme and Uguru, 1990; Akingbola *et al*., 2006).

5. Conclusion

Findings of this study has shown that there is a significant decrease in HCT, HGB, RBC and Platelet count of malaria parasitized pregnant women subjects. The subjects tended to have a normal WBC. Malaria parasite should therefore be assayed in conjunction with haematological parameters in routine antenatal diagnosis and appropriate supplement should be given depending on the laboratory test result.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

The ethical approval was obtained from ethical committee of Kaduna State Ministry of Health, Kaduna State.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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