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STUDIES ON THE EFFECT OF MALARIA ON HAEMATOLOGICAL PARAMETERS AMONG RESIDENTS OF GWADABAWA LOCAL GOVERNMENT SOKOTO STATE, NIGERIA

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Abstract

Malaria remain a major public health concern in Nigeria where it account for more morbidity and mortality than any other country in the world. This study investigate the effects of malaria on haematological parameters among residents of Gwadabawa Local Government, Sokoto State Nigeria. A total of 350 individuals were randomly selected from 350 systematically selected households across five wards of the area. A sample of 2ml of venous blood was collected by venopuncture into ethylene diamine tetra-acetic acid bottle. Malaria parasite was detected by microscopic examination of thick and thin blood films stained with 10% Giemsa. Haemoanalysis was conducted using Genesis6000HA. The study revealed that, there is significant difference between the infected and non infected individuals in the following blood parameters; MCH, MCV,HCT and PLT. P=0.030, 0.010, 0.031

and 0.004 respectively. Malaria affect some blood parameters among infected individuals which could leads to considerable morbidity. Hence proper management of these blood parameters is vital for the treatment of infected individuals and also, improved sanitation, health education, environmental modification and other vector control measures as well as prompt diagnosis and treatment of infected individuals should be carried out to prevent the spread of the infection in the area.

INTRODUCTION

Malaria is a life-threatening disease caused by *Plasmodium* parasites. The parasites are spread to people through the bites of infected female *Anopheles* mosquitoes, called "malaria vectors" (WHO, 2015).Malarial parasites belong to the genus*Plasmodium*.*Plasmodium* is the only genus belonging to the family Plasmodiidae, order Haemosporida, class Coccidea, phylum Sporozoa(Apicomplexa). Thegenus contains over 125 species that cause malariain mammals, reptiles and birds (Hommel and Gilles, 2006). *Plasmodium falciparum*, *P. vivax, P. ovale*, and *P. malariae*cause human malaria, amongwhich *P. falciparum* is responsible for the majority of malaria related deaths and severe sickness (CDC, 2012). *P. knowlesi*that causes malaria in macaque monkeys has been recently reported to infect humans inSoutheast Asia (Collins, 2012).

About 30-40 species of *Anopheles* mosquitoes carry malaria among which*Anopheles gambiae*, *A. funestus*, and *A. arabiensis*are the most notable vectors in Africa (Tonnang*et al*., 2010).

Globally, approximately 214 million cases of malaria occur annually and 3.2 billion people are at risk of infection. Approximately 438,000 deaths were attributed to malaria in 2015, particularly in sub-Saharan Africa (SSA), where an estimated 90% of all malaria deaths occur (WHO, 2015).

However, according to World Malaria Report 2018, in 2017, an estimated 219 million cases of malaria occurred worldwide, compared with 239 million cases in 2010 and 217 million cases in 2016.Although there were an estimated 20 million fewer malaria cases in 2017 than in 2010, data for the period 2015–2017 highlight that no significant progress in reducing global malaria cases was made in this timeframe.Most malaria cases in 2017 were in the WHO African Region (200 million or 92%), followed by the WHO South-East Asia Region with 5% of the cases and the WHO Eastern Mediterranean Region with 2% (WHO, 2018).

Malaria still remains a major health challenge in Nigeria where it accounts for more cases and deaths than any other country in the world. Malaria is a risk for 97% of Nigeria's population (CRS, 2018).

Blood plays a very vital function in the human body. Typically, blood consists of cellular constituents including erythrocytes, leukocytes and thrombocytes that are essential for the various functions in body physiology (Okoroiwu*et al.,* 2014).Haematological changes are some of the most common complications in malaria and they play a major role in malaria pathogenesis. This study was therefore conducted to investigate the effects of malaria on haematological parameters in the area.

MATERIALS AND METHOD

Study Area

The study was conducted in Gwadabawa Local Government Area, Sokoto State, Northwest Nigeria. Gwadabawa is a Local Government Area in Sokoto State, Nigeria. Its headquarters are in the town of Gwadabawa on the A1 highway. It has an area of 991 km^2, with a latitude of 13.3°N and a longitude of 5.24° E (Thomas, 2017). Administratively, the Local Government has eleven wards of which five wards including (Gwadabawa, Chimola, G/Kaya, Mammande and Gigane) were randomly selected for the study.

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Study Population

The study population comprised of individuals of ≥ 1year from systematically selected households (HHs). One individual was randomly selected from each HH.

Sample Size Estimation

The minimum number of study participants was estimated by using minimum sample size determination formula $n = z^2p\ (1-p)/d^2$ (Abubakar, 2014)

where n = the sample size,

z=1.96 at 95% confidence interval (CI),

d= margin of error, at 5% (standard value of 0.05).

p = Malaria prevalence rate in the locality from previous studies which was 31.9% (Abubakar, 2014).

$$\frac{n = (1.96)2 \times 0.319 \times 0.681}{(0.05)2}$$

$$= \frac{0.8345453424}{0.0025}$$

= 333.8181

This was rounded to 350.

Ethical Considerations

The study was conducted after obtaining ethical clearance from Sokoto State Ministry of Health and Ministry for Local Government, Sokoto State. Before commencement of the study, the principal investigator conducted meetings with the community leaders in all selected localities during which the objectives of the study including procedures to be followed were explained. The consent of each respondent was sought prior to data collection. For participants less

than 18 years old, an assent was obtained from parents or caretakers/guardians.

Study Design

The study design was a community-based cross-sectional HH survey. Each selected member of the HH was checked for malaria parasites using microscopy. 271 individuals that were tested positive and 79 malaria negative individuals as control were subjected to haemoanalysis.

Sample Collection

An Experience Laboratory Technician and healthcare providers were trained on the study procedures. A sample of 2 ml of venous blood was collected by venopuncture from each participant into Ethylene diamine tetra-acetic acid (EDTA) bottle as described by Igbeneghu and Odaibo (2013).

Laboratory Analysis of Blood Sample

The collected blood sample was taken to Parasitology and Microbiology Laboratory as well as Haematology and Blood Transfusion Laboratory, Specialist Hospital Sokoto State for malaria microscopy and haemoanalysis respectively. Malaria parasites detection was done by microscopic examination of thick and thin blood films stained with 10% Giemsa. Haematocrit, leucocyte count, platelet count, haemoglobin concentration, erythrocyte count, Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC), of Malaria positive individuals and negative individuals as control were estimated using Genesis 6000HA haematology analyzer.

Data Analysis

The resultant values of haemoanalysis were subjected to descriptive statistics and presented as mean ± standard deviation, and between the test and control subjects, t-test was used to show significant difference at p <0.05 using SPSS version 26.

RESULTS

Haematological Parameters Of Malaria Infected Participants In The Study Area

The haematological parameters of malaria infected individuals in the study area are presented in (table 1). In malaria infected and control subjects, the values were, 3.8450×10^6/ml and 3.8950×10^6/ml respectively (RBC), 10.0000g/dl and 11.2250g/dl respectively (HGB), 5.6000×10^3g/l and 6.6000×10^3g/l respectively (WBC), 31.3000g/dl and 29.6500g/dl (MCHC), 25.8000pg and 28.8250pg respectively (MCH), 82.45000fl and 97.4000fl respectively (MCV), 31.9000% and 37.9000% respectively (HCT), 285.7500×10^3g/l and 210.000×10^3g/l respectively (PLT).

However, there is no significant difference between the infected and non infected individuals in the following parameters; RBC, HGB, WBC and MCHC. P=0.804, 0.109, 0.061 and 0.172 respectively but the following parameters were significantly different; MCH, MCV, HCT and PLT. P=0.030, 0.010 and 0.031 and 0.004 respectively.

Table 1: Haematological Parameters of Malaria infected Participants in Gwadabawa Local Government, Sokoto \State

Parameter	Mean ± standard deviation		t-value	p-value	95%CI
	Malaria positive No.(271)	Malaria negative No.(79)			
RBC×10⁶/ml	3.8450±0.29354	3.8950±0.24906	-0.260	0.804	-0.524-0.424
HGB g/dl	10.0000±0.94163	11.2250±0.89954	-1.881	0.109	-2.819-0.369
WBC ×10³g/l	5.6000±0.71645	6.6000±0.29439	-2.582	0.061	-2.077-0.077

MCHC g/dl	31.3000±0.88318	29.6500±1.81567	1.614	0.172	-0.764-3.395
MCH pg	25.8000±1.55134	28.8250±1.46145	-2.839	0.030	-5.635-0.415
MCV fl	82.45000±3.94673	97.4000±6.31348	-4.016	0.010	-24.50- -5.400
HCT %	31.9000±2.92916	37.9000±3.129	-2.800	0.031	-11.250- -0.750
PLT ×10^9 g/l	285.7500±24.971	210.000±20.330	4.705	0.004	35.957-115.543

DISCUSSION

Haematological parameters are very important in the management of malaria infected patients. Although the participants were majorly having mild infection with low parasitemia, the results obtained from this study showed that the HCT value is significantly lower in malaria infected subjects, when compared with negative subjects (P-value = 0.031). This finding is similar to the work of Garba *et al.* (2015) who reported 38% and 41% for infected and uninfected subjects respectively, but differ from the work done by Samje *et al*. (2009) in the University of Buea Cameroon where they recorded 45% PCV level among malaria infected patients. This decrease in PCV level (anaemia) may be due to some degree of haemolysis in malaria infected patients (Hoffbrand *et al*., 2005), or nutritional deficiency.

This research work shows that platelet count is significantly higher in malaria infected patients when compared to negative individuals (P= 0.004). This varied from the report of Cheesbrough (2000) and Hoffbrand *et al*. (2005) that mild thrombocytopenia with counts down to 100 x 109/L is common in malaria infected patients and is most marked in patients with severe *falciparum* infection. The extent of thrombocytopaenia correlates with parasite density, severity of malaria infection and clinical outcomes. The lack of significant reduction in platelet count among malaria positive participants could be attributed to low parasites density among the infected participants.

White Blood Cells (WBC) count was slightly lower among malaria positive than malaria negative participants although the difference is not statistically significant (P-value =0.061). The result is in conformity with the work of Manas *et al.* (2014) which reported a decrease in leucocytes count (leucopaenia) among malaria subjects, but different from the work of Garba *et al.* (2015) who reported an increase in leucocyte count among malaria subjects. Leucopenia has been linked with depletion in the lymphocyte through apoptosis or due to sequestration of the cells in the lymph nodes or other body tissues.

Red Blood Cells (RBC) count were also found to be slightly reduced among malaria positive participants compared to malaria negative participants (P-value = 0.804). Reduction in RBC count among malaria infected individuals was also reported by manas *et al.* (2014) 4.33×10^{12}/l and 4.63×10^{12}/l among malaria positive and negative individuals respectively.

The lack of significant reduction in RBC could be due to the fact that the individuals examined were mostly having mild infection with a low parasitemia. Reduction in RBC count is majorly evident in severe malaria infection resulting from cytoadherence, rosetting, sequestration and increased rigidity and deformability of red cell membrane which leads to splenic clearance of both infected and uninfected red cells. All these conditions are not associated with mild infection, hence the lack of significant reduction in RBCs among the malaria infected participants.

Haemoglobin (HGB) was also found to be slightly reduced among the malaria infected participants as compared to malaria negative participants (P-value = 0.109). This value is less than the reference value (12.0 -16.5), thus indicating anaemic condition. Such reduced value of HGB (anaemia) was also reported in the work of Benjamin and Sylvester (2018) 10.46g/dl. The reduction could be attributed to the

digestion of the haemoglobin by the parasite as the parasite utilizes the host haemoglobin for its growth and reproduction.

Mean Corpuscular Haemoglobin Concentration (MCHC) was however found to be slightly higher in malaria positive individuals (P-value 0.172). Such a slightly elevated MCHC value among malaria infected participants was also reported in the work of Tsinlu *et al.* (2017). MCH was found to be significantly lower (P-value = 0.030) among positive individuals thus indicating anaemea. Such a reduction in MCH level could be attributed to the digestion of the haemoglobin by the parasites. The MCV was also discovered to be significantly low, 15% less than malaria uninfected participants (P-value = 0.010), although the value was within the reference value (80.0 - 99.0). Such a lower MCV level could be attributed to nutritional deficiency.

CONCLUSION

Malaria significantly affect some blood parameters among infected individuals which could leads to considerable morbidity. Hence proper management of these blood parameters is vital for the treatment of infected individuals.

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