# Studies on Some Haematological Parameters among Malaria Infected Patients Attending a Tertiary Hospital in Nigeria

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### Abstract

Malaria is among the leading public health issues in Sub Sahara Africa. Among malaria patients there are changes in the haematological status. The study investigated haematological status of malaria parasite infected patients attending outpatient clinic at Federal Medical Centre Yenagoa, Bayelsa state, Nigeria. 43 participants comprising of 21 males and 22 females within the age of 18-45 years were involved in the study. Another 20 age matched individuals with no case of parasitaemia served as control. Blood samples were collected by venipuncture techniques. The samples were analyzed using Westergren method for erythrocyte sedimentation rate (ESR) and automated haematology analyzer for full blood counts (System XS-1000i). Results showed that the test and control participants (males) were 10.46g/dl and 13.64g/dl respectively (haemoglobin), 33.86% and 41.05% respectively (packed cell volume), $8.45×10^9$/L and $7.32×10^9$/L respectively (total white blood cell count), $185.29×10^9$/L and $259.45×10^9$/L respectively (platelets) and 30.33mm/hour and 8.45mm/hour (erythrocyte sedimentation rate) and for females; 10.10g/dl and 13.36g/dl respectively (haemoglobin), 30.91% and 40.05% respectively (packed cell volume), $9.13×10^9$/L and $7.27×10^9$/L respectively (white blood cell), $176.36×10^9$/L and $252.50×10^9$/L respectively (platelets) and 34.00mm/hour and 7.85mm/hour (erythrocyte sedimentation rate) (females). There was a significant ($P<0.05$) reduction in platelets, packed cell volume, haemoglobin, and elevation in white blood cell and erythrocyte sedimentation rate. The alterations may suggest risk of anaemia and thrombocytopaenia in the patients. Therefore, there is the need for immediate diagnosis at early stage of the infection for proper treatment.

**Keywords:** Blood; Haematological aberration; Mosquito; Parasitaemia; Public health

## Introduction

Malaria is among the major public health concern in Sub-Sahara Africa [1-3]. As such it's one of the major causes of mortality and morbidity especially in children [4]. Majority of malaria infection occurs in Sub-Sahara Africa as against any other area in the world. Malaria endemicity vary from country to country [4], and Approximately 15 nations accounts for 80% and 78% of cases and deaths emanating from malaria infection on global scale, respectively [5]. Malaria is endemic in Nigeria, Democratic Republic of Congo (DRC), Ethiopia, and Uganda and as such approximately half of global malaria case occurs in these regions [6].

Malaria is caused by plasmodium species (a protozoan). Four major species of plasmodium exist in Africa including *ovale, vivax, falciparuum, malariae* [3,7-9]. Among the species, *P. falciparum* is the major cause of malaria in West Africa [10].

Malaria is transmitted by Mosquito, an iniquitous dipteran fly. Mosquito has the tendency to transmit malaria and host of other diseases [11] including filariasis, yellow fever, dengue fever, encephalitis, chikungunya, yellow and dengue fevers, lymphatic filariasis especially in tropical countries. Different species of mosquito belong to varying genera (viz: *Aedes, Culex, Anopheles and Mansonia* etc) exist and they can transmit different diseases in both humans and animals.

Specifically the genus *Anopheles* is a major vector that transmits malaria parasite. Several species of the genus exist, but the common species include *Anopheles gambiae, A. funestus, A. arabiensis* and *A. melas* [12]. But in Nigeria, *Anopheles gambiae* is among the frequently encountered species. The parasite is transmitted through bite of an infected female anopheles mosquito [4]. Anopheles mosquito that carries the parasite

desposites the sporozoites on the host, which then invades the liver and then the red blood cells, thereby predisposing the individual to intermittent shivering, pyrexia, sweating and spleen enlargement [1]. This could lead to anaemia in infected patients.

Blood plays a very vital function in the human body. Typically, blood consists of cellular constituent including erythrocytes, leukocytes and thrombocytes that are essential for the various functions in body physiology [4]. In disease condition, the cells and roles of the cellular components are altered in both production and function. Blood differentials including neutrophils, eosinophils, lymphocytes, basophils and monocytes provide clues to the kind of infection especially the status of the white blood cells. According to Okoroiwu et al. [4], instance of neutrophilia in infection associated with bacteria, and neutropenia a disease caused by non-bacteria agent have been previously reported. Surve et al. [13] reported that malaria could lead to changes in haematological status alongside with other conditions such as anaemia, thrombocytopenia and leukocytosis, leukopenia, lymphocytosis, monocytosis, eosinophilia and neutrophilia. According to Ifeanyichukwu and Esan [14], thrombocytopaenia is among the major haematological aberrations frequently observed among malaria patients and usually disappears when the malaria infection is treated.

The effects of malaria often manifest in haematological system [13]. Studies have shown that parasitaemia has the tendency to cause anaemia where it has degenerative impact and suppresses bone marrow [15]. Variations in haematological parameters may be influenced by any disease condition such as malaria where they can cause complications probably due to their role in the pathogenesis of malaria [16,17]. In addition, thrombocytopenia is a common phenomenon among *P. falciparum* caused malaria. Due to this effect, there is the need to frequently monitor the effect of parasitemia on haematological parameters. In Nigeria some studies on the effect of malaria on haematological status have been conducted in different locations including Niger Foundation Hospital, Independence Layout, Enugu [15], Owerri in Imo state [4], University of Calabar Teaching Hospital, Calabar [1], Federal Medical Centre, Ido-Ekiti, Ekiti State [14], Usmanu Danfodiyo University Teaching hospital Sokoto [18]. Therefore, this present study was aimed at assessing haematological status among malaria infected patients attending Federal Medical centre Yenagoa metropolis, Bayelsa state, Nigeria.

## Materials and Methods

### Study area

Yenagoa is among the developing cities in Nigeria. Yenagoa is the capital of Bayelsa. The state lies in the sedimentary basin, and fishing is a major occupation of the indigenous people of the area. Civil service and business are also source of livelihood of resident of the area. The atmospheric temperature (28 ± 6 ºC) and relative humidity (50-95%) is also common to other region in Niger Delta region of Nigeria [19-23].

### Selection criteria for subjects

**Inclusion criteria:** Participants of this research were individuals attending the general outpatient department of the Federal Medical Centre Yenagoa, Bayelsa state within the age of 18-45 years. Generally, 43 individuals comprising of 21 males and 22 females. Only subjects who's blood samples were confirmed positive for the presence of malaria antigen using rapid diagnostic test kit supplied by ACCESS BIO were recruited for the study. Also another 20 age matched subjects were used as control. The control subjects were confirmed negative using the same procedure.

**Exclusion criteria:** Pregnant women, lactating mothers, and individuals with known cases of HIV/AIDs, hepatitis, B and C, tuberculosis, diabetics and cardiovascular diseases were excluded from this study.

### Blood collection

A standard venipuncture approach was used to collect 5ml of blood from each subject from the anticubital or dorsal vein and dispensed into a dipotassium EDTA anticoagulant vaccutainer containing 1.5mg/ml of anhydrous salt and mixed for haemoglobin concentration, packed cell volume, platelets count, total while blood cell count, differential counts and erythrocyte sedimentation rate.

### Laboratory analysis

Full blood counts including white blood cells count, haemoglobin concentration, platelets count and differential count were estimated using sysmex XS1000i automated haematology analyzer. Erythrocyte sedimentation rate was estimated using westergren method Alexy et al. [24] with slight modification by Eledo [25], Eledo et al. [23].

### Statistical analysis

The resultant values 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 20 software.

## Results and Discussion

The haematological status of malaria infected patients attending Federal Medical centre Yenagoa is presented in Table 1 and 2 for males and females, respectively. In the males malaria infected and control subjects the values were 10.46g/dl and 13.64g/dl respectively (haemoglobin), 33.86% and 41.05% respectively (packed cell volume), $8.45×10^9$/L and $7.32×10^9$/L respectively (white blood cell), $185.29×10^9$/L and $259.45×10^9$/L respectively (platelets) and 30.33mm/hour and 8.45mm/hour (erythrocyte sedimentation rate). Furthermore in females, 10.10g/dl and 13.36g/dl respectively (haemoglobin), 30.91%

and 40.05% respectively (packed cell volume), 9.13×10⁹/L and 7.27×10⁹/L respectively (white blood cell), 176.36×10⁹/L and 252.50×10⁹/L respectively (platelets) and 34.00mm/hour and 7.85mm/hour (erythrocyte sedimentation rate). There was significant variation (P<0.001) among the subjects and the control.

**Table 1:** Effect of malaria on some haematological parameters in males among patients attending out-patient unit of Federal Medical Centre Yenagoa, Bayelsa state Nigeria.

| Parameters | Mean ± Standard Error | | t-alue | P-value |
|---|---|---|---|---|
| | Subjects (n=21) | Control (n=20) | | |
| PCV, % | 33.86 ± 0.47 | 41.05 ± 0.40 | -11.528 | 0.000 |
| Hb, (g/dl) | 10.46 ± 0.22 | 13.64 ± 0.13 | -12.257 | 0.000 |
| WBC, ×10⁹/L | 8.45 ± 0.19 | 7.32 ± 0.23 | 3.830 | 0.000 |
| Platelets ×10⁹/L | 185.29 ± 5.65 | 259.45 ± 10.56 | -6.275 | 0.000 |
| ESR, mm/hour | 30.33 ± 1.46 | 8.45 ± 0.60 | 13.592 | 0.000 |
| Neutrophil, % | 71.05 ± 0.89 | 65.15 ± 0.89 | 4.676 | 0.000 |
| Lymphocytes, % | 24.38 ± 0.73 | 29.15 ± 0.87 | -4.223 | 0.000 |
| Monocytes, % | 1.62 ± 0.15 | 3.60 ± 0.47 | -4.089 | 0.000 |
| Eosinophils, % | 2.62 ± 0.23 | 1.80 ± 0.21 | 2.584 | 0.014 |
| Basophile. % | 0.29 ± 0.10 | 0.30 ± 0.13 | -0.088 | 0.930 |

**Table 2:** Effect of malaria on some haematological parameters in females among patients attending out-patient unit of Federal Medical Centre Yenagoa, Bayelsa state Nigeria.

| Parameters | Mean ± standard error | | t-value | P-value |
|---|---|---|---|---|
| | Subjects (n=22) | Control (n=20) | | |
| PCV, % | 30.91 ± 0.64 | 40.05 ± 0.56 | -10.649 | 0.000 |
| Hb, (g/dl) | 10.10 ± 0.19 | 13.36 ± 0.18 | -12.547 | 0.000 |
| WBC, ×10+/L | 9.13 ± 0.16 | 7.29 ± 0.25 | 6.321 | 0.000 |
| Platelets ×10⁹/L | 176.36 ± 4.00 | 252.50 ± 10.44 | -7.298 | 0.000 |
| ESR, mm/hour | 34.00 ± 1.40 | 7.85 ± 0.64 | 16.407 | 0.000 |
| Neutrophil, % | 73.09 ± 0.66 | 65.05 ± 0.79 | 7.840 | 0.000 |
| Lymphocytes, % | 23.14 ± 0.63 | 29.20 ± 0.77 | -6.132 | 0.000 |
| Monocytes, % | 1.14 ± 0.07 | 3.70 ± 0.42 | -6.327 | 0.000 |
| Eosinophils, % | 2.14 ± 0.21 | 1.80 ± 0.22 | 1.120 | 0.269 |
| Basophile. % | 0.23 ± 0.09 | 0.25 ± 0.12 | -0.150 | 0.881 |

The significant elevation in white blood cell counts and decline in packed cell volume and haemoglobin in malaria infected patients suggests effect of infection and stress. Obeagu et al. [15] reported that elevation in platelets and white blood cells counts and decline in red blood cells, haemoglobin, packed cell volume etc is an indication of the release of leukocytes as a result of infection and stress. Furthermore, an elevated erythrocyte sedimentation rate is one of the main characteristics in individuals infected with malaria, and increased sedimentation of the red cells regularly manifest in elevated serum globulin [1]. According to Francis et al. [1], lower concentration of packed cell volume could be associated to mechanical devastation of parasitized red cells. Furthermore, the authors also reported that lower neutrophils could enhance development of neutropenic leukocytopenia due to an increase in mononuclear, while lower platelets could be due to hyper-reactive splenomegaly in addition to humoral immune-response.

The findings of this study had dissimilarity with the work of Okoroiwu et al. [4] that reported significant decline in basophils, eosinophils, monocytes, lymphocytes, neutrophils and white blood cells, but showed similar trend in the case of packed cell volume and platelets. The trend also showed some similarity with the work of Francis et al. [1] that reported significant decrease in pack cell volume, platelets, neutrophils, eosinophils, and significant elevation in white blood cells, erythrocytes and sedimentation rate, basophils, eosinophils, monocytes and lymphocytes. The observation in this study is comparable to the trend of packed cell volume, white blood cell and platelets reported by Garba et al. [18].

The variation could be due to age of the patients, and other underlined medical conditions that is not known at as the time of the study. According to Francis et al. [1], red cells parasitization and destruction are usually low in regions of stable malaria

among adolescence and adult. According to Subhashree et al. [26], haematological status is influenced by factors including age, ethnicity, diet, genetic and gender.

The major blood characteristics showed that packed cell volume, and platelets were lower in females compared to male, while white blood cell and erythrocytes sedimentation rate were higher in female compared to male. This trend has been reported by Francis et al. [1].

## Conclusion

This study found that plasmodium parasitaemia leads to variation in haematological status. Thus, causing a significant reduction in neutrophil, lymphocytes, monocytes, haemoglobin and packed cell volume, and increase in erythrocyte sedimentation rate and white blood cell counts among patients when compared with the control subjects. These variations suggest the possible risk of anaemia in patients. Hence there is the need for immediate diagnosis when the symptoms are observed to enhance effective management

## Authors' Contribution

Author BOE conceived the idea, involved in sample collection and laboratory analysis. Author SCI managed literature search, carried out the statistical analysis and wrote the initial draft. All authors approved the manuscript.

## Ethical Consideration

Permission was obtained from the ethics committees of the Medical Laboratory Science Department of Madonna University, Elele, Nigeria and Federal Medical Centre Yenagoa, Nigeria. Informed consent was obtained from the patients prior to sample collections.

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