



An Investigation of the Haematological Alterations Associated with Malaria-Infected Adults in Aba, South Eastern Nigeria

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

This study was designed to determine the haematological alterations associated with male and female malaria patients. Thick and thin Giemsa stained blood films were made on a slide from 2ml of venous 100 blood samples collected and viewed under a light microscope. Forty (40) samples were selected by a simple random sampling of patients aged between 21 to 60 years, made up of four experimental groups which included ten malaria positive males (MPM), ten malaria negative males (MNM), ten malaria positive females (MPF) and ten malaria negative females (MNF). The haematological parameters were evaluated using Sysmex KX-21N automated haematology analyzer. The result of the hematological alterations associated with male malaria patients showed a significant increase ($p < 0.05$) in the mean value of WBC of the malaria positive male patients compared to the control and an insignificant increase in the HCT whereas there was significant decrease ($p < 0.05$) in the mean values of HGB, RBC, MCV, MCH, MCHC and PLT of malaria positive male patients compared to the control. Similarly, the results of the female patients showed a significant decrease ($p < 0.05$) in the mean values of HCT, HGB, RBC, MCV, MCH, MCHC and PLT of malaria positive female patients compared to the control but a significant increase in WBC. From the finding of this study, it can be concluded that malaria may lead to anaemia and

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thrombocytopenia in both males and females but malaria may not lead to leucopenia and immune deficiency in both males and females. Further studies should be carried out to pinpoint the findings of this study to pursue it for its clinical relevance in the diagnosis and management malaria. If the relationship between malaria and haematological parameters are clearly established, it might be helpful to the development of a malaria vaccine in the nearest future.

Keywords: Malaria; haematological parameters; alteration; Aba; Nigeria.

1. INTRODUCTION

Malaria remains the most severe and widespread protozoal infection of humans, in spite of intensive worldwide efforts to reduce its transmission. It is a protozoan disease transmitted by the bite of an infected female Anopheles mosquito and remains a leading communicable disease in the developing countries of the world and occurs mostly in the tropical regions where it accounts for considerable morbidity and mortality. About 300-500 million people show clinical cases of malaria each year and approximately 1 to 2 million die annually [1]. Malaria contributes to both poverty and underdevelopment of the nation, community, family, and individuals because people spend large parts of their income on its prevention and treatment. In West Africa, about 75 - 80% of malaria is caused by *P. falciparum*, [1] followed by *P. malariae* which constitutes about 15% of malaria infection and about less than 4% is due to *P. ovale*. *P. vivax* does not occur so often in West Africa due to the genetic absence of Duffy antigens [2], Over 40% of the world's population is at risk of contracting malaria, which is endemic in 91 countries, mostly developing ones [3]. The World Health Organization reported that malaria is responsible for nearly 90% of deaths in Africa [4], while records have shown that about 50% of the Nigerian population suffers from at least one episode of malaria annually with over 45% of all out-patient visits being associated with disease [5]. Approximately 0.25 million deaths of Nigerian children under the age of 5 have been associated with malaria yearly [6]. Haematological changes are sometimes associated with malaria and the changes involve the major cell lines such as red blood cells, leukocytes, and thrombocytes [7,8]. Anaemia, thrombocytopaenia, and leukocytosis or leukopenia in malaria have been reported, but the extent of these alterations sometimes varies with the level of sickness, endemicity, background hemoglobinopathy, nutritional status, demographic factors and malaria immunity. There is a paucity of information on haematological alterations associated with male

and female malaria-infected patients in Aba, Abia state, Nigeria and this necessitated this study Aba, as the findings can further assist in the diagnosis and management of malaria. The objectives of this study is to determine hematological alterations in Haematocrit (HCT), red blood cell count (RBC), haemoglobin content (HGB), white blood cell count (WBC), mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC) and platelet level (PLT)) associated with male and female malaria patients.

2. MATERIALS AND METHODS

2.1 Sample Collection

The study was carried out in the laboratory of the Living Word Mission Hospital Aba, Abia State, Nigeria. Oral consent was obtained from all patients before the study. Ethical approval for this study was obtained from the Director Living word mission Hospital Aba, Abia State, Nigeria. Thick and thin Giemsa stained blood films were made on a slide from 2ml of venous 100 blood samples collected and viewed under a light microscope. Forty (40) samples were selected by simple random sampling of patients aged between 21 to 60 years made up of four experimental groups which included ten (10) malaria positive males (MPM), ten (10) malaria negative males (MNM), ten (10) malaria positive females (MPF) and ten (10) malaria negative females (MNF). The blood from each experimental group was collected into Ethylene diamine-tetra-acetic acid (EDTA) bottle for laboratory investigations to perform full blood count. Patients suffering from malnutrition, hepatitis, smokers, HIV/AIDS patients, those on anti-malaria drugs, typhoid fever, dengue fever and meningitis patients were excluded from the study.

2.2 Evaluation of Hematological Parameters

All haematological parameters such as White Blood Cell Count (WBC), Red Blood Cell Count

(RBC), Haematocrit (HCT), Hemoglobin Level (HB level), Platelet Counts (PLT), Mean Cell Volume (MCV), Mean Cell Hemoglobin (MCH), and Mean Cell Hemoglobin Concentration (MCHC) were determined with automated haematological analyzer Sysmex-KX-21N which provided a high level of accuracy through the use of automatic floating discriminators.

2.3 Statistical Analysis

The data collected were pooled and analyzed for their central tendencies using descriptive statistics, values were given as mean \pm standard deviation of 10 observations. ANOVA and LSD were employed to test the significant differences ($p < 0.05$) among treatment means. All analysis was performed using SPSS for Windows statistical software package version 20. The resulting outputs were presented in tables.

3. RESULTS AND DISCUSSION

3.1 Hematological Alterations Associated with Male Malaria Patients

The hematological alterations associated with male malaria patients showed that white blood cell count (WBC) was increased from (5.59 \pm 1.62) to (13.79 \pm 2.18) and the difference was statistically significant at ($p < 0.05$) (Table 1). Moreover, red blood cell count (RBC) and Haemoglobin (HGB) was decreased from (4.84 \pm 0.63) to (2.04 \pm 0.67) and (12.11 \pm 1.22) to (3.91 \pm 1.13) respectively, both differences were statistically significant at ($p < 0.05$). On the other hand, Haematocrit level (HCT) was increased from (41.98 \pm 2.78) to (42.18 \pm 2.74) and the difference was statistically insignificant. Also, mean cell volume (MCV), mean cell Haemoglobin, (MCH), mean cell Haemoglobin

concentration (MCHC) and platelet level (PLT) were decreased from (983.74 \pm 3.560) to (77.94 \pm 6.77), (32.24 \pm 1.32) to 922.94 \pm 1.45), (34.42 \pm 350 to 930.02 \pm 1.10) and 336.20 \pm 55.25) to 126.40 \pm 17.15) respectively, and these differences were statistically significant at ($p < 0.05$) (Table 1).

3.2 Hematological Alterations Associated with Female Malaria Patients

Haematological alterations associated with female malaria patients showed that WBC was increased from (5.80 \pm 1.58) to (13.85 \pm 2.72) and the difference was statistically significant at ($p < 0.05$) (Table 2). On the other hand, RBC, HGB, HCT, and MCV were decreased from (4.36 \pm 0.43) to (2.04 \pm 0.55), (11.96 \pm 1.33) to (3.91 \pm 1.16), (35.93 \pm 1.49) to (29.88 \pm 2.92) and (88.82 \pm 4.50) to (75.74 \pm 5.43) respectively; and these differences were statistically significant at ($p < 0.05$) (Table 2). Similarly, MCH, MCHC, and PLT were also decreased from (29.52 \pm 2.54) to (23.54 \pm 2.04), (33.93 \pm 1.08) to (30.22 \pm 1.07) and (284.0 \pm 24.60) to (139.30 \pm 28.39) respectively, and these differences were statistically significant at ($p < 0.05$) (Table 2).

3.3 Discussion

Malaria accounts for considerable morbidity and mortality. Every year it caused the death of more than one million people in Africa and is responsible for fifteen percent (15%) of clinical illnesses in the tropical regions of this continent [9]. As seen in this study, the result of hematological alterations associated with malaria-infected patients is in agreement with the report which showed a significant decrease in PLT and HCT ($p < 0.05$) and also a significant increase in WBC ($p < 0.05$) of the malaria

Table 1. Haematological alterations associated with male malaria patients

Haematological parameters	Malaria positive males	Malaria negative males
WBC (/l)	13.79 \pm 2.18 ^a	5.59 \pm 1.62 ^b
RBC (/l)	2.04 \pm 0.67 ^a	4.84 \pm 0.63 ^b
HGB (g/l)	3.91 \pm 1.13 ^a	12.11 \pm 1.22 ^b
HCT (%)	42.18 \pm 2.74 ^a	41.98 \pm 2.78 ^a
MCV (fl)	77.94 \pm 6.77 ^a	83.74 \pm 3.56 ^b
MCH (pg)	22.94 \pm 1.45 ^a	32.24 \pm 1.32 ^b
MCHC (g/dl)	30.02 \pm 1.10 ^a	34.42 \pm 1.35 ^b
PLT (/ul)	126.40 \pm 17.15 ^a	336.20 \pm 55.25 ^b

Values are given as Mean \pm Standard Deviation of 10 observations (N= 10). Mean values in the same row with different superscripts differ significantly ($p < 0.05$). Key: WBC= White Blood Cell, RBC = Red Blood Cell, HGB = Haemoglobin, HCT= Haematocrit, MCV= Mean Cell Volume, MCH = Mean Cell Haemoglobin, MCHC= Mean Cell Haemoglobin Concentration, PLT= Platelet

Table 2. Haematological alterations associated with female malaria patients

Haematological parameters	Malaria positive females	Malaria negative females
WBC (/l)	13.85±2.72 ^a	5.80±1.58 ^b
RBC (/l)	2.04±0.55 ^a	4.36±0.43 ^b
HGB (g/l)	3.91±1.16 ^a	11.96±1.33 ^b
HCT (%)	29.88±2.92 ^a	35.93±1.49 ^b
MCV (fl)	75.74±5.43 ^a	88.82±4.50 ^b
MCH (pg)	23.54±2.04 ^a	29.52±2.34 ^b
MCHC (g/dl)	30.22±1.07 ^a	33.93±1.08 ^b
PLT (/ul)	139.30±28.39 ^a	284.0±24.60 ^b

Values are given as Mean ± Standard Deviation of 10 observations (N= 10). Mean values in the same row with different superscripts differ significantly ($p < 0.05$). Key: WBC= White Blood Cell, RBC = Red Blood Cell, HGB = Haemoglobin, HCT= Haematocrit, MCV= Mean Cell Volume, MCH = Mean Cell Haemoglobin, MCHC= Mean Cell Haemoglobin Concentration, PLT= Platelet

patients compared to the control group [10]. This could be a result of anemia associated with the mechanical destruction of parasitized red cells as well as with the splenic clearance of parasitized and detected erythrocytes. The increase in WBC may be a result of an effective immune response to the malaria [9]. The significant decrease in HGB, HCT and RBC suggested that malaria could lead to anemia and reduction in hemoglobin, which may be attributed to increased breakdown of the red blood cells by malaria parasites [11]. Hyper-reactive splenomegaly, occurring especially in the usually predominant falciparum malaria, combined with humoral immune response may have contributed to the finding of a lower platelet count observed in this study.

4. CONCLUSIONS

From the results of the presented study, it can be safely concluded that malaria may lead to anaemia and thrombocytopenia, but it may not cause the leucopenia and immune deficiency in both males and females. Further studies that use our results should be carried out to pinpoint clinical relevance in the diagnosis and management of the malaria burden. The clear establishment of the relationship between malaria and haematological parameters might be helpful to the development of a vaccine for malaria in the nearest future.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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