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# Changes in White Blood Cells Differential Associated with Adult Malaria-Infected Patients

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***Author's contribution***

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

***Article Information***

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## ABSTRACT

**Aims:** Malaria parasites are expected to impact the white blood cell differential of malaria patients, but reports on changes in white blood cell differentials of malaria patients are not well documented, hence this study was undertaken to determine changes in white blood cell differentials associated with male and female malaria patients.
**Study Design:** Twenty male and twenty female malaria patients were divided into four groups made up of ten malaria positive males (MPM), ten malaria negative males (MNM), ten malaria positive females (MPF) and ten malaria negative females (MNF).
**Methodology:** The hematological parameters were evaluated using automated full blood count Sysmex machine.
**Results:** The result of changes in white blood cell differential associated with male and female malaria patients showed an increase in lymphocyte percentage (LYM%), mixed cell count percentage (MXD%), neutrophil percentage (NEU%), lymphocyte absolute value (LYM#), mixed cell count absolute value (MXD#) and neutrophil absolute value (NEU#) of both malaria positive males and females compared to malaria negative males and females which were statistically significant ($P < 0.05$).
**Conclusion:** This study has shown that malaria parasite increased all white blood cell differential

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parameters significantly in male and female patients examined. White blood cell differential in adult malaria-infected patients are associated with an increase in white blood cell differential parameters irrespective of gender. Further studies should be carried out to determine the clinical relevance of this finding especially as it could assist in the diagnosis of malaria infection.

*Keywords: Changes; white blood cell differential; adult; malaria.*

## 1. INTRODUCTION

Haematological parameters are measurable indices of blood that serve as a marker for disease diagnosis [1]. Haematological abnormalities such as anaemia and thrombocytopaenia have been observed in patients with malaria [2,3]. In spite of intensive worldwide efforts to reduce its transmission, malaria remains the most severe and widespread protozoan infection of humans. Over 40% of the world's population is at risk of contracting the disease, which is endemic in 91 countries, mostly developing ones. Almost all cases of malaria are caused by four species of the genus *Plasmodium* – namely *vivax, falciparum, malariae,* and *ovale*. Malaria infection imposes a tremendous socio-economic burden on humanity, accounting for 85% of global infectious disease burden along with other diseases [4]. Approximately 1.2 billion people live in areas of high risk and 2.1 billion in low-risk areas and each year, there are nearly 247 million cases and 1 million deaths.

In Nigeria, there are over 100 million people at risk of malaria every year, and it is estimated that about 50% of the adult population experience at least one episode yearly [5]. In Nigeria, about 96 million people are exposed to malaria and out of these 64 million people get infected, and almost 300,000 deaths are reported annually in the general population, of which over 100,000 deaths are attributed to children [6]. Malaria causes a lot of debilitating effect in adults and the economic loss due to malaria in Nigeria has been put at 132 billion Naira comprising the cost of treatment and transport to the source of treatment, loss of person-hours, absenteeism from places of work and other indirect costs [5]. Malaria remains a major health concern worldwide, causing 216 million infections and approximately 655,000 deaths in the year 2010 [7]. About 91 percent of malaria-related deaths are in Africa with 86 percent of victims being children aged under 5years [8]. Malaria is responsible for a significant number of deaths in endemic countries particularly in sub-Saharan Africa [9,10]. It is one of the three killers among communicable diseases in Africa [11]. Haematological changes in the course of a malaria infection, such as anemia, thrombocytopenia and leukocytosis or leucopoenia are well recognized. These alterations vary with the level of malaria endemicity, background hemoglobinopathy, nutritional status, demographic factors and also malaria immunity [12,13,14]. Haematological changes are some of the most common complications in malaria, and they play a major role in malaria pathology [15,16]. These changes involve the major cell lines such as red blood cells, leucocytes and thrombocytes [17,18]. There appears to be a paucity of data on the changes in white blood cell differentials associated with adult malaria patients hence this study aims to determine changes in white blood cell differential associated with adult- 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. Ethical clearance was obtained from the Director Living Word Mission Hospital Aba and consent was obtained from all patients before the study. Thick and thin Giemsa stained blood films were made on a slide from 2 ml 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 White Blood Cell Differential Parameters

White blood cell differential parameters such as lymphocyte percentage (LYM%), mixed cell count percentage (MXD%), neutrophil percentage (NEU%), lymphocyte absolute value (LYM#), mixed cell count absolute value (MXD#) and neutrophil absolute value (NEU#) 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 ± standard deviation of 10 observations. ANOVA and LSD were employed to test the significant differences ($p < 0.05$) among treatment means. All analyses were performed using SPSS for Windows statistical software package version 20. The resulting outputs were presented in tables.

## 3. RESULTS

### 3.1 Changes in White Blood Cell Differential Associated with Male Malaria Patients

The changes in White Blood Cell differential associated with male malaria patients showed that lymphocyte percentage (LYM%) increased from (29.0 ± 5.44) to (56 ± 6.50) and the difference was statistically significant at ($p < 0.05$) (Table 1). Similarly, mixed cell count percentage (MXD%) and neutrophil percentage (NEU%) increased from (16.64 ± 3.26) to (35.04 ± 7.08) and 51.50 ± 8.38) to (83.30 ± 4.77) respectively, both differences were statistically significant at ($p < 0.05$) (Table 1). Furthermore, lymphocyte absolute value, (LYM#), mixed cell count absolute value (MXD#), and neutrophil absolute value (NEU#) were increased from (1.59 ± 0.54) to (5.19 ± 2.04), (-.90 ± 0.40) to (3.20 ± 0.93) and (4.56 ± 0.86) to (10.06 ± 3.26) respectively, and these differences were statistically significant at ($p < 0.05$) (Table 1).

### 3.2 Changes in White Blood cell Differential Associated with Female Malaria Patients

The changes in White Blood Cell differential associated with female malaria patients showed that LYM % increased from (33.33 ± 7.80) to (61.0 ± 10.59) and the difference was statistically significant at ($p < 0.05$) (Table 2). Similarly, MXD% and NEU% increased from (13.94 ± 4.84) to (37.74 ± 6.67) and (53.66 ± 13.45) to (82.90 ± 4.23) respectively, both differences were statistically significant at ($p < 0.05$) (Table 2). Furthermore, LYM#, MXD# and NEU# increased from (1.66 ± 0.55) to (5.09 ± 2.32), (0.98 ± 0.33) to (4.06 ± 3.26) and (4.33 ± 1.25) to (8.56 ± 1.51) respectively, and these differences were statistically significant at ($p < 0.05$) (Table 2).

## 4. DISCUSSION

It is projected that more than 40% of the world's population resides in malaria-endemic areas and 300 - 500 million cases and 1.5 - 2.7 million deaths occur each year due to malaria [19]. Hematological changes are the most common complications of malaria and hematological abnormalities that have been reported in malaria and such include anemia, thrombocytopenia, atypical lymphocytosis, infrequently disseminated intravascular coagulation, Leucopenia, leucocytosis, Neutopenia, Neutrophilia, Eosinophilia and monocytosis [20,21,22].

**Table 1. Changes in white blood cell differential associated with male malaria patients**

| Haematological parameters | Malaria positive males | Malaria negative males |
|---|---|---|
| LYM% (%) | 56.0±6.50[a] | 29.0±5.44[b] |
| MXD% (%) | 35.04±7.08[a] | 16.64±3.26[b] |
| NEU% (%) | 83.30±4.77[a] | 51.50±8.38[b] |
| LYM# (/ul) | 5.19±2.04[a] | 1.59±0.54[b] |
| MXD# (/ul) | 3.20±0.93[a] | 0.90±0.40[b] |
| NEU# (/ul) | 10.06±3.26[a] | 4.56±0.86[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: LYM%= Lymphocyte Percentage, MXD%= Mixed Cell Count Percentage, NEU%= Neutrophil Percentage, LYM#= Lymphocyte Absolute Value, MXD#= Mixed Cell Count Absolute Value, NEU#= Neutrophil Absolute Value*

**Table 2. Changes in white blood cell differential associated with female malaria patients**

| Haematological parameters | Malaria positive females | Malaria negative females |
|---|---|---|
| LYM% (%) | 61.0±10.59[a] | 33.33±7.80[b] |
| MXD% (%) | 37.74±6.67[a] | 13.94±4.84[b] |
| NEU% (%) | 82.90±4.23[a] | 53.66±13.45[b] |
| LYM# (/ul) | 5.09±2.32[a] | 1.66±0.55[b] |
| MXD# (/ul) | 4.06±3.26[a] | 0.98±0.33[b] |
| NEU# (/ul) | 8.56±1.51[a] | 4.33±1.25[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: LYM%= Lymphocyte Percentage, MXD%= Mixed Cell Count Percentage, NEU%= Neutrophil Percentage, LYM#= Lymphocyte Absolute Value, MXD#= Mixed Cell Count Absolute Value, NEU#= Neutrophil Absolute Value*

The changes in white blood cell differential associated with male and female malaria patients showed a significant increase ($p < 0.05$) in lymphocyte percentage (LYM%), mixed cell count percentage (MXD%), neutrophil percentage (NEU%), lymphocyte absolute value (LYM#), mixed cell count absolute value (MXD#) and neutrophil absolute value (NEU #) of the malaria positive males compared to the malaria negative males. This result is in line with the reports of [23] and [24]. These works showed a significant increase in LYM%, NEU%, LYM# and NEU# respectively. The reason for the improvement in these parameters may be as a result of the production of different kinds of white blood cells and antibodies to fight the impending infection or disease. In this study, a significant increase in the neutrophil level of individuals infected observed could be a representation of early release of neutrophil from the bone in response to the infection [24].

## 5. CONCLUSION

Malaria may not lead to leucopenia and immune deficiency in both males and females as it increased all white blood cell differential parameters studied. White blood cell differentials in adult malaria-infected patients are associated with an increase in white blood cell differential parameters irrespective of gender. Further studies should be carried out to determine the clinical relevance of this finding especially as it could assist in the diagnosis of malaria infection.

## CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the author.

## ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the author.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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