



## **Age-Related Haematological Variations in Patients with Asymptomatic Malaria in Akure, Ondo State, Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors All authors read and approved the final manuscript.*

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## ABSTRACT

**Background:** Malaria is a life-threatening infectious disease of widespread burden. Malaria remains a leading communicable disease in the developing countries of the world. It occurs mostly in the tropical and subtropical regions and accounts for considerable morbidity and death. Malaria which is liable for a major amount of mortalities in endemic countries has been revealed to have both direct and indirect impacts on the haematological parameters. The study was done to compare the levels of haematological parameters of asymptomatic malaria patients based on age groups.

**Methods:** The study is a cross-sectional study among asymptomatic malaria patients based on age groups. This study was conducted in Oda Road area of Akure, Ondo State. Two hundred (200) subjects were recruited for this study with each group comprising of 100 subjects for patients with asymptomatic malaria for the 2 age groups (16-30 years and 31-65 years). The data were presented in tables and as mean  $\pm$  standard deviation and analyzed using student-test for parametric data and chi-square for non parametric data by statistical packages for social sciences (SPSS, Version 20.0) and level of significance set at as  $p \leq 0.05$ .

**Results:** The results showed that subjects on age group 16-30 years were 100(50%) comprising of 50 males (25%) and 50 females (25). Also age group 31-65 years has 100 subjects (50%) comprising of 50 males (25%) and 50 females (25). The results showed significant difference in MCV ( $p=0.008$ ), MCH ( $p=0.024$ ) and no significant difference in PCV ( $p=0.675$ ), WBC ( $p=0.224$ ), LYM ( $p=0.109$ ), GRAN ( $p=0.061$ ), MID ( $p=0.066$ ), RBC ( $p=0.119$ ), Hb ( $p=0.546$ ), MCHC ( $p=0.262$ ), PLT ( $p=0.783$ ), when compared between age groups in years (16-30 and 31-65).

**Conclusion:** The study showed increase in MCV and MCH of asymptomatic malaria patients within the age group of 31-65 years compared to asymptomatic malaria patients on 16-30 years age group. This shows that microcytic hypochromic anaemia may be experienced in asymptomatic malaria patients within the age group of 16-30 years more than in 31-65 years age group.

*Keywords: Age; haematological parameters; asymptomatic malaria.*

## 1. INTRODUCTION

According to WHO [1], globally, in 2017, 219 million people were stricken with malaria, which was an increase of 2 million cases as compared to the previous year; of these, approximately 435,000 died due to related complications. Malaria remains a leading communicable disease in the developing countries of the world [2]. It occurs mostly in the tropical and subtropical regions and accounts for considerable morbidity and death. It causes the death of more than one million in Africa every year, and is responsible for fifteen percent (15%) of clinical illnesses in the tropical regions of the continent [3].

It has been documented that asymptomatic malaria parasitaemia (ASMP) serves as reservoir for malaria due to gametocyte transmission and represents, perhaps, one step in the heterogeneous set of the disease pathways [4-6]. Asymptomatic malaria is prevalent in highly endemic areas of Africa, with only a small percentage of individuals exhibiting clinical symptoms [7]. The clinical consequence of asymptomatic malaria is not fully understood.

Some researchers are of the view that asymptomatic parasitaemia is involved in the development of partial immunity and may protect against clinical disease from new infections [7]. Also, there are reports that asymptomatic parasitaemia provides a reservoir for transmission and may be a precursor in the progression to symptomatic disease [7]. The asymptomatic parasitaemics are healthy carriers of malaria parasites and serve as reservoir of infection. The symptomatic people can be treated during their clinical manifestation but the asymptomatics remain unnoticed to pose a public health danger to the population as long as there is high mosquito vector density to transmit the parasites [8].

Changes in haematological parameters are likely to be influenced by any disease condition which affects the haemopoetic physiology at any level [9]. This is likely to happen with an endemic disease such as malaria that affects the host homeostasis at various fronts resulting in a myriad of clinical presentation. Typically, microscopic slide examination of peripheral blood remains the most widely used test and is the gold standard for detecting malaria infection [10].

However, due to it requires technical expertise and is time-consuming in smear examinations. Moreover, the World Health Organization (WHO) recommends the use of antimalarial drugs based on a definitive demonstration of parasites in the peripheral blood smear [11]. Haematological changes are some of the most common complications in malaria and they play a major role in malaria pathology. These changes involve the major cell lines such as red blood cells, leucocytes and thrombocytes [12]. The haematologic picture, however, varies from person to person and largely depends on nutritional status, intensity of malaria transmission, age, and co-morbidities, such as helminthiasis [13]. Also, Malaria infected patients tended to have significantly lower platelets, WBCs, lymphocytes, eosinophils, RBCs and Hb level, while monocyte and neutrophil counts were significantly higher in comparison to non-malaria infected patients [14]. The most common complication during malaria infection is thrombocytopenia. The most significantly altered parameters are haemoglobin, packed cell volume and Erythrocyte Sedimentation Rate (ESR) [15]. To foster the knowledge of haematological parameters, this is thus, aimed at evaluating the haematological parameters of asymptomatic malaria patients by comparing the level of haematological parameters of asymptomatic malaria patients with non-malaria patients.

Malaria infection in human is usually associated with a reduction in haemoglobin level frequently leading to anaemia. *Plasmodium falciparum* causes the most severe and profound anaemia with a significant risk of death. This cannot be explained simply by the direct destruction of parasitized red blood cells at the time of release of merozoites [16].

The study was done to compare the levels of haematological parameters of asymptomatic malaria patients based on age groups.

## 2. MATERIALS AND METHOD

### 2.1 Research Design

The study is a cross-sectional study among asymptomatic malaria patients based on age groups (16 - 30 years and 31 - 65 years).

### 2.2 Study Area

This study was conducted on asymptomatic malaria patients in the Oda Road area of Akure,

Ondo State. Akure is a city in South-Western Nigeria, and is the largest city and capital of Ondo State with a population of 484,798 as at the 2006 population census having latitude 7° 15'0"N and longitude 5°11'42"E.

### 2.3 Target Population

Two hundred (200) subjects were recruited for this study with each group comprising of 100 subjects for patients with asymptomatic malaria for the 2 age groups (16-30 years and 31-65 years). The subjects were selected following purposive sampling technique. These are the major population of the country and the main work force. They are the adolescents and the adults' population of the study area. The bone marrow activities are fully developed at these ages and can participate on the study with full understanding of the procedures and consents obtained willingly.

### 2.4 Blood Collection

5ml of venous blood was collected from each participant into an Ethylene Diamine Tetra-acetic Acid (EDTA) bottle which was then used for the determination of full blood count and Malaria.

### 2.5 Method of the Test

Screening for Malaria parasite was carried out using Rapid Diagnostic Test. A pink line at the positive and control band indicated a positive reaction whereas only one pink line at the control band indicated negative reaction. No pink line at both positive and negative control bands indicates an invalid result. Thick and thin blood films from each blood specimen were made, allowed to air-dry and stained in 10% Giemsa stain solution for 30 min. The stained smears were rinsed in buffer solution and allowed to air-dry. The stained thick films were examined under bright field light microscope for estimation of malaria parasite density while the thin films were examined for species of Plasmodium.

### 2.6 Full Blood Count (FBC)

Measurement of haemoglobin, red blood cells, white blood cells and platelets count were done by using ADVIA® 2120i Haematology system (SIEMENS). The cell count was cross-checked by experienced Medical Laboratory Scientist on duty.

**Table 1. Age and frequency distribution of the subjects**

S/N	Age Groups (years)	Frequency(n)	Percentage (%)
1	16-30	100	50
	Male	50	25
	Female	50	25
2	31-65	100	50
	Male	50	25
	Female	50	25

**Table 2. Mean  $\pm$  standard deviation of haematological parameters of asymptomatic malaria patient based on age group**

Parameters	16-30 years	31-65 years	t-Value	P-Value
PCV(%)	35.50 $\pm$ 5.95	34.60 $\pm$ 6.32	0.423	0.675
WBC( $10^9/L$ )	10.55 $\pm$ 6.23	7.99 $\pm$ 4.05	1.231	0.224
LYM(%)	25.56 $\pm$ 15.89	34.69 $\pm$ 15.33	-1.635	0.109
GRAN(%)	68.64 $\pm$ 17.90	56.42 $\pm$ 18.36	1.922	0.061
MID(%)	4.81 $\pm$ 5.16	8.88 $\pm$ 9.15	-1.880	0.066
RBC( $10^{12}/L$ )	4.35 $\pm$ 0.86	3.87 $\pm$ 0.82	1.588	0.119
Hb(g/dl)	11.87 $\pm$ 1.96	11.44 $\pm$ 2.14	0.609	0.546
MCV(fl)	79.99 $\pm$ 7.13	87.56 $\pm$ 9.61	-2.790	0.008*
MCH(pg)	26.74 $\pm$ 2.29	28.97 $\pm$ 3.98	-2.335	0.024*
MCHC(g/dl)	33.47 $\pm$ 1.09	33.01 $\pm$ 1.37	1.135	0.262
PLT( $10^9/L$ )	172.31 $\pm$ 47.93	166.80 $\pm$ 80.90	0.277	0.783

## 2.7 Method of Data Analysis

The data were presented in Tables and as mean  $\pm$  standard deviation and analyzed using student-t test for parametric data and chi-square for nonparametric data by statistical packages for social sciences (SPSS, Version 20.0) and level of significance set at as  $p \leq 0.05$ .

## 3. RESULTS

Table 1 shows age and frequency distribution of the subjects. The subjects on age group 16-30 years were 100(50%) comprising of 50 males (25%) and 50 females (25). Also age group 31-65 years has 100 subjects (50%) comprising of 50 males (25%) and 50 females (25).

The table above showed significant difference in MCV (79.99 $\pm$ 7.13fL, 87.56 $\pm$ 9.61fL,  $p=0.008$ ), MCH (26.74 $\pm$ 2.29Pg, 28.97 $\pm$ 3.98Pg,  $p=0.024$ ) and no significant difference in PCV (35.50 $\pm$ 5.95%, 34.60 $\pm$ 6.32%,  $p=0.675$ ), WBC (10.55 $\pm$ 6.23 $\times 10^9/L$ , 7.99 $\pm$ 4.05 $\times 10^9/L$ ,  $p=0.224$ ), LYM (25.56 $\pm$ 15.89%, 34.69 $\pm$ 15.33%,  $p=0.109$ ), GRAN (68.64 $\pm$ 17.90%, 56.42 $\pm$ 18.36%,  $p=0.061$ ), MID (4.81 $\pm$ 5.16%, 8.88 $\pm$ 9.15%,

$p=0.066$ ), RBC (4.35 $\pm$ 0.86 $\times 10^{12}/L$ , 3.87 $\pm$ 0.82 $\times 10^{12}/L$ ,  $p=0.119$ ), Hb (11.87 $\pm$ 1.96g/dL, 11.44 $\pm$ 2.14g/dL,  $p=0.546$ ), MCHC (33.47 $\pm$ 1.09g/dL, 33.01 $\pm$ 1.37g/dL,  $p=0.262$ ), PLT (172.31 $\pm$ 47.93 $\times 10^9/L$ , 166.80 $\pm$ 80.90 $\times 10^9/L$ ,  $p=0.783$ ), when compared between age groups in years (16-30 and 31-65).

## 4. DISCUSSION

The study showed increase in MCV and MCH of asymptomatic malaria patients within the age group of 31-65 years compared to asymptomatic malaria patients on 16-30 years age group. This shows that microcytic hypochromic anaemia may be experienced in asymptomatic malaria patients within the age group of 16-30 years more than in 31-65 years age group. This could be attributed to bone marrow functional activity related to maturity. There were no changes observed in other haematological parameters studied. This shows that asymptomatic malaria has no changes in the haematological parameters except in MCV and MCH. The clinicians and those developing drugs for these patients should take note of these changes only in MCV and MCH. A lower PCV in the malaria infected patients may reflect anaemia which is often

mainly due to mechanical destruction of parasitized red cells as well as splenic clearance of parasitized and defected erythrocytes. Also, Haemoglobin (HGB), Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH) and Mean Cell Haemoglobin Concentration (MCHC) of samples are significantly different from the control which agrees with a study by [7]. Studies on changes in haematological parameters of asymptomatic malaria patients based on age groups are limited and that prompt this study for an understanding on the age-related variations which will be helpful in maintaining a longer life span of the inhabitants of this part of the world and immigrants. Malaria is a disease of concern in tropical and sub-tropical countries like Nigeria and the rest of them. Anaemia has been associated with chronic malaria resulting from dyserythropoiesis and ineffective erythropoiesis. These mechanisms could be responsible for the decrease in the haemoglobin level observed among the seemingly healthy parasitaemic subjects. A report suggested that persistent asymptomatic malarial infections significantly increase the risk of becoming anaemic [17]. The kind of anaemia associated with age of those affected with asymptomatic malaria presents as microcytic hypochromic anaemia as a chronic health challenge. This kind of anaemia may be more pronounced in 16-30 years age group of asymptomatic malaria patients compared to 31-60 years patients. The patients on 16-30 years have a more developed bone marrow with a higher haematopoietic activity than the patients on 16-30 years.

Immune complexes generated by malarial antigens lead to sequestration of the injured platelets by macrophages in the spleen. Also, platelet consumption in disseminated intravascular coagulation is thought to contribute to thrombocytopenia in malaria [7,18-22].

## 5. CONCLUSION

The study showed increase in MCV and MCH of asymptomatic malaria patients within the age group of 31-65 years compared to asymptomatic malaria patients on 16-30 years age group. This shows that microcytic hypochromic anaemia may be experienced in asymptomatic malaria patients within the age group of 16-30 years more than in 31-65 years age group.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## CONSENT

Informed consent was obtained from the subjects who participated in the study. The purpose of the study was explained to all participants. Participation in the study was entirely voluntary. Anonymity and confidentiality was ensured and maintained.

## ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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