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# Occurrence of Plasmodium falciparum Malaria Associated with ABO Blood Group in Darazo, Bauchi State, Nigeria

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**Research Article**

## Abstract

Public concern due to *P. falciparum* infection from endemic localities is increasing. The present study was carried out to investigate the relationship between blood group types and *P. falciparum* malaria. Rapid Diagnostic Tests (malaria HRP-2) were used to detect malaria and Giemsa stain was used for microscopic examination under oil immersion. ABO groups were determined by agglutination test. Out of the 330 participants, 118 (35.8%) were infected with *P. falciparum* parasites. Males and females had the prevalence of 38.6% and 33.5%, respectively with no significant difference ($\chi^2$=1.07, P>0.05). The age group 11-20 years had the highest prevalence (73.8%) than the other age groups with a significant difference ($\chi^2$=52.8, P<0.05). Malaria infection with *P. falciparum* showed no significant association (P>0.05) with blood types. Patients with blood groups A and B were significantly (P<0.05) susceptible to *P. falciparum* infection in relation to age groups. Present findings indicate that patients of all age groups belonging to blood group A and B are more susceptible to *P. falciparum* infection.

**Keywords:** *Plasmodium falciparum;* Blood groups; Giemsa; Agglutination

## 1. Introduction

Malaria affects 3.3 billion people of half of the world population in 106 countries and territories [1]. Recent estimates show that about 198 million cases and 584 000 deaths due to malaria were reported worldwide [2]. Malaria mortality rates have fallen by 47% globally since 2000 and by 54% in the WHO African Region [1].

Thirty countries in Sub-Saharan African account for 90% of global malaria deaths among which Nigeria, Democratic Republic of Congo, Ethiopia and Uganda account for nearly 50% of the cases [2].

Malaria is a major public health problem in Nigeria where it accounts for more cases and deaths than any other country in the world. Ninety-seven per cent (97%) of Nigerians are at risk for malaria infection with an estimated 100 million cases and over 300,000 deaths per year [2].

Malaria is caused by Plasmodium parasites. The parasites are spread to people through the bites of infected Anopheles mosquitoes, which bite mainly between dusk and dawn. Malaria responsible causal agent is an obligate intracellular protozoan parasite in the genus plasmodium. In Nigeria, there are four parasite species that cause malaria in humans: *Plasmodium falciparum, Plasmodium vivax, Plasmodium malariae* and *Plasmodium ovale*, but *P. falciparum* and *P. vivax* are the most common. *Plasmodium falciparum* is the deadliest [1]. Previous studies have associated blood groups to malaria [3].

The blood group types (ABO) consist of A, B, H carbohydrate antigens which have the capacity of regulating protein activities during infections and antibodies against these antigens [4]. Association between plasmodium infection, haemoglobin genotypes and blood group of Northern Nigerian nomadic Fulani under-five children revealed that haemoglobin genotypes AA to be significantly infected than other haemoglobin genotypes. The parasite was found to be more associated with group A than any other group [5]. A good number of investigations in Nigeria and elsewhere have been conducted to find out whether or not ABO blood antigens are associated with susceptibility of *P. falciparum malaria* [6,7].

Studies conducted to find out the relationship between blood group type and the susceptibility or resistance to malaria showed contradictory results. The blood group $O^+$ for instance was reported to have the least susceptibility to malaria with significant sample size [8]. The susceptibility of malaria prevalence in relation to blood group phenotypes of patients in Nigeria is therefore necessary to set a baseline data and fill up the gap of knowledge in Bauchi State. The present study aimed to investigate the association between the blood phenotypes with *P. falciparum* infection of patients attending the General hospital in Darazo, Bauchi State, Nigeria.

## 2. Materials and Methods Study Area and Participants

A cross sectional study was conducted in the General hospital, Darazo Local Government Area (LGA), Bauchi State, Nigeria (Figure 1).

Darazo Local government is found in Bauchi state in the Northern guinea savannah ecological zone of Nigeria. The area covers 3015 Km$^2$ with an estimated population of 251.597 based on the 2006 census. The state generally is located between latitudes 9° 3' and 12° 3' N and longitudes 8°50' and 11°E. The climate is characterized basically by two seasons: the rainy season (May to October) and dry season (November to April). August records the highest relative humidity of 65.5% and February records the lowest 16.5% [9].

The General Hospital is the main health centre for

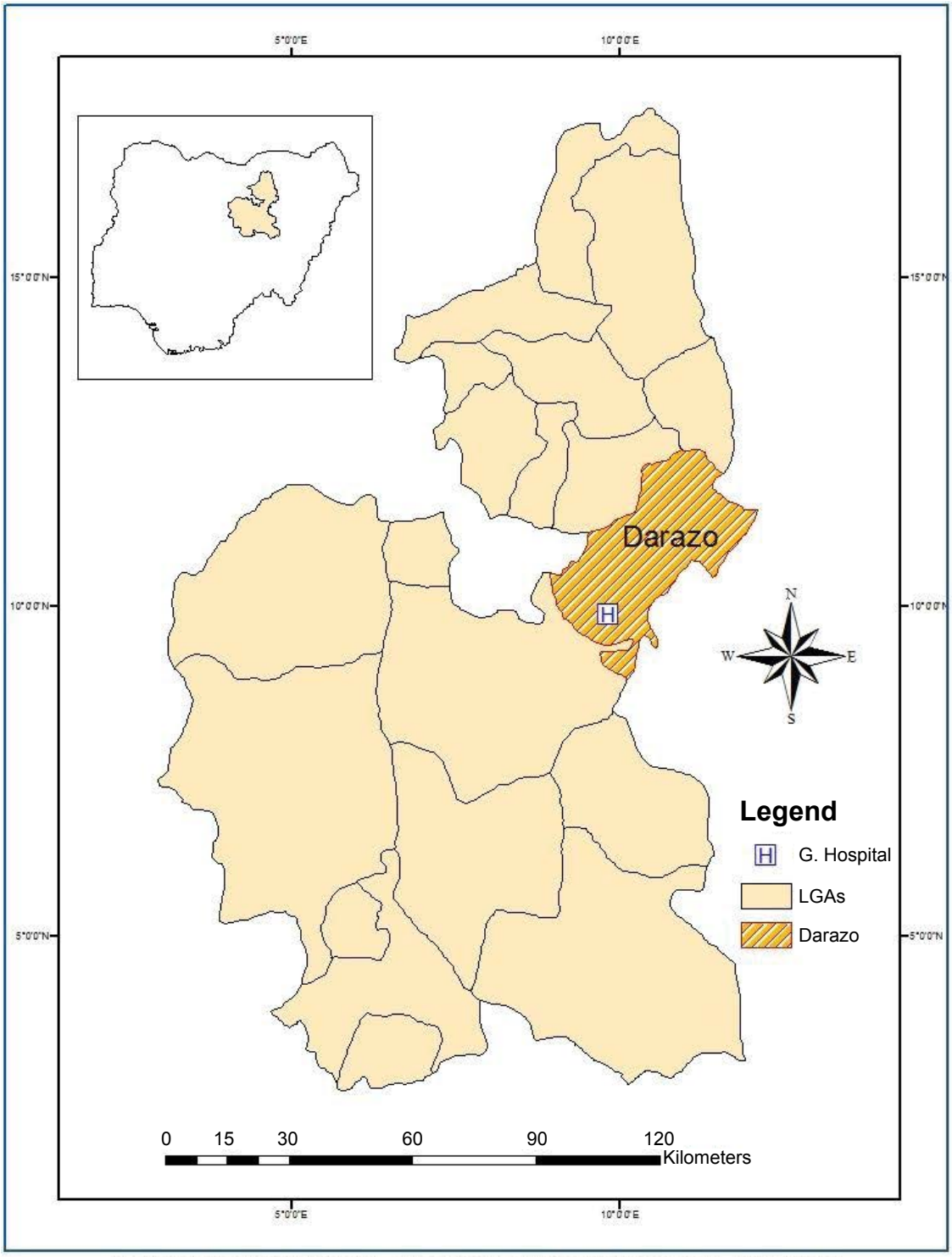


**Figure 1.** Map of Bauchi showing Darazo General Hospital.

the whole local government and has a laboratory with free malaria diagnosis every Wednesdays of the week. The study population was composed of all groups age of patients who sought medical attention at the Hospital.

A total of three hundred and thirty participants were randomly selected and screened as study participants excluding individuals who took anti-malarial drugs within two weeks prior to blood test.

## 3. Laboratory Analysis

2 ml of venous blood from each participant was collected into EDTA-anticoagulated tubes. A drop of blood was placed on a clean glass slide to prepare thick and thin blood films using 10% Giemsa solution. The stained slides were allowed to air-dry for 10 min and then examined under a light microscope using X100 oil immersion objective. Prior to slides' preparation and following the manufacturer instructions Rapid Diagnostic Tests using Malaria HRP-2 were prepared by streaking a drop of blood on the kit and by adding the buffer. All tests were read after five minutes when the red colour line on the test kit showed positivity of malaria. Confirmation of *P. falciparum* using Giemsa-stained slides determined malaria infection.

### 3.1 Blood group determination

ABO blood groups were typed by agglutination using commercial anti-sera kits (Eldoncard® 2511, Sandtofen, D-K 2820, Gentofte, Denmark) and followed manufacturer's guide. Two drops of whole blood were placed in two different places of a grease-free clean glass slide on which a few drops of anti-sera for blood group A and B was applied. The blood cells and the antigen were mixed with applicator stick and the result recorded accordingly.

### 3.2 Ethical clearance

The study protocol was reviewed and approved by the ethical review Committee of the General Hospital Darazo, Darazo LGA, Bauchi State, Nigeria. Written informed consent form was obtained from all study participants or their parents for those below 18 years old.

### 3.3 Statistical analysis

Data was analyzed using XLStat 15.1 and SISA software. Chi-square ($\chi^2$) was used to determine association between age, sex, blood groups and malaria. Values were considered to be statistically significant when P value is less or equal to 0.05.

## 4. Results and Discussion

Table 1 describes the prevalence of malaria in relation to age groups and sex of participants in Darazo LGA, Bauchi State, Nigeria. Out of 330 patients examined, 118 (35.8%) were infected with *Plasmodium falciparum*.

| | Number Examined | Number Infected | Prevalence of Infection (%) |
|---|---|---|---|
| **Age group** | | | |
| 0-10 | 166 | 44 | 26.5 |
| 11-20 | 61 | 45 | 73.8 |
| 21-30 | 73 | 15 | 20.5 |
| 31-40 | 14 | 6 | 42.9 |
| 41-above | 16<br>$\chi^2$=52.8 | 7<br>P=0.001 | 43.8 |
| **Sex** | | | |
| Male | 127 | 49 | 38.6 |
| Female | 203<br>$\chi^2$=1.07;<br>P=0.30 | 68<br>OR=1.27 | 33.5<br>95% confidence interval (CI):<br>0.80>1.27>2.02 |
| **Blood group** | | | |
| A | 45 | 11 | 24.4 |
| B | 147 | 54 | 36.7 |
| AB | 39 | 16 | 41.0 |
| O | 99 | 37 | 37.4 |
| Total | 330<br>$\chi^2$=3.15 | 118<br>P=0.37 | 35.8 |

**Table 1.** Prevalence of malaria in relation to age group, sex and ABO blood groups of participants in General Hospital Darazo, Bauchi State, Nigeria.

Malaria prevalence was significantly higher 45 (73.8%) among the age group 11 to 20 years as compared to other groups ($\chi^2$=52.8, P=0.001). The sex-related prevalence showed no significant difference of malaria between male, 49 (38.6%) and females, 68 (33.5%) ($\chi^2$=1. 07; P>0.05) with the odd ratio of 1.27.

The blood group related malaria prevalence (Table 1) also showed no significant difference of malaria between A, B, AB, O blood groups with prevalence of 45(24.4%), 147 (36.7%), 39 (41.0%) and 99 (37.4%), respectively.

Table 2 describes the prevalence of malaria in relation to blood group and age group of participants in Darazo LGA.

Malaria prevalence was higher for age group belonging to blood group A, B, AB and O with prevalence of 7(71.4%), 29(79.3%), 11(72.7%) and 14 (64.3%), respectively. Malaria prevalence was significantly higher ($\chi^2$=10.2 P= 0.016; $\chi^2$=32.8 P=0.001) among all the age groups belonging to blood group A and B respectively as compared to other blood groups.

The prevalence of infection (35.8%) observed in patients in the present study shows that *P. faciparum* malaria is still a problem in the study area which is endemic to the disease. However, the prevalence of infection in this study was higher compare to 30.2% by in Nigeria, 13.0% reported by among donors in

**Table 2.** Prevalence of malaria related to blood group and age group among participants.

| Blood group | Age | Number examined | Infected | Non-infected | Prevalence of Infection (%) |
|---|---|---|---|---|---|
| **A** | 0-10 | 28 | 4 | 24 | 14.3 |
| | 11-20 | 7 | 5 | 2 | 71.4 |
| | 21-30 | 9 | 2 | 7 | 22.2 |
| | 31-40 | 0 | 0 | 0 | 0.0 |
| | 41-above | 1<br>$\chi^2$=10.2; P=0.016 | 0 | 1 | 0.0 |
| **B** | 0-10 | 70 | 20 | 50 | 28.6 |
| | 11-20 | 29 | 23 | 6 | 79.3 |
| | 21-30 | 35 | 5 | 30 | 14.3 |
| | 31-40 | 5 | 2 | 3 | 40 |
| | 41-above | 8<br>$\chi^2$=32.8; P=0.001 | 4 | 4 | 50 |
| **AB** | 0-10 | 19 | 5 | 14 | 26.3 |
| | 11-20 | 11 | 8 | 3 | 72.7 |
| | 21-30 | 4 | 1 | 3 | 25 |
| | 31-40 | 3 | 1 | 2 | 33.3 |
| | 41-above | 2<br>$\chi^2$=6.3; P=0.14 | 1 | 1 | 50 |
| **O** | 0-10 | 49 | 15 | 34 | 30.6 |
| | 11-20 | 14 | 9 | 5 | 64.3 |
| | 21-30 | 25 | 7 | 18 | 28 |
| | 31-40 | 6 | 3 | 3 | 50 |
| | 41-above | 5<br>$\chi^2$=7.7; P=0.10 | 3 | 2 | 60 |
| **Total** | | **330** | **118** | **212** | **35.8** |

Ghana hospital [10,11]. The highest prevalence in the current study compared to the above mention may be due to the differences in sampling size and may be due to the presence of vectors in their localities. Seasonality affects the prevalence of malaria in urban City of Nigeria with the highest peaks coinciding with the height of wet season [12].

This study was conducted during the dry season. This may account for the weak prevalence of infection since malaria prevalence seems to be higher during rainy season. This results although not very high as compared to the prevalence of risk of infection in Nigeria (97%) showed that people in the locality are prone to malaria [2]. This averagely low prevalence might also account for the level of awareness of people in the locality and also the unavailability of mosquitoes breeding ponds during the period of study.

The prevalence of infection in males and females was slightly higher with the odd ratio of 1.27 but not significant. The finding in this study agreed with Sirina et al. [11] and Bonilla [13] were male had a higher rate of infection than females. However, the study disagreed to that of which reported more females infected than males [14].

Individuals aged between 11 to 20 years had the highest infestation prevalence of infection (73.8%). The reason for this difference observed in terms of age is not actually clear and need some further investigation. However, it might be suggested that the age range encompass more vulnerable patient with a low level of immunity and frequent exposures s to the vector.

The observation that prevalence of infection of *P. falciparum* malaria related to blood phenotypes A, B, AB and O did not show any significant difference was not in agreement with study by in India who reported significant higher prevalence of blood group B (41%) and A (29.2%) followed by group O (22%) and group AB (7%) [15]. The present results in this study may account for the sample size which seemed to be smaller in some groups than other. This may also suggest that the blood group types had an unknown impact on the malaria incidence in the present study. This result partially corroborates with the report of though, in this study rosette formation have not been assess in participants [16].

The prevalence of malaria in relation to blood group and age group showed significant influence on *P. falciparum* malaria incidence, this agreed with findings of who reported blood phenotypes A, B and AB high-

er for *P. falciparum* with a OR>1.5 compared with group O individuals for each age groups [17]. This suggests that group AB and O are more resistant to *P. falciparum* malaria.

## 5. Conclusion

The study revealed that, participants of blood group A and B in relation to the prevalence of *P. falciparum* malaria and age groups were more prone to malaria as compared to patients with other blood groups.

Further studies on the severity of *P. falciparum* malaria could be useful to test the role of blood group in disease severity.

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