

# Original Research Article

## **PREVALENCE OF ABO BLOOD GROUPS AND ITS RELATIONSHIP WITH MALARIA PARASITEMIA AMONG STUDENTS OF FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE, ONDO STATE.**

### **Abstract**

There are different reports on the increasing evidence about the relationship between *Plasmodium falciparum* malaria and ABO blood group, but the range is yet to be understood. This study was carried out to determine the prevalence of malaria parasitaemia and its relationship with ABO blood group among newly admitted students of FUTA. A total of 312 blood samples were examined. Thick and thin blood films were made from each sample of blood collected with use of sterile syringe and needles and ABO blood group typing were carried out using monoclonal antisera A, B and D. The 312 samples analyzed were made up of 126 (40.4%) rhesus positive and 10(3.21%) rhesus negative. In decreasing order, 60.0%, 45.3%, 39.1% and 37.3% students occurred in blood group AB, O, A and B respectively with geometric parasite density of 3.02, 3.99, 4.29, 3.5 respectively. 136(43.6%) of the total sample examined were positive for malaria parasitemia of which *P. falciparum* account for 82(60.3%), *P. vivax* 34(25.0%) and *P. malariae* 20(14.7%). 97(46.2%) and 39(38.2%) of the total male and female students were infected. 146(50.7%) malaria parasitemia seems to be moderately high in age group 16-20yrs. There was no significant difference in age group and sex ( $P>0.05$ ) of the subjects; but there was a significant difference in prevalence of malaria parasitemia and blood groups ( $P<0.05$ ). This study indicates that individual of blood group O and AB are more susceptible to malaria infection.

**Keywords:** Malaria, Parasitemia, Relationship, Blood group, Rhesus factor, Genotype.

### **Introduction**

28 Malaria is a parasitic disease caused by protozoan of the phylum *Apicomplexa*, class  
 29 *sporozoasida* and subclass *coccidian*. It is vectored by female *Anopheles* mosquitoes. The  
 30 infective sporozoite in their salivary gland is transmitted to human during blood feeding.  
 31 Malaria is one of the most severe public health problems and a leading cause of death in  
 32 many developing countries especially Africa. According to World Malaria Report there were  
 33 about 219 million cases of malaria in 104 endemic countries. Individuals with less immunity  
 34 are at most risk from the disease. These include young children, pregnant mothers, travellers  
 35 and people from endemic areas who are not regularly exposed to infection (Tidi *et al.*, 2013).

36 *Plasmodium* infection has long been identified as a main public health problem in the tropical  
 37 and subtropical countries (Agbolade *et al.*, 2013). Despite the high morbidity and mortality,  
 38 certain individuals living in malaria endemic regions appear relatively protected compared to  
 39 those who suffer frequent severe malaria attacks. Resistance to malaria infection is  
 40 dependent on the development of an immune response by the host and to a varying extent, on  
 41 certain innate characteristic possessing protective value against infection. These factors  
 42 include sickle cell trait (HBAS) and sickle cell disease (HbSS), ABO blood type and the level  
 43 of G-6-P-Dihydrogenase activity (Otajevwo, 2013). Malaria parasites are known to respond  
 44 differently to their environment in the human host such as the structure of haemoglobin (Tidi  
 45 *et al.*, 2013). Malaria parasite does not thrive well in sickle cell individuals; this natural  
 46 protection has made the haemoglobin 'S' gene resilient in malaria-infested areas, particularly  
 47 Africa. The protection against malaria is bestowed only on people who have sickle cell trait  
 48 and have inherited just a single gene because haemoglobin 'S' is known to interfere with the  
 49 growth and reproduction of malaria parasite (Goldfarb *et al.*; 2009a and Aidoo *et al.*; 2009b).

50 The blood grouping system consists of the A, B and H carbohydrate antigens, which can  
 51 regulate protein activities during infection and antibodies against these antigens (Gayathri *et*  
 52 *al.*, 2013). ABO blood grouping is based on the presence or absence of A and B blood group

antigens on the surface of red blood cells (RBC) derived from inherited gene (Tadesse and Tadesse, 2013). It has been the most important selective force on the human population. Variations in reports on the association of ABO blood groups and disease progression of malaria show the complexity of the interaction between the parasite and host immune responses. There is a hypothesis that *Plasmodium falciparum* malaria has shaped the distribution of ABO blood groups in humans (Tadesse and Tadesse, 2013). It is thought that an understanding of the nature of relationship between ABO blood groups and malaria parasitaemia would provide an invaluable window in the effort to contain the malaria scourge and that studies of malaria parasitaemia from that stand point in populations of malaria endemic regions will be helpful in elucidating any such relationship (Otajevwo, 2013).

## **Materials and Methods**

### **Study area**

The study was conducted at the Federal University of Technology Akure, (FUTA) Ondo State. Akure is the capital and the largest city of Ondo State which covers a land area of 14,793 square kilometers within south-west of Nigeria. It lies between latitude 7°15'0"N and longitude 5°11'42"E and has a population of about 484,798. Akure, has an average temperature of 25.6°C and relative humidity of 85% (Eludoyin and Elu, 2007).

### **Ethical clearance**

Prior to the commencement of the research, relevant approval was obtained from the Chief Medical Director of the University Health Centre. Informed consent of the study subjects was sought from the students before samples were collected from them.

### **Sample collection**

75 Using sterile needle and syringes, two millimetres (2ml) of venous blood was collected from  
76 the subjects with the assistance of the Laboratory technologists by vein puncture technique.  
77 Blood collected were dispensed into ethylene- diamine-tetra-acetic acid (EDTA)  
78 anticoagulated blood containers, properly mixed and labelled appropriately. Relevant data  
79 including department, age and gender were obtained from the respondents at the end of  
80 collection to aid the epidemiological studies.

## 81 **Laboratory analysis**

82 Thick and thin films were prepared on the same clean and grease free slide after appropriate  
83 labelling and allowed to air dry on laboratory working bench. Thin films were fixed with  
84 methanol and allowed to evaporate while the thick films were not fixed with methanol. Slides  
85 were arranged on a staining rack and flooded with 10% Giemsa Stain solution for 10-15  
86 minutes. The stain was washed under a slow flowing tap water and allowed to air dry.  
87 Finally, the films were carefully examined under oil immersion microscope objective (x100).

## 88 **Blood group and Rhesus test.**

89 The ABO blood group of each subject was determined using cell grouping Antisera (A, B and  
90 D). Three (3) drops of each subject blood sample is placed on separate points on a sterile  
91 white tiles divided into three (3) cells. A drop of antisera A, B and D were placed beside the  
92 blood and thoroughly mixed to obtain a homogenous mixture with the aid of a sterile rod and  
93 the tile was rocked gently to ensure uniform mixing. The mixtures were carefully observed to  
94 determine blood group of students by the presence of agglutination or not. Antiserum D was  
95 used to determine the Rhesus factor. Finally the blood samples of respondents were grouped  
96 based on these observation and confirmation into blood group  $A^+$ ,  $A^-$ ,  $B^+$ ,  $B^-$ ,  $AB^+$ ,  $AB^-$ ,  $O^+$  and

## 97 **O. Data analysis**

Data obtained were subjected to Chi-square test and ANOVA (SPSS version 20) to assess the difference between frequencies (the relationships between blood groups and *Plasmodium species*) and analysed at 95% level of significance. Observed difference was considered to be significant for  $p < 0.05$ .

$$\text{Prevalence} = \frac{\text{Number of infected individual}}{\text{Total number of individuals examined}} \times 100$$

## Results

Table 1 shows the demographic characteristics of the sampled population. The age group of the sampled population ranged from 16-30 years. Most of the subjects 67.3% (210) were males, while 32.7% (102) were females. The distribution of the various ABO blood group were 46(14.7%), 59(18.9%), 15(4.8%) and 192(61.5%) for A, B, AB and O respectively. 288(92.3%) of the subjects were rhesus D positive; while only 24(7.7%) of them were rhesus D negative.

A total of 312 blood samples were sampled, out of which 192(61.5%) males and 96(30.8%) females were rhesus positive and 18(5.8%) males and 6(1.9%) females were rhesus negative. 29(9.3%), 43(13.8%), 10(3.2%) and 128(41.0%) male students were grouped into blood groups A, B, AB and O respectively. For the females, 17(5.4%), 16(5.1%), 5(1.6%) and 64(20.5%) were grouped into A, B, AB and O respectively.

The data on the relationship of ABO blood groups with malaria parasitaemia are presented in Table 3. Out of the 312(100.0%) students sampled, 136(43.6%) were positive for malaria parasitaemia. AB individuals 9(60.0%) were infected with malaria parasites with geometric mean density value of 3.02 in their peripheral blood, blood group O with 87(45.3%) and a mean density value of 3.99. The least infected was group B with only 22(37.3%). Statistical

analysis showed significant association in malaria parasitaemia and ABO blood groups  
(P=0.006, P<0.05).

**Table 1: Demographic characteristic of the study Subjects.**

| Parameters           | Number (%) |
|----------------------|------------|
| <b>Age</b>           |            |
| 16-20                | 146(50.7)  |
| 21-25                | 147(37.4)  |
| 26-30                | 19(36.8)   |
| <b>ABO</b>           |            |
| A                    | 46(14.7)   |
| B                    | 59(18.9)   |
| AB                   | 15(4.8)    |
| O                    | 192(61.5)  |
| <b>Rhesus factor</b> |            |
| Rh positive          | 288(92.3)  |
| Rh negative          | 24(7.7)    |
| <b>Gender</b>        |            |
| Male                 | 210(67.3)  |
| Female               | 102(32.7)  |

**Table 2: ABO blood group and Rhesus factor distribution**

| Blood group | Gender | Rhesus positive (%) | Rhesus negative (%) | Total (%) |
|-------------|--------|---------------------|---------------------|-----------|
| A           | M      | 28(9.7)             | 1(4.2)              | 29(9.3)   |
|             | F      | 16(5.6)             | 1(4.2)              | 17(5.4)   |
| B           | M      | 40(20.8)            | 3(12.5)             | 43(13.8)  |
|             | F      | 15(15.6)            | 1(4.2)              | 16(5.1)   |

|     |       |   |           |          |           |
|-----|-------|---|-----------|----------|-----------|
| 147 | AB    | M | 9(3.1)    | 1(4.2)   | 10(3.2)   |
| 148 |       | F | 5(1.7)    | 0(0.0)   | 5(1.6)    |
| 149 | O     | M | 115(39.9) | 13(54.2) | 128(41.0) |
| 150 |       | F | 60(20.8)  | 4(16.7)  | 64(20.5)  |
| 151 | Total | M | 192(61.5) | 18(5.8)  |           |
| 152 |       | F | 96(30.8)  | 6(1.9)   |           |

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155 **Table 3: Association of ABO blood group with Malaria Parasitaemia**

|     |             |                 |                     |                       |
|-----|-------------|-----------------|---------------------|-----------------------|
| 156 |             |                 |                     |                       |
| 157 | Blood group | Number examined | Number positive (%) | mean parasite-density |
| 158 | A           | 46              | 18(39.1)            | 4.29                  |
| 159 | B           | 59              | 22(37.2)            | 3.51                  |
| 160 | AB          | 15              | 9(60.0)             | 3.02                  |
| 161 | O           | 192             | 87(45.3)            | 3.99                  |
| 162 | Total       | 312(100%)       | 136(43.6)           |                       |

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164 (P=0.006, P<0.05)

165 Table 4 shows the data obtained on sex distribution as they relate to ABO blood groups'

166 association with malaria parasite infection. Out of the 312(100.0%) sampled population,

167 97(46.2%) males and 39(38.2%) females were positive for malaria infection. Of the infected

168 male subjects, 13(13.4%), 15(15.5%), 8(8.2%) and 61(62.8%) were of blood group A, B, AB

169 and O respectively. For females, 5(12.8%), 7(17.9%), 1(2.6%) and 26(66.7%) fell into group

170 A, B, AB and O respectively. The association of malaria parasitaemia with ABO blood

171 groups among gender was not statistically significant ( $X^2=1.767$ , P=0.184, P>0.05)

172 The prevalence of malaria parasitaemia within age-group is summarized in Figure 3. The age

173 group of 16-20 years recorded the highest prevalence rate (50.7%), the age-group with the

174 least prevalence rate (36.8%) were subjects of 26-30 years. Statistical analysis showed no

175 significant difference in malaria infection and age-group ( $X^2=5.62$ , P=0.06, P>0.05)

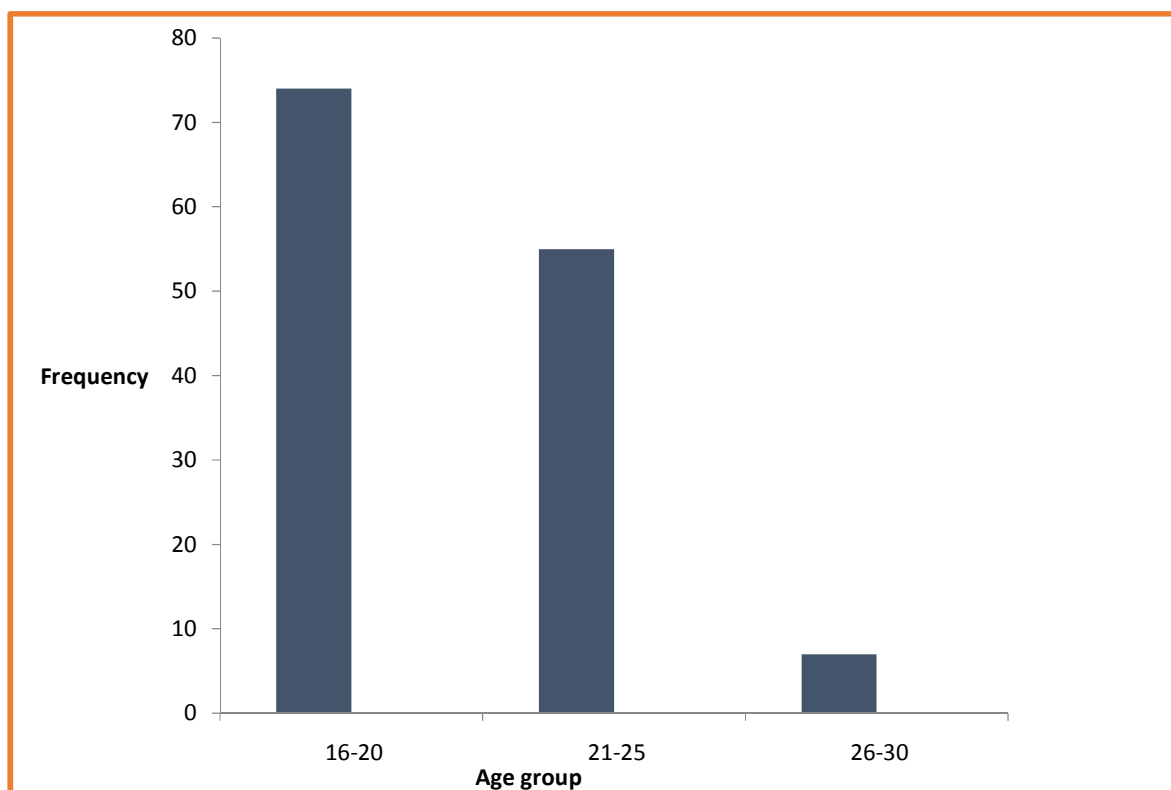
176 Table 5 shows that out of 136 positive cases, 82(60.3%), 34(25.0%) and 20(14.7%) blood  
177 samples were parasitized with *P. falciparum*, *P. vivax* and *P. malariae* respectively.

178 **Table 4: Sex distribution as related to ABO blood group association with malaria**  
179 **Parasitaemia**

| 180 | Blood group | Gender | Number positive (%) |
|-----|-------------|--------|---------------------|
| 181 | A           | M      | 13(13.4)            |
| 182 |             | F      | 5(12.8)             |
| 183 | B           | M      | 15(15.5)            |
| 184 |             | F      | 7(17.9)             |
| 185 | AB          | M      | 8(8.2)              |
| 186 |             | F      | 1(2.6)              |
| 187 | O           | M      | 61(62.8)            |
| 188 |             | F      | 26(66.7)            |
| 189 |             |        |                     |
| 190 | Total       | M      | 97(46.2)            |
| 191 |             | F      | 39(38.2)            |

192 ( $X^2=1.767$ ,  $P=0.184$ ,  $P>0.05$ )

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194

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Fig 3: Prevalence of malaria within age group.

**Table 5: Distribution of *Plasmodium* species among infected subjects**

| <i>Plasmodium</i> species | Number Positive | Number infected by species (%) |
|---------------------------|-----------------|--------------------------------|
| <i>P. falciparum</i>      | 136             | 82(60.3)                       |
| <i>P. vivax</i>           | 136             | 34(25.0)                       |
| <i>P. malariae</i>        | 136             | 20(14.7)                       |

## Discussion

This findings showed that the most prevalent blood group is O (61.5%) and the least is AB (4.8%), this is consistent with the reports of Ilozumba and Uzozie (2009) and Tidi *et al* (2013). This might be as result that ABO blood group is known to exhibit racial patterns (Bray *et al.*, 1999; Otajevwo, 2013). 192(61.5%) males and 96(30.8%) females were rhesus positive while 18(5.8%) males and 6(1.9%) females were rhesus negative . This confirmed that the occurrence of rhesus factor negative even when minimal, may not be insignificant considering the medical implications in terms of child birth and still birth, arising from haemolytic disease of newborn (Otajevwo, 2013).

136(43.6%) of the 312 students sampled harboured malaria parasites of various densities. This prevalence rate suggests mesoendemicity of malaria parasite infection in the study area which is line with WHO (2002) standard for classification of endemicity. However, the result is different from the prevalence rate (45.8%) reported by Afolabi *et al* (2015); This result shows that the prevalence of malaria is still relatively high among the students in the study

area as value obtained are relatively close. This is an indication that the students are exposed to mosquito bites which may be as a result of unsanitary condition of the environment and exposure to mosquito at one point or the other. Agbolade *et al* (2013) reported that inadequate use of mosquito nets and insecticides could also be a predisposing factor. Other likely pre-disposing factors in the area may include over-crowding in hostels which could facilitate vector-man contact, and malaria parasite transmission (Otajevwo, 2013).

Gender specific prevalence showed that male and female students were equally at risk of getting infected (Table 4). However, disease prevalence was slightly higher in male (46.2%) than female (38.2%). This correlates with the work of (Bonilla and Rodriguez, 1993; Muntaka and Opoku-okrah, 2013), where males had a higher malaria parasite infection rate than females. The presents study was, however, in contrast to that of (Vlassoff and Bonilla, 1994; Otajevwo, 2013), which reported more females being infected than males. This higher prevalence of *Plasmodium* infection in males than females recorded in this work, could be due to the fact that males expose their bodies more often than the females and thus increases their chances of being bitten by the mosquito (Akanbi *et al.*, 2010).

Blood group AB was more significantly infected with malaria parasites than other blood groups. This is similar with the reports of Ilozumba and Uzozie (2009a) and Wolofsky (2009b) who reported highest malaria parasitaemia in blood group AB individuals. This significant association is an indication that malaria susceptibility may be ABO blood group dependent as suggested by Hill *et al* (1992) and Ademowo *et al* (1995). The lack of antibodies in the serum of AB blood group could be implicated in their susceptibility to infection.

This study also revealed that malaria parasitaemia could be age-related. A progressive increase in prevalence was observed as the age increased. This correlates with the results of

some earlier studies in Nigeria (Coker *et al*, 2001; Nebe *et al.*, 2002 and Muntaka and Opoku-okrah, 2013). Prevalence of malaria parasitaemia was highest (50.7 %) in the 16-20 years age group and declined in older groups. A similar trend was observed in the findings of Alli *et al* (2010) who recorded predominant infection rate in adolescents. Brooks *et al* (2004) and Akanbi *et al* (2010); reported that the degree of immunity is related to the duration of exposure to *Plasmodium* species which is longer for older persons.

This work discovered that *Plasmodium falciparum* was the highest of the species responsible for malaria infection. This is in accordance with the findings of (Tidi *et al.*, 2013; Aliu *et al.*, 2014; Singh *et al.*, 2015). This high rate could be due to the availability of mosquitoes vectors for the transmission of infection and suitable environmental conditions for the multiplication of *P. falciparum*. The low rate of *P. malariae* and *P. vivax* may be because they tend to be selective in the type of blood cells they infect for example, *P. malariae* and *P. ovale* prefers leucocytes and young red blood cells than the old blood cells (Akanbi *et al.*, 2009).

## Conclusion

Malaria remains an endemic disease in tropical and subtropical regions. The high prevalence of malaria parasitaemia encountered, establishes that socioeconomic factors, such as appalling sanitary condition, low standard of living, inadequate use of treated mosquito nets are still very much in play as a predisposing factor to malaria infection in the study area. Revealed progressive decline in malaria susceptibility as age increases, ABO phenotype and Rhesus factor of human being could be a possible risk factor for malaria susceptibility or resistance as prevalence observed among blood groups differs. Therefore, there is need for the government to incorporate control programs such as public enlightenment, free intense

266 distribution of ITNs and tools that will give prompt and correct diagnosis of malaria  
267 parasites which will help reduce morbidity and mortality of the disease.

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