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Research Article

Susceptibility of Humans of The ABO Blood Groups to *P. falciparum* infection Among Patients Attending Ahmadu Bello University Clinic (Sickbay), Samaru-Zaria, Kaduna State, Nigeria.

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Abstract: The effects of patients' blood groups, age and sex on the prevalence of malaria in the Ahmadu Bello University Clinic (Sickbay), Samaru-Zaria, Kaduna State were investigated. A total of 178 (24.5%) of 728 patients investigated had malaria infection. Prevalence of malaria was higher in females (32.0%) than in males (19.1%). Prevalence of malaria in children less than 10years old (44.4%) was higher than in older age groups. Patients with O blood group occur most in the clinic, but prevalence of malaria was highest among those with B blood group (35.3%) and lowest in those with O blood group (17.7%). There was significant association between ABO blood groups and malaria infection in the study area (P>0.05). The study confirms low malaria endemicity in the area, high malaria prevalence in children less than 10years and recommends ways to reduce infection in them.
Keywords: Malaria, Prevalence, Susceptibility, Humans, ABO Blood Group, Patients, Plasmodium, Zaria.

INTRODUCTION

Malaria is an infectious disease that up till now has remained an intriguing moving target and one of the world's most serious health problems. Malaria accounts for 2.0% of global death and in the African region of WHO, 9.0% of deaths are attributable to malaria [1]. In humans, malaria is caused by four species of the protozoan parasites of the genus *Plasmodium* namely; *Plasmodium falciparum, Plasmodium malarie, Plasmodium ovale* and *Plasmodium vivax*[2]. *P. falciparum* is the predominant parasite responsible for over 90% of human infections and the leading cause of death during childhood [1]. *P. malarie* and *P. ovale* are responsible for about 8% and 2% of infections respectively [3]. *P. vivax* does not occur in Nigeria and does not cause infection in Africa because of the genetic deficit of Duffy antigen receptors required for invasion of RBCs by *P. vivax*[4]. Apart from the parasite being inoculated into the definitive host through the bite of the vector, it could also be transmitted through transfusion of infected blood, or by injection using contaminated needles. Very occasionally, congenital transmission occurs when the mother is non-immune to plasmodiasis [5].

P. malarie and *P. ovale* usually occurs as mixed infection with *P. falciparum*[6]. Even where microscopic examination identifies only a single parasite species, a mixed infection with *P. falciparum* cannot be excluded [7]. *P. falciparum* is notorious for being responsible for severe and complicated malaria which often result in deaths. It also has the inherent capacity to develop resistance to antimalarial drugs.

There are growing epidemiological and molecular evidence that blood group affects host susceptibility to *P. falciparum* infection [8].The most well-known and medically important blood types are in the ABO group. They were discovered in 1900 and 1901 at the University of Vienna by Karl Landsteiner in the process of trying to learn why blood transfusion sometimes causes death and at other times save a patient's life [9].In 1930, he belatedly received the Nobel Prize for this discovery. There are four principal types; A, B, AB and O [10]. While blood types are 100% genetically inherited, the environment potentially can determine which blood types in a population will be passed on more frequently to the next generation. It does this through natural selection. Specific ABO blood types are thought to be linked with increased or decreased susceptibility to particular disease. For instance, individuals with type A blood are at a somewhat higher risk of contracting small pox and developing cancer of the oesophagus, pancreas and stomach. People who are type O are at higher risk for contracting cholera and plague as well as developing duodenal and peptic ulcers [10].

A link between the ABO blood group and malaria susceptibility has long been suspected. Significant association between blood group and *P. falciparum* malaria have been reported from cross-sectional and case-control studies in Brazil by Beiguelman *et al.*[11], Gabon by Migot-Nabias *et al.*[12], India by Singh *et al.*[13], Sri Lanka by Lell *et al.*[14] and Zimbabwe by Fisher *et al.*[15]. However, other studies in Columbia by Kassim and Ejezie [16], India by Thakur and Verma [17], Sudan by Bayoumi *et al.*[18] and Nigeria by Akimboye *et al.*[19] and Martin *et al.*[20] could not find an association between malaria and blood group.

Despite the numerous studies and huge literature available on the relationship between malaria and ABO blood types worldwide, there are important omissions in our knowledge of the association between the disease and blood types in Nigeria. This study is intended to provide some information on the prevalence of malaria and the association between the ABO blood types and the disease in the study area.

METHODOLOGY

Study Area

The study area is the Ahmadu Bello University clinic (Sickbay), Samaru-Zaria, Kaduna State, Nigeria. Zaria is approximately 670m above mean sea level. It is located on latitude $11^0$03'N and longitude $7^0$42'E, about 664km away from the sea. The area is characterized with vegetation of the northern guinea savannah exhibiting a strong seasonality of rainfall (six months of rainfall and six months of dryness). The rainy season starts around May and terminates around October, while the dry season last between November and April. The mean monthly temperature of Zaria is 27^0C [21]. Visit was made to the clinic twice weekly (Fridays and Saturdays) between August and November.

Phenotype Definition

All patients referred to the clinic laboratory for malaria parasite (MP) test on both sampling days constitute subjects for this research work.

Data Collection

Patients were diagnosed for malaria infection by staining a thin smear of their blood with Geimsa. Data on blood group of patients was obtained for patients referred to the clinic on both sampling days. However, patients with no record of their blood group were typed for ABO blood group by standard haemogglutination technique.

Statistical Analysis

The data obtained was subjected to statistical analysis using Chi-square to test for significant association between ABO blood group and *Plasmodium falciparum* infection at 0.05 α level. Prevalence of malaria was determined by dividing the number of positive by the number examined and expressing as a percentage.

RESULTS

A total of 728 patients' blood samples were examined between the months of August and November, out of which 178 were positive for malaria parasites, giving an overall prevalence of 25.5%. 81 (19.1%) of 425 males examined were positive while 97 (32.0%) of 303 females examined had malaria infection (Table 1). Prevalence of malaria was highest in females than males.

Table 1: prevalence of malaria infection among sex of patients

SEX	NUMBER EXAMINED	NUMBER POSITIVE
Male	425	81 (19.1%)
Female	303	97 (32.0%)
Total	728	178 (24.5%)

Table 2 shows the age and sex specific prevalence of malaria among the patients. Of the seven age categories encountered, patients within 0 – 10 years age category had a prevalence of 44.4%, 11 – 20 years had a prevalence of 27.1%, 21 – 25 years had a prevalence of 23.1%, 26 – 30 years had a prevalence of 11.7%, 31 – 35 years had a prevalence of 12.3%, 36 – 40 had a prevalence of 21.3% and 41 years and above had a prevalence of 9.1%. Prevalence of malaria was highest in patients 0 – 10 years old and least in those ages 41 and above.

Table 2: Age and Sex specific prevalence of malaria infection in patients

AGE CATEGORY	NUMBER EXAMINED			NUMBER POSITIVE		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
0 – 10	35	28	63	14 (40.0%)	14 (50.0%)	25 (44.4%)
11 – 20	183	127	310	39 (21.3%)	45 (35.4%)	84 (27.1%)
21 – 25	113	86	197	20 (17.7%)	26 (30.1%)	46 (23.1%)
26 – 30	47	30	77	3 (6.4%)	6 (20.0%)	9 (11.7%)
31 – 35	32	17	49	2 (6.3%)	4 (23.5%)	6 (12.3%)
36 – 40	11	8	19	2 (18.2%)	2 (25.0%)	4 (21.3%)
41≥	4	7	11	1 (25.0%)	0 (0.0%)	1 (9.1%)
Total	425	303	728	81 (19.1%)	97 (32.0%)	178 (24.5%)

The monthly prevalence of malaria among the patients is shown in Table 3. Malaria prevalence was highest in September (38.7%) and least in November (10.9%).

Table 3: Monthly prevalence of malaria infection in patients

MONTHS	NUMBER EXAMINED	NUMBER POSITIVE
August	161	62 (38.5%)
September	142	55 (38.7%)
October	232	40 (17.2%)
November	193	21 (10.9%)
Total	728	178 (24.5%)

Table 4 shows the effect of patients' blood on the prevalence of malaria in patients. A total of 164 patients with A blood group were examined, 53 (32.3%) were positive for malaria infection. A total of 119 patients with blood group B were examined, out of which 42 (35.3%) were positive for malaria infection. 16 (24.2%) of 66 AB blood group patients examined were infected. 67 (17.7%) of 379 O blood group patients examined had malaria infection. There was significant association between malaria infection and the ABO blood group patients (P>0.05).

Table 4: prevalence of malaria infection in ABO blood groups patients

	NUMBER EXAMINED				NUMBER POSITIVE			
SEX	**A**	**B**	**AB**	**O**	**A**	**B**	**AB**	**O**
Male	94	78	42	211	26 (24.7%)	19 (24.4%)	6 (14.3%)	30 (14.2%)
Female	70	41	24	168	27 (38.6%)	23 (56.1%)	10 (41.7%)	37 (22.0%)
Total	164	119	66	379	53 (32.3%)	42 (35.3%)	16 (24.2%)	67 (17.7%)

DISCUSSION OF FINDINGS

The overall prevalence of malaria infection in the study population was low (24.5%). The reason for this low prevalence rate may be related to climatic factors. Zaria which is located in the guinea savannah zone of north eastern Nigeria is drier with less rainfall and few waterholes for vectorial life, a situation that will result in low prevalence. Also, high level of awareness on malaria in the study area might be a contributing factor to this low prevalence.

In the study area, age group 0 – 10years had the highest rate of infection (44.4%) while the age group 41 and above had the lowest rate of infection (9.1%). High infection rate in age group 0 – 10years could be due to low transferred maternal immunity or infection acquired through the mother or inadequate protection. This is consistent with the findings of Marsden [22] and Ricke *etal.*[23]. Immunological response in the younger individuals is low, therefore, more exposure to falciparum infection risks.

Females were more infected than males in this study. This agrees with the findings of Nebe *et al.*[24]. Studies have shown that females have better immunity to malaria due to genetic and hormonal factors [25]. The higher prevalence of infection in females than males in this study disagrees with the report of Mature*et al*[26], who recorded higher prevalence of malaria in males than females. This could due to the fact that females expose themselves more than males in campuses, particularly in the study area, by wearing clothes that expose more of their bodies. By doing this, they expose themselves to more mosquito bites.

The highest prevalence of malaria occurred in August and September. These months coincided with the peak of rainfall in the study area which could have offered improved breeding condition for malaria vectors and by extension higher vector density for enhanced transmission. This is consistent with the findings of Adamu [21], who reported higher prevalence in July, August and September which coincided with the peak of rainfall.

The blood group related prevalence reveals that all blood groups were affected, although blood group B had the highest prevalence (35.3%) and blood group O had the lowest prevalence (17.7%). This is consistent with the findings of Andrew *et al.*[8] who recorded low prevalence of malaria in blood group O in comparison with other blood groups. Significant association between falciparum malaria and ABO blood groups have been reported by Beiguelman *et al.*[11] and Migot-Nabias *et al.*[12]. Their findings suggest that children with blood group O are protected from severe malaria compared with children of other blood groups. However, the global health impact on the frame-shift deletion underlying blood group O needs to be put in context by considering its high frequency. Roughly, half the people of the Sub-Sahara Africa and many other human populations at risk of life threatening disease caused by *P. falciparum* are homozygous for this null mutation and are protected by being blood group O [27]. This explained the significant association between malaria and ABO blood group in this study.

SUMMARY, CONCLUSION AND RECOMMENDATION

This study reveals low prevalence of *P. falciparum* malaria in Ahmadu Bello University Clinic (Sickbay), Samaru-Zaria, Kaduna, Nigeria. Age, sex, months of study and blood groups are variously associated with malaria prevalence in the study area. There is need for females, particularly on campuses to reduce the level of exposure of their bodies to mosquito bites, as this could increase transmission of malaria parasite amongst students. Children bellow 10years of age are at higher risk of infection. Health education therefore becomes very necessary to teach mothers and other people to provide adequate protection to their children; the need to keep their environment clean and tidy, destroying anything that may become breeding sites conducive for mosquitoes.

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