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Malaria Infection and ABO Blood Grouping in Iwo Community, Southwestern Nigeria

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Abstract: This study examined the association between ABO blood groups and malaria infection among 1688 apparently healthy adult volunteers in Iwo, Southwestern Nigeria. Thick and thin Giemsa-stained blood smears were prepared for malaria parasite identification and quantification and ABO blood group antigens tests were performed by standard tube and tile techniques. Of the 1688 individuals, 810 (48.0%) were group O, 410 (24.3%) were group B, 357 (21.1%) were group A and 111 (6.6%) were group AB. Three hundred and fifty four (43.7%) of the group O individuals, 209 (50.9%) of the group B, 171 (47.8%) of the group A and 59 (53.1%) of the AB had malaria infection. There was no significant association between ABO blood groups and malaria infection ($\chi^2 = 7.70$; df = 3; p = 0.06). The result of the analysis of variance showed that there were significant differences in the mean parasite densities of ABO blood groups for *P. falciparum* infected subjects (F = 22.64; p<0.001) and *P. falciparum-P. malariae* co-infected subjects (F = 4.64; p = 0.04). The results of the study suggest that while none of the blood groups had obvious advantage on the other with respect to malaria infection, O individuals appeared to be the most protected against high parasite density followed by B individuals while A and AB individuals were more likely to experience high parasite density.

Key words: Adults, malaria infection, ABO blood groups, parasite density, tube, tile

INTRODUCTION

Many researchers have studied the relationships between ABO blood group and susceptibility to malaria. Some studies reported no significant association between *P. falciparum* malaria and the ABO blood group. Bayoumi *et al.* (1986) examined apparently healthy adults in a malaria endemic area in Central Sudan and found no association between malaria prevalence and ABO blood groups. Similarly, Montoya *et al.* (1994) in Columbia observed no significant differences between the presence of malaria infection and ABO antigens. Uneke *et al.* (2006) reported similar results as that of Montoya *et al.* (1994) in Nigeria. Thakur and Verma (1992) found no significant difference in the rate of seropositivity for malaria antibodies among subjects with different blood groups. Akinboye and Ogunrinade (1987) in Nigeria reported absence of no significant association between ABO blood group and malaria parasitaemia or antibody titer. Kazim and Ejezie (1982) in Lagos, Nigeria reported no significant association between ABO blood group and malaria parasitaemia.

Findings from some other studies indicated the existence of a significant association between *P. falciparum* malaria and the ABO blood group. Pant *et al.* (1992) observed a significant association between prevalence of malaria infection and ABO blood groups among healthy adults and children. Singh *et al.* (1995) observed a significantly lower *P. falciparum* parasitaemia among individuals with blood groups A and O. Lell *et al.* (1999) in Gabon reported a significant association between blood group A and severe malaria. Migot-Nabias *et al.* (2000) showed that blood group O was associated with protection against higher parasitaemia. Pathirana *et al.* (2005) studied adults and children with severe malaria and noted that cases of severe malaria were significantly less likely to be of blood group O and significantly more likely to be blood group AB. In Brazil, Beiguelman *et al.* (2003) observed a significant association between individuals with A and/or B antigens and the number of malaria episodes. Fischer and Boone (1998) in Zimbabwe noted that individuals with blood group A had significantly lower haemoglobin levels and a greater risk of developing

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severe cerebral malaria. There are no reports on association between parasitaemia and ABO blood groups among apparently healthy adults. Although, the relationship between blood group and susceptibility to malaria has been studied by several researchers, results have been contradictory and unable to establish an unequivocal link between ABO blood groups and malaria prevalence or malaria parasitaemia.

Therefore, more studies are required to possibly establish a characteristic pattern for the association between malaria prevalence or malaria parasitaemia and ABO blood groups in every locality. The aim of this study was to determine the pattern of relationship between asymptomatic malaria and ABO blood groups among apparently healthy adults in Iwo community Southwestern Nigeria.

MATERIALS AND METHODS

The study was carried out in Iwo, a semi-urban community in Southwestern Nigeria. It is situated between Latitudes 7°37'30" and 7°38'30"N and Longitudes 4°10'30" and 4°12'00"S. A total of 1688 individuals (≥16 years) with no clinical signs and symptoms of ill health as of the time of investigation were screened for the study after clinical examination and informed consent was obtained. Ethical approval for this study was obtained from the Ethical Committee of Ladoke Akintola University Teaching Hospital, Osogbo, Osun State, Nigeria.

A sample of 5 mL of venous blood was collected from each participant into Ethylene Diamine Tetra-Acetic Acid (EDTA) bottle for laboratory investigations. Thick and thin blood films stained with 3% Giemsa were examined under the microscope for malaria parasites. At least 200 microscopic fields were examined before declaring a smear as negative. If after 200 leucocytes had been counted, 10 or more parasites were identified the estimation was done based on the number of parasites per 200 leucocytes. However, if after 200 leucocytes had been counted, <10 parasites were counted, counting was continued to 500 leucocytes and the number of parasites per 500 leucocytes was recorded. For the positive slides the number of parasites counted per 200 or 500 leucocytes was used to calculate parasite density on the basis of the individual's true leucocyte count/μL of blood. ABO blood group antigens tests were performed by standard tube and tile techniques. Controls were set up appropriately. The anti-A and anti-B were controlled with A_1 cells and B cells. Commercially prepared anti-A and anti-B were used according to the manufacturer's instructions.

Statistical analysis: χ^2-test was used to test differences in percentages or proportions. Analysis of Variance (ANOVA) was used for multiple comparisons of means. Pairwise comparisons were made using the Student's t-test. A p-value of <0.05 was considered significant.

RESULTS

The distributions of ABO blood groups and the number positive for *Plasmodium* sp. in this study population are shown in Table 1. Of the 1688 individuals, 810 (48.0%) were group O, 410 (24.3%) were group B, 357 (21.1%) were group A and 111 (6.6%) were group AB. There was no significant association between ABO blood group and malarial infection ($\chi^2 = 7.70$; df = 3; p = 0.06). Table 2 shows the malarial parasite density and ABO blood groups of *Plasmodium* sp. infected subjects among the study population. A decreasing order of mean parasite density A>AB>B>O was observed both for *P. falciparum* and *P. falciparum-P. malariae* infections. The results of the analysis of variance showed that there were significant differences in the mean parasite densities of ABO blood groups for *P. falciparum* infected subjects (F = 22.64; p<0.001) and *P. falciparum-P. malariae* co-infected subjects (F = 4.64; p = 0.04) but there was none for *P. malariae* (F = 2.24; p = 0.12). For *P. falciparum* infection, parasite density was significantly

Table 1: Distribution of ABO blood groups and *plasmodium* Sp. Infections among the study population

Blood groups	No. examined (%)	No. of positive for *Plasmodium* sp. Pf (%)	Pm (%)	Pf + Pm (%)	Total (%)
ABO					
A	357 (21.1)	158 (44.3)	7 (2.0)	6 (1.7)	171 (47.8)
B	410 (24.3)	192 (46.8)	8 (2.0)	9 (2.2)	209 (50.9)
AB	111 (6.6)	53 (47.7)	2 (1.8)	4 (3.6)	59 (53.1)
O	810 (48.0)	341 (42.1)	5 (0.6)	8 (1.0)	354 (43.7)
Total	1688 (100.0)	744 (44.1)	22 (1.3)	27 (1.6)	793 (47.0)

Table 2: Malaria parasite density and ABO blood grouping of *Plasmodium* Infected subjects among the study population

		Pf		Pm		Pf + Pm	
Blood groups	No. examined (%)	No.	Mean±SD (×10³/μL)	No.	Mean±SD (×10³/μL)	No.	Mean±SD (×10³/μL)
A	357 (21.1)	158	5.1±7.0	7	0.6±0.4	6	6.8±4.9
B	410 (24.3)	192	2.6± 3.0	8	0.7±0.6	9	2.5±1.8
AB	111 (6.6)	53	4.7± 6.1	2	1.7±0.9	4	5.5±2.4
O	810 (48.0)	341	2.0±2.5	5	0.6±4.3	8	2.0±0.9
	1688	744	-	22	-	27	-

Pf: *Plasmodium falciparum* infected subjects; Pm: *P. malariae* infected subjects; Pf + Pm: Mixed *P. falciparum-P. malariae* infected subjects

higher in group A individuals than in group B individuals ($p<0.0001$) and group O individuals ($p<0.0001$); it was significantly higher in Group AB individuals than in group B individuals ($p = 0.02$) and roup O individuals ($p = 0.01$); it was significantly higher in group B individuals than in group O individuals ($p = 0.02$). There was no significant difference between the parasite densities of group A and AB individuals ($p = 0.6$). Of the 4 groups of individuals with respect to ABO blood grouping the mean *P. falciparum* parasite density was significantly lowest in O individuals of the A, AB and B individuals the mean parasite density was significantly lowest in B individuals while the mean parasite densities in A and AB individuals were not significantly different. For *P. falciparum-P. malariae* infection, parasite density was significantly higher in group A individuals than in group O individuals ($p = 0.04$) and B individuals ($p = 0.04$); it was significantly higher in group AB individuals than in group B individuals ($p = 0.01$) and group O individuals ($p = 0.02$). There were no significant differences between the parasite densities of groups A and AB individuals ($p = 0.4$) and between those of groups B and O individuals ($p = 0.4$).

DISCUSSION

The distributions of ABO blood groups in the study population were similar to that earlier reported for Southwestern Nigeria (Falusi *et al*., 2000). There was no significant relationship between prevalence of malaria and ABO blood groups in this study. Similar studies carried out by Bayoumi *et al.* (1986), Montoya *et al.* (1994) and Uneke *et al.* (2006) reported similar observations but Ademowo *et al.* (1995) and Pant *et al.* (1992) reported significant association between malaria prevalence and ABO blood groups. While the studies of the researchers mentioned above that showed no association were carried out on apparently healthy adults the ones that showed association were on adults and children and these could be responsible for the significant association observed. Group O individuals had relatively low malarial parasite density compared to the other blood groups in this study. Whether parasite density level determines severity is debatable. However, it is likely that the potential for and severity of a malaria attack depends on an individual's total parasite load. Also, studies have shown that the appearance of symptoms during asymptomatic malaria follow-up were related to the parasitaemia found on day 0 as the patients who developed symptoms had a significantly higher parasitaemia than those who did not (Cucunuba *et al*., 2008). The low parasite density associated with blood group O individuals may partly be responsible for the relative resistance to the severe disease caused by *P. falciparum* (Uneke, 2006). The mechanism by which blood group O confers the somewhat protective effect against higher parasitaemia compared to blood groups A, B and AB is not understood but one probably explanation is based on rosette formation (Uneke, 2006; Cserti and Dzik, 2007). Some studies have established that parasitized erythrocytes form rosettes more readily with red cells of either A, B or AB blood groups than those of O blood group (Udomsangpetch *et al*., 1989, 1993; Carlson and Wahlgren, 1992; Rowe *et al*., 1995; Barragan *et al*., 2000). Parasite-triggered red blood cell rosette formation has been associated with the severity of clinical disease and with the development of cerebral malaria (Treutiger *et al*., 1992; Rowe *et al*., 1995; Chotivanich *et al*., 1998; Fischer and Boone, 1998).

CONCLUSION

The results of the study suggest that while none of the blood groups had obvious advantage on the other with respect to malaria infection, O individuals were the most protected against high parasitaemia followed by B individuals while A and AB individuals experienced high parasitaemia and since the development of symptoms in asymptomatic malaria had been linked with level of parasitaemia, O individuals should be least likely to have the severe form of malaria.

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