Journal of Advances in Medicine and Medical Research

30(4): 1-7, 2019; Article no.JAMMR.49930
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Association of Malaria Parasitaemia with ABO/Rhesus Blood Group among Out-patients of Township Clinic Gwagwalada Abuja, Nigeria

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Authors' contributions

"This work was carried out in collaboration among all authors. Author BBM designed the study and wrote the protocol. Author HRM wrote the first draft of the manuscript and managed the literature searches. Author HM managed the analyses of the study. Author FAN carried out the laboratory analyses. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2019/v30i430185
Editor(s):
(1) Dr. Ravi Kumar Chittoria Department of Plastic Surgery and Advanced Centre For Microvascular, Maxillofacial & Craniofacial, Laser Surgery, Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry, India.
Reviewers:
(1) Victor B. Oti, Nasarawa State University, Nigeria.
(2) Florencia del Puerto, Universidad Nacional de Asunción, Paraguay.
(3) Cosmas Samuel, University of Nigeria, Nigeria.
Complete Peer review History: http://www.sdiarticle3.com/review-history/49930

Original Research Article

Received 07 May 2019
Accepted 17 July 2019
Published 29 July 2019

ABSTRACT

Aim: This study was carried out to determine association of malaria parasitaemia with ABO/Rhesus blood group.
Methodology: A total of 150 blood samples were randomly selected and examined for the presence of *Plasmodium falciparum* using microscopy, blood group was determined using agglutination technique.
Results: A total 92 (61.3%) were found to be infected with *P. falciparum*, the prevalence was highest among under five (0-10) than older groups, and higher among males 55 (63.2%) than female 37 (58.7%). Majority of the patients were rhesus positive 90(64.3%) while 2(20.0%) were rhesus negative. High percentage of blood group O, 70 (46.7%) was observed, followed by A 39(26.0%), B 34 (22.7%) and AB 7 (4.6%). All ABO blood groups showed varied presence of *P. falciparum* 51(72.8%), 22(56.4%), 17(50.0%) and 2(28.5%) for O, A, B and AB, respectively.

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Parasite density was also higher in blood group O 70 (41.69%), followed by B 34 (30.67%), and A 39 (28.09%) then AB 7 (16.84%).
Conclusion: It can be concluded that malaria parasitaemia is higher in males than female and in the younger ages than the older ones. Also Blood groups O are the most susceptible to malaria infection and AB are the least infected. However further investigation is needed to clearly establish the association ABO/Rhesus blood groups and *P. falciparum* infection and the need for intensified control methodology of the disease and education of the populace on the effect of rhesus negative cannot be over emphasized.

Keywords: Malaria; Parasitaemia; ABO/Rhesus Blood group; Plasmodium falciparum; Abuja; Nigeria.

1. INTRODUCTION

Malaria is a very important disease in sub-Saharan Africa with high morbidity and mortality [1]. It is caused by *plasmodium* species transmitted by *Anopheles* mosquito, associated with the high morbidity and mortality through anaemia, cerebral complications and other mechanisms [2]. About 694million people in Africa are estimated to be at risk of malaria, which reserve 21% of the global population at risk according to the September 2015 WHO weekly epidemiological record, there were about 214 million cases of malaria and 3438,000 deaths in that year [3]. The most common individuals at high risk of malaria infection in endemic areas are people of low immunity, for instance, foreigners, pregnant women and children [4].

Despite the high morbidity and mortality associated with malaria attacks, certain individuals develop resistance owing to the development of an immune response by the host and to a varying extent, on a certain innate characteristic possessing protective value against infection [5].The factors include sickle cell trait (Hbas) and sickle cell disease Hbss [6]. The ABO blood group types [7] and the level of G-6-p- dehydrogenase [8]. There are currently 30 known human blood group types [9], but the ABO and Rhesus Blood system are clinically the most important. The ABO Blood groups consists of A, B and H carbohydrate Antigen which can regulate protein activities during infection and against these infections [10]. The Rhesus system blood groups consist of Rhesus- positive and Rhesus- negative on the basis of the presence or absence of Rhesus antigens on the red blood cell surface. The link between ABO Blood groups and the incidence of malaria parasitemia or immunity to malaria is still unclear [11]. This is probably because the relations between the blood group and malaria have not been well studies [12]. Understanding the nature of relationship between ABO Blood groups and malaria parasitemia should provide a significant knowledge on whether ABO Blood groups have an impact on infection status of the individuals possessing a particular ABO Blood group [13]. In view of that this investigation was conducted to find out whether or not ABO/Rh blood groups antigens are associated with susceptibility or severity of *P. falciparum* malaria among patients visiting the-out-patient unit of Township clinic Gwagwalada, FCT, Abuja, Nigeria.

2. MATERIALS AND METHODS

2.1Study Area

The study was carried out at Township clinic Gwagwalada, Federal capital Territory (F.C.T) Abuja. The city falls on latitude 9°2´N and longitude 7°0´E, elevation of 322.6m above the sea level, with a temperature ranging from 36°C - 40°C and the annual total of rainfall of 45mm – 110mm, located in the Southern Guinea Savannah agro ecological zone of Nigeria.

2.2 Study Participants

A total number of 150 subjects (87 males and 63 females) took part in the exercise. These febrile subjects were recruited while visiting the out-patient unit of the township clinic in Gwagwalada Abuja. The subjects were between the ages of zero (0) to fifty (50) years.

2.3 Inclusion and Exclusion Criteria

Only patients who tested positive for *Plasmodium falciparum* malaria were included in further studies, those tested negative were excluded from the study.

2.4 Sample Collection, Staining and Examination of Slides

Capillary blood was collected by finger pricking using 70% isopropanol and sterile disposable lancet. HCCl puncture was used for infants.

Immediately, thin and thick films were prepared on a grease free slide. The thick film was fixed with methanol and allowed to dry. The dry films were stained in 10% Geimsa for 10 minutes finally, the films were examined under an oil immersion microscope objective (100x), according to Cheesbrough [14].

2.5 Determination of Parasite Density

Parasite Density was determined for febrile patients who tested positive for *P. falciparum* by counting the number of parasites (asexual forms only) against 200 white blood cells (WBC). The counting was done by using hand tally counters. The number of parasites counted was expressed per microlitre of blood [15].

{(Number of parasites/ Number of leucocytes) X (8000/1)}

2.6 ABO/ Rhesus Grouping

ABO/Rhesus blood grouping was done using commercially prepared monoclonal anti-A, anti-B and anti-D, (anti sera + Agappe Diagnostics TD, India). One drop of each grouping antisera was added to each of the three test tubes labelled anti-A, anti-bodies and anti-AB respectively. The tubes were placed on wooden rag. One drop of the test blood sample was added to each tube and the suspension properly mixed by tapping the tube. They were left undisturbed for one hour at room temperature. After that the tubes were examined for agglutinations [14].

2.7 Statistical Analysis

Data were entered in Microsoft Excel, checked for its correctness, and exported to and analyzed using SPSS version 13 (SPSS Inc, Chicago, IL). Chi-square test was used to assess the difference between frequencies (the associations between blood groups and *P. falciparum* malaria cases). ANOVA was used to test the difference between parasite densities means. Observed difference was considered to be significant at $P<0.05$.

3. RESULTS

3.1 Prevalence of Malaria

Out of the total of 150 blood samples collected, 92 (61.3%) were found to be infected with *Plasmodium falciparum*. The prevalence was found to be highest among under five children (0-10) but the difference was not significant P>0.05). Similarly, the prevalence was higher among males 55 (63.2%) than female 37 (58.7%) but there was no significance difference (Table 1).

Majority of the patients were rhesus positive 90(64.3%) while 2(20.0%) rhesus negative. High percentage of blood group O 70 (46.7%) phenotype was observed among the study participants. There was however no significant difference between the various ABO Blood group and prevalence of *P. falciparum* by age of subjects (P>0.05) (Table 2).

Table 1. Prevalence of malaria parasite by age, sex and Rhesus factor

Age (Years)	Number examined	Number infected (%)	Chisquare	df	p Value
0 - 10	22	20 (90.9)	12.689	4	0.013*
11 – 20	39	25 (64.1)			
21 – 30	37	21 (56.8)			
31 – 40	28	16 (57.1)			
41 – 50	24	10 (41.7)			
Total	150	92 (61.3)			
Sex					
Male	87	55 (63.2)	0.31	1	0.577ns
Female	63	37 (58.7)			
	150	92 (61.3)			
Rhesus factor					
Rhesus positive	140	90 (64.3)	7.718	1	0.005*
Rhesus negative	10	2 (20.0)			
Total	150	92 (61.3)			

Among the 87 males that took part in the study, subjects with blood group O 42(48.3%) was more prevalent among the subjects, but statistical analysis showed no significant difference between the blood groups (P>0.05) (Table 3). All ABO blood groups showed the presence of *P. falciparum* to a certain level, 51(72.8%), 22(56.4%), 17(50.0%) and 2(28.5%) for O, A, B and AB, respectively with significant difference P<0.05) (Table 4). Parasite density was found to be higher in blood group O 70 (41.69%), followed by B 34 (30.67%), and A 39 (28.09%) then AB 7 (16.84%). The associations were also found to be statistically different (P<0.05). (Table 5).

4. DISCUSSION

The malaria prevalence of 92(61.3%) obtained in the study is a reflection of high rate of the infection in the area and suggesting hyperendemicity [16]. The prevalence was higher than 54.6% obtained in the Northwest [17]. Prevalence of 36.1% and 36.6% were observed in Abia State (southeast) and Plateau (north central) states respectively [18]. The higher prevalence of malaria in subject 0-10years (9.1%) is an indication of their low immunity, and is in line with finding from other studies done within sub-Saharan Africa [19]. Males (63.2%) were more infected than to females (58.7%), the reason for this has not been established scientifically but may be due to the fact that males within the study area engage more in outdoor activities (occupation) that bring them in contact with mosquitoes during the early hours of the day and at dusk while women in this part of Nigeria are usually not exposed to the public owing to religion and cultural believes Portilo and Sullivan [20]. Apart from exposure, stress (physically and mentally) due to their responsibility, may also be the predisposing factor [21], however some suggested that genetic factors could play a role by endorsing female with immuno-regulatory potentials to cope better with some disease. This is also in agreement with studies by Agbonlahor *et al.,* [7].

ABO Blood grouping is based on the presence or absence of A and B antigens in the surface of red blood cells (RRCs) and Rh grouping is based on the D antigen presence or absence on the RBC surface [22]. A higher percentage of blood group O 70(46.6%) phenotype was observed, although [5] showed that a distribution pattern of blood group O followed by A is characteristic for African countries endemic of malaria, stating that the distribution of blood groups is geographically and ethnically dependent. The distribution frequency of ABO was similar to the findings of other scientists [23,24].

Table 2. Prevalence of malaria based on the ABO Blood grouping in the study population

Age (Years)	Number examined	Number (%) with blood groups			
		A	B	AB	O
0 – 10	22	6 (27.3)	5 (22.7)	1 (4.5)	10 (45.5)
11 - 20	39	9 (23.1)	10 (25.6)	2 (5.1)	18 (46.2)
21 - 30	37	11 (29.7)	9 (24.3)	1 (2.7)	16 (43.2)
31 - 40	28	7 (25.0)	6 (21.4)	2 (7.1)	13 (46.4)
41 - 50	24	5 (20.8)	4 (16.7)	1 (4.2)	14 (58.3)
Total	150	38 (25.3)	34 (22.7)	7 (4.7)	71 (47.3)
	Chisquare	2.666			
	df	12			
	p Value	0.997ns			

Table 3. Gender distribution of ABO blood groups

Gender	Number examined	Number (%) with blood groups			
		A	B	AB	O
Males	87	22 (25.3)	18 (20.7)	5 (5.7)	42 (48.3)
Females	63	16 (25.4)	16 (25.4)	2 (3.2)	29 (46.0)
Total	150	38 (25.3)	34 (22.7)	7 (4.7)	71 (47.3)
	Chisquare	0.914			
	df	3			
	p Value	0.822ns			

Table 4. Prevalence of malaria parasite among the various blood groups

Blood Groups	Number Examined	Number (%) Positive for *P. falciparum*	Chi-square	df	p Value
A	39	22 (56.4)	8.047	3	0.045*
B	34	17 (50.0)			
AB	7	2 (28.6)			
O	70	51 (70.8)			
Total	150	92 (60.5)			

Table 5. Malaria parasite density by ABO blood groups of subjects

Blood Groups	No Positive	Mean parasite Density ± S.D
A	39	2809 ± 1.6
B	34	3067 ± 1.4
AB	7	1684 ± 0.2
O	70	4169 ± 1.6
Total	150	

Also, out of 150 patients that were examined only 10 (6.7%) patients were Rhesus negative, the remaining 140 (93.3%) patients were Rhesus positive, this is in agreement to previous findings [25,26]. Individuals with blood group O were found to be more susceptible to malaria infection O (72.8%) compared with other Blood groups. This could be as a result of the fact that both ABO and Rh blood group have attracted enormous attention regarding their association with genetic and infectious diseases [27], previous studies on patients of cancer and tumor [28], heart disease [29] and parasitic and viral infections [30] indicated associations of ABO and Rh blood groups. More so Malaria parasites are more common and severe in group O individuals compared with other Blood groups. Blood group A, B, and AB has their corresponding antigens whereas O has none. Malaria parasite find it hard to invade the red cells of individuals with the A, B and AB groups and required to digest the surface Antigen through enzymatic activity. There is however evidence that other Blood groups were almost at the same level of morbidity, and thus there is need for assessment of relation between ABO and Malaria severity. Wolofsky et al. [31], showed that there was no significant relationship between the prevalence of malaria and ABO blood groups and *P. falciparum* sporozoites invade and mature irrespective of the different ABO blood groups [32].

5. CONCLUSION

It can be concluded that malaria parasitaemia is higher in males than female and in the younger ages than the older ones. Also Blood groups O are the most susceptible to malaria infection and AB are the least infected.

6. RECOMMENDATION

Based on the findings of this study in-depth studies are required to clearly establish the association, parameters such as Hbs, Hbc, and CR and iron status, place of residence should be explored. Also due to the high prevalence rate obtained in the study there is need for an intensified control methodology of malaria. Due to the implication of Rhesus negative in abortion and haemolytic disease of the newborn there is need to educate the populace about its effect.

CONSENT AND ETHICAL APPROVAL

The study protocol was approved by the ethical committee of the township clinic. Written/ informed consent was sought for and obtained from all adult participants while consent for children was provided by their parents/guardians.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle3.com/review-history/49930