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Short Communication

Asymptomatic Malaria among Blood Donors in Benin City Nigeria

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Abstract

Background: This study aimed at determining the prevalence and associated risk factors for asymptomatic malaria parasitaemia and anemia among blood donors in a private medical laboratory in Benin City, Nigeria.

Methods: Venous blood was collected from a total of 247 blood donors. Malaria status, ABO, Rhesus blood groups and hemoglobin concentration of all participants were determined using standard methods.

Results: The prevalence of asymptomatic malaria infection was higher among commercial blood donors than volunteer group (commercial vs. volunteer donor: 27.5 %vs. 13.8%; OR = 2.373, 95% CI = 0.793, 7.107, *P* = 0.174). Asymptomatic malaria was not significantly affected by gender (*P* = 0.733), age (*P* = 0.581), ABO (*P*= 0.433) and rhesus blood groups (*P* =0.806) of blood donors. Age was observed to significantly (*P* = 0.015) affect malaria parasite density with donors within the age group of 21-26 years having the highest risk. The prevalence of anemia was significantly higher among commercial donors (commercial vs. volunteer donors: 23.4% vs. 3.4%: OR = 8.551, 95% CI = 1.135, 64.437, *P* = 0.013) and donors of blood group O type (*P* =< 0.0001).

Conclusions: Asymptomatic malaria parasitaemia and anemia was higher among commercial donors than voluntary donors. Mandatory screening of blood donors for malaria parasite is advocated to curb transfusion transmitted malaria and associated sequelae.

Introduction

Malaria is a leading cause of morbidity and mortality worldwide, affecting people of all age groups. Recent reports from the World Health Organization (WHO) indicate that, there were approximately 219 million cases of malaria in 2010 and an estimated 660,000 occurring mostly among African children (1). The prevalence of malaria in the world varies markedly from region to region. Nigeria accounts for a quarter of all malaria cases in the 45 malaria endemic countries in Africa (2).

Blood transfusion is a rapid and effective therapeutic intervention used widely for persons with life threatening anemia, often caused by malaria, malnutrition and a host of other factors. Blood donors can be divided into two broad groups: paid and unpaid, the latter commonly referred to as voluntary donors. Due to the endemicity of infectious diseases associated with blood loss in sub-Saharan Africa, the demand of blood for transfusion cases is high (3), and often in critical shortage. International policies recommend that blood be screened for malaria parasite prior to transfusion (4). Sadly, this is not done routinely in Nigeria, as in most countries in sub-Saharan Africa (5). Emphasis is often placed on screening for the human immunodeficiency virus (HIV), while paying little or no attention to the effect of transfusion transmitted malaria.

When malaria is transmitted through blood transfusion to a non-immune recipient, it can be rapidly fatal (6). Although, reports shows that a good number of recipients of blood transfusion living in malaria-endemic areas in sub- Saharan Africa are semi-immune to malaria (7), the degree of protection that this immunity confers against transfusion-transmitted malaria is unknown. Malaria due to *Plasmodium falciparum* can be acquired even with transfusion of a small number of infected red blood cells (8). Children and pregnant women, who form the bulk of recipients of blood in sub-Saharan Africa, are more likely to be immunologically compromised (6), thus exposing them to complications of transfusion-transmitted malaria. Hemoglobin assessment is an important criterion for blood donor selection. This is critical for the safety of blood donor and recipient. A number of African studies have reported that low hemoglobin concentration is frequent in most blood donors (9-11). This has great implication for the rate of recovery of patients transfused with blood.

In Nigeria, health care system comprises both public and private health facilities (12). The choice of healthcare facility patronized by an individual is largely determined by his/her taste, satisfaction with service and the perceived quality of care provided (12), among other factors. Although studies exist on prevalence of malaria parasitaemia among blood donors in Nigeria, none have focused on blood donors in non-public health care facilities in Edo State, Nigeria. Against this background, this study aimed at determining the prevalence and associated risk factors for asymptomatic malaria infection and anemia among blood donors in a private medical laboratory in Benin City, Nigeria.

Materials and Methods

Study center

This study was conducted from December 2011 to March 2013 in a government approved private medical laboratory outfit in Benin City, Nigeria.

Study population

A total of 247 apparently healthy blood donors consisting of 236 males and 11 females were recruited for this study. The age range of the study participants were 15 – 46 years. The prospective blood donor should appear generally well and should not be febrile, breathless, or suffering from a persistent cough (13). In malaria endemic regions, prospective blood

donors with fever and rigors should be exempted from donation (13). All study participants appeared generally well and did not present with fever and/or rigors. Informed consent was obtained from all participating subjects prior to specimen collection.

The study was approved by the Ethical Committee of Edo State Ministry of Health and the owner of the private medical laboratory used.

Collection and processing of samples

Five milliliters of blood were collected from all participants and were dispensed into ethylene diamine tetra-acetic acid (EDTA) containers and mixed. ABO and rhesus blood group were determined as previously described (14). Briefly, a drop of each participant's blood was placed on three separate areas on a clean white tile. Each drop of blood was mixed with a drop of commercially prepared antiserum A, B and D respectively and observed for agglutination. Malaria was diagnosed by examination of stained thick blood films as previously described (15). Briefly, thick and thin films were made from each blood specimen and stained in 3% Giemsa stain for 30 minutes. The films were examined using oil immersion lens and a total of 200 fields per film were examined. The parasite density was calculated from Giemsa stained thick films by multiplying the ratio of number of malaria parasite to 200 white blood cells by an assumed total white blood cell count of 5000 cells/μL to give malaria density in cells/μL.

Hemoglobin estimation was determined using an auto-analyzer - Sysmex KX-21 Hematology analyzer (Sysmex Cooperation, Kobe, Japan). Anemia was defined as a hemoglobin concentration < 12 g/dl for females and <13.0 g/dl for males (16).

Statistical Analysis

The parametric data were analyzed with student t-test and ANOVA while the non-parametric data were analyzed with Chi square (X^2) test and odd ratio analysis using the statistical software INSTAT® (GraphPad software Inc., La Jolla, CA, USA). Statistical significance was set at $P< 0.05$.

Results

A total of 64 (25.9%) out of the 247 prospective donors examined had malaria parasite in their blood. The prevalence of asymptomatic malaria among the prospective blood donors did not differ significantly in relation to type of donor ($P = 0.174$), gender ($P = 0.733$), age ($P = 0.581$) and blood groups [ABO ($P =0.446$) and rhesus blood group ($P =0.806$)] (Table 1).

Table 1: Prevalence of malaria parasitaemia among prospective blood donors

Characteristics		N	No Infected (%)	OR	95% CI	*P* value
Type of Donor	Commercial	218	60 (27.5)	2.373	0.793, 7.107	0.174
	Voluntary	29	4 (13.8)	0.421	0.141, 1.262	
Gender	Male	236	62 (26.2)	1.603	0.337, 7.629	0.733
	Female	11	2 (18.2)	0.624	0.131, 2.967	
Age (Years)	15 -20	68	12(17.6)			0.581
	21-26	109	39 (35.7)			
	27-32	36	7 (19.4)			
	33-38	19	4 (21.1)			
	≥39	15	2 (13.3)			
ABO Blood Group	O	141	42 (29.8)			0.446
	A	55	11 (20.0)			
	B	43	9 (20.9)			
	AB	8	2 (25.0)			
Rhesus Blood Group	-VE	24	7 (29.2)	1.199	0.473, 3.041	0.806
	+VE	223	57 (25.6)	0.834	0.329, 2.114	

N- number tested; **OR**- odd ratio; **CI**- confidence interval

Age was observed to significantly affect malaria parasite density with donors within the age group of 21-26 years having the highest risk. Gender, type of donor, ABO and Rhesus blood groups did not significantly (P>0.05) affect malaria parasite density among study participants (Table 2). The prevalence of anemia was 21.1%. Type of donors was significantly associated with anemia with commercial donors having higher prevalence (commercial vs. voluntary: 23.4% vs. 3.4%: OR=8.551 95%CI =1.135, 64.437; P = 0.013).The prevalence of anemia was significantly (P< 0.0001) higher among blood group O donors compared with donors of other ABO blood groups. However, gender, age, rhesus blood group and presence of asymptomatic malaria did not significantly affect the prevalence of anemia (Table 3).

Table 2: Malaria parasite density among prospective blood donors

Characteristics		No infected	Mean parasite density (±SD)	*P* value
Type of Donor				
Commercial		60	225 (± 119.4)	0.057
Voluntary		4	106 (± 42.7)	
Gender	Male	62	218.5 (±120.3)	0.162
	Female	2	112.5 (±24.7)	
Age (Years)				
15 -20		12	170.8 (±82.3)	0.015
21-26		38	246.3 (±137.0)	
27-32		7	103.5 (±62.2)	
33-38		4	168.8 (±66.4)	
≥39		3	108.3 (±38.2)	
ABO BloodGroup				
O		42	196.4 (± 172.5)	0.378
A		11	125.0 (±46.3)	
B		9	133.3(±57.4)	
AB		2	137.5 (±17.7)	
Rhesus Blood Group	+VE	57	213.1 (± 100.13)	0.303
	- VE	7	189.28 (± 80.17)	

SD- standard deviation

Table 3: Prevalence of anemia among prospective blood donors

Characteristics		N	No Anemic (%)	OR	95% CI	*P* value
Type of Donor	Commercial	218	51 (23.4)	8.551	1.135, 64.437	0.013
	Voluntary	29	1 (3.4)	0.117	0.016, 0.881	
Gender	Male	236	50 (21.7)	1.210	0.253, 5.780	1.000
	Female	11	2 (18.1)	2 (18.1)	0.173, 3.950	
Age (Years)						
15 -20		68	12 (17.6)			0.107
21-26		109	31 (28.4)			
27-32		36	6 (16.7)			
33-38		19	2 (10.5)			
≥39		15	1 (6.7)			
ABO Blood Group						
O		141	45 (31.9)			< 0.0001
A		55	4 (7.2)			
B		43	3 (6.9)			
AB		8	0 (0.0)			
Rhesus Blood Group						
-VE		24	9 (37.5)	2.512	1.030, 6.125	0.061
+VE		223	43 (19.3)	0.398	0.163, 0.971	
Malaria Status						
Positive		64	19 (29.6)	1.919	0.996, 3.697	0.074
Negative		183	33 (18.0)	0.521	0.271, 1.004	

N- number tested; **OR**- odd ratio; **CI**- confidence interval

Discussion

This study aimed at determining the prevalence and associated risk factors for asymptomatic malaria infection and anemia among blood donors in Benin City, Nigeria. Malaria induced by blood transfusion is a potential health hazard. Sadly however, this is often neglected in many malaria endemic areas of the world (17).

The prevalence of asymptomatic malaria infection in this study was 25.9%. This is lower than values obtained in a number of Nigerian studies (17-21). The variation could be due to differences in geographical location as Uneka et al.,(17), Ekwunife et al.,(18), Okocha et al.,(19), Mbanugo et al.,(20), and Alli et al.,(21) were all conducted in eastern Nigeria in contrast to our study which was done in the mid - western region of the country. Asymptomatic malaria remains a challenge for malaria control programs as it significantly influences transmission dynamics (22).It often goes undetected and untreated, resulting in a major source of gametocytes for local mosquito vectors (23).In a malaria endemic country like Nigeria (24), where the screening of blood prior to transfusions is unpopular (25), and purchase and use of over the counter anti-malaria drugs is rife (26), blood donors may harbor plasmodia species asymptomatically that have over time developed resistant genes to available anti-malaria drugs, further compromising the recovery of blood recipients.

The WHO recommends the recruitment of volunteer non-remunerated blood donors from low-risk populations to ensure the safety of transfused blood (27). Several studies have reported that infectious diseases are more prevalent among donors who are recruited by monetary incentives (28-30) as they may intentionally fail to identify high risk behaviors during the donation interview in order to obtain the incentive offered (31).In this study, commercial blood donors were observed to have a higher prevalence of asymptomatic malaria infection than voluntary blood donors, albeit the difference was not statistically significant. In areas where malaria is endemic, asymptomatic *Plasmodium falciparum* parasitaemia is common among immune inhabitants and a large proportion of individuals always harbor malaria parasites without any associated clinical symptoms (22).This may well account for this observation. Although male participants were observed to have a higher prevalence of asymptomatic malaria infection (26.2%), gender did not significantly affect its prevalence. Similar findings have been reported in other Nigerian studies (17, 32).Age, rhesus and ABO blood groups of blood donors were not risk factors for asymptomatic malaria infection among study participants. These findings have been reported elsewhere (32, 33).

Malaria parasite density was significantly affected by age of blood donors. Blood donors within the age group of 21-26 years were observed to have the highest parasite count. This is in line with a previous report (17).The WHO reports that young people in malaria endemic areas of sub-Saharan Africa are more disposed to malaria infection than older individuals (34). With respect to ABO blood group system, participants of the blood group O type were observed to have the highest burden (count) of malaria parasite, albeit the difference was not statistically significant. A previous study has reported that O blood group provides protection against malaria infection (35).It is however important to note that the study by Rowe et al., (35) was on patients with symptomatic malaria in contrast to ours which was on asymptomatic blood donors. This finding lends support to an earlier report elsewhere that ABO does not affect the parasite density but rather the clinical outcome of the disease where blood group O is known to protect against malaria (36).

The prevalence of anemia in this study was 21.1%, and is higher than 13.7% reported in another Nigeria study (37).An important factor to consider is that the etiology of anemia is multifactorial, and thus several underlying

morbid and co-morbid conditions could cause wide variations in the prevalence of anemia (38).Commercial donors were significantly more likely to be anemic. This is in line with an earlier Nigerian report (39). Commercial blood donors have been reported to donate blood much more frequently than volunteer donors (40). Repeated blood donation has been reported to be significantly associated with depleted iron store (41), which is known to contribute to the development of anemia. This may explain the observed higher prevalence of anemia among commercial donors in this study. The prevalence of anemia was significantly affected by ABO blood group with donors of the blood group O type having the highest prevalence. Blood group O individuals have been previously reported to have the highest prevalence of anemia in an Indian study (42). The reason for this finding however is not entirely clear. Many communities in Africa experience chronic shortage of blood for transfusion purpose (43). Perhaps, being able to serve a wider spectrum of blood recipients, blood group O donors may engage much more frequently in repeated blood donation than persons of other blood groups, within very short periods and thus run the risk of developing anemia.

Conclusion

Asymptomatic malaria parasitaemia and anemia were observed to be higher among commercial blood donors than voluntary donors. Malaria parasite infected blood transfused to a non–immune individual is associated with fatal outcomes. Mandatory screening of blood donors for malaria parasite is advocated to curb transfusion transmitted malaria and associated squeal. Voluntary donation of blood should be encouraged.

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