

Comparison of Microscopy and Rapid Diagnostic Test Methods for detection of Malaria Parasite Infection among Blood Donors in Port Harcourt, Rivers State, Nigeria

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Abstract: Transfusion-transmitted malaria unfortunately is still common in malaria endemic countries such as Nigeria because blood donors are not routinely screened for malaria before donation. Also the diagnostic method of malaria is still an issue in the scientific community. This study compared Giemsa-stained blood film microscopy and malaria rapid diagnostic test (RDT) in the determination of the prevalence of malaria parasite among blood donors in Port Harcourt, Rivers State. A total of 300 (202 male and 98 female) blood donors were studied. 123 (41.00%) were infected with malaria parasite out of which 91 (30.33%) were male and 32 (10.67%) were female. The difference in prevalence of malaria Parasite in both sexes was statistically significant ($P < 0.05$). Blood donors screened within age group 20-30 had the highest participants and also the highest prevalence of malaria Parasite (65.85%) and the difference in prevalence of malaria between the various age group was not statistically significant ($p > 0.05$). 123 donors (41.00%) tested positive with microscopy whereas 70 (23.33%) tested positive to RDT and the difference was statistically significant ($p < 0.05$). In conclusion, this study showed that there is high prevalence of malaria parasite among the blood donors in Port Harcourt and that microscopy remain the gold standard for diagnosis of malaria because it is more sensitive when compared with RDTs.

Keywords: Malaria parasite; Prevalence; blood donors; microscopy; RDT; Rivers state.

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I. Introduction

Malaria infection is caused by the presence of the sporozoa - *Plasmodium* in man or other animal's red blood cells, usually transmitted to humans when an infected female mosquito of the genus *Anopheles* bites man for blood meal (Terri, 2009). Malaria is and may continue to be major public health problem, causing much suffering and pre-mature death especially in the poorer area of tropical Africa, Asia and Latin America particularly among young children. According to WHO (2016), there were 212 million new cases of malaria worldwide in 2015 with Africa accounting for most of the cases (90%). In 2015, 15 countries and regions had ongoing malaria transmission, about 3.2 billion people; almost half of the world populations are at risk of malaria. Malaria is avoidable and treatable, and increase determinations are vividly reducing the malaria burden in many places. Between 2000 and 2015, malaria incidence among population at risk (the rate of new cases) fell by 37% globally. In that same period, malaria death rate among population at risk fell by 60% globally among all age groups and by 65% among children under 5 years. (WHO, 2016)

Blood Transfusion which is the use of blood and blood products as a form of treatment to save lives can lead to transfusion transmitted infections such as malaria (Okocha *et al.*, 2005). The first case of transfusion transmitted malaria was reported as far back as in 1911 (Woolsey, 1911), since then, increase numbers of cases have been reported world-wide. In every country without an exception, severe anaemia, surgery, trauma and complications of pregnancy forms the bulk of clinical conditions that requires blood transfusion (WHO, 2011). There exists proof of evidence that the human *Plasmodium* parasite can continue to exist in stored and frozen blood (Talib and khurana, 1995), which makes malaria transmission by transfusion therapy an issue of major concern.

In Nigeria, some studies have been undertaken to ascertain the prevalence of malaria among blood donors; Abah and Joe-Cliff (2016) reported 28.00% in Port Harcourt; Falade *et al.*, (2010) reported 20.00%, Agboola *et al.*, (2010) reported 28.00% in Lagos; Kennedy and Ibinabo (2015) reported 67.5% in Port Harcourt by microscopic whereas 15.0% tested positive by RDT; Oladeinde *et al.*, (2014) reported 27.5% and 13.8% among commercial and volunteer blood donors in Benin City, respectively. These studies indicated wide spread of prevalence of malaria among blood donors in Nigeria.

Malaria is endemic in Nigeria; therefore, it is necessary to lay emphasis on the need to screen every donor through proper laboratory test to reduce the incidence of post-transfusion malaria. Malaria is usually confirmed by microscopic examination of blood films or antigen based-rapid diagnostic test (RDTs) (Abba *et al.*, 2012). Rapid diagnostic tests (RDT) which are available commercially are often more accurate than blood films at diagnosis of malaria parasite, but their sensitivity and specificity depends on manufacturer and again are unable to quantify the parasitaemia load (Wilson, 2012). In a resource scarce setting, it has become routine to use a history of subjective fever as the indication to treat for malaria and mismanagement of non-malaria fever, which wastes resources and erodes confidence (Nadjim and Behrens, 2012).

Blood donors are not screened for malaria parasites on routine bases or as a policy in the University of Port Harcourt Teaching Hospital (UPTH) prior to donation, therefore the risk of transmission of malaria parasites to blood recipients and the likelihood of their development of clinical disease remains high (Kennedy and Ibinabo, 2015). This study is aimed at comparing Giemsa-stained blood film microscopy and malaria rapid diagnostic test methods for detection of and prevalence of malaria parasite among blood donors in Port Harcourt.

II. Materials And Methods

Study Area

This study was carried out in the University of Port Harcourt Teaching Hospital and Army Force Blood Transfusion, Military Hospital Port Harcourt, Rivers State. The University of Port Harcourt Teaching Hospital (UPTH) is a major tertiary-care, teaching and research facility in Port Harcourt, Rivers state, Nigeria. Located at 4°53'58"N 6°55'43"E. The Military Hospital is an Armed Force Health facility in Port Harcourt, Rivers State. It was built by Shell -BP in the early 60's originally to serve the company's expatriates and local staff as a centre of medical care. Presently the ownership hospital has been transferred to the government. It is Located at 4°49'36"N 7°0'11"E.

Ethical Considerations: Clearance was obtained from the authorities of Military Hospital, Port Harcourt and University of Port Harcourt Teaching Hospital, Port Harcourt and the research ethics unit of the University of Port Harcourt. Also written consent was obtained from each subject.

The study population: The study population is made of 300 blood donors, donating blood to the blood bank of University of Port Harcourt Teaching Hospital Port Harcourt and Military Hospital, Rivers State. A total of 73 of venous blood samples were collected from University of Port Harcourt Teaching Hospital and 227 of venous blood samples were collected from Army Force Blood Transfusion unit of Military Hospital, Rivers State.

Collection of blood sample: Five milliliters of venous blood samples were collected into an ethylene diamine tetra acetic acid (EDTA) containing bottles for the study, using vein puncture technique. The donors were within the age of 18 - 60 years. All collected samples were transported to the parasitology laboratory of the Department of Animal and Environmental Biology of the University of Port Harcourt.

Laboratory Analysis The collected blood samples were analyzed within 1 - 2h of collection. Thick film and Rapid Diagnostic Test (RDT) were used according to the Technique outline by Cheesbrough (2005) and manufacturer's manual.

Detection of Malaria Parasites using RDT:L Each sample was subjected to malaria RDT using the Carestart™ Malaria HRP2 (PF) according to manufacturer's instruction. The Carestart™ Malaria HRP2 (PF) is designed for the diagnosis of *P. falciparum* infection.

Statistical analysis

The data was analyzed using percentage and difference between groups were determined by the one-way analysis of variance (ANOVA) or paired t-test and Chi-square with the level of significance set at $P < 0.05$.

III. Result

Out of the 300 blood donors studied, 123 had malaria parasite giving prevalence rate of 41.00%. From the total population, 91 (30.33%) male and 32 (10.67%) were positive. The difference in prevalence of malaria parasite in both sexes was statistically significant ($P < 0.05$). Prevalence of malaria parasite on bases of sex is presented in Table i. The prevalence of malaria in relation to age is presented in Table ii. Blood donors screened within age group 20 - 30 had the highest participants and also the highest prevalence of malaria parasite (65.85%) followed by the age group 31-40 (17.07%). The difference in prevalence of malaria between the various age groups was not statistically significant ($P > 0.05$). On the basis of diagnostic method, 123 donors (41.00%) tested positive and 177 (59.00%) tested negative to microscopy whereas 70 (23.33%) tested positive to RDT and 230 (73.33%) tested negative to RDT. This indicates that more than 50% of infected donors in this study were missed by RDT which is a very large proportion. Tables' iii and IV showed prevalence of malaria parasitaemia using microscopy and RDT methods respectively. The difference in prevalence of malaria parasite

in relation to diagnostic method was statistically significant ($P < 0.05$). Table V shows the comparison between microscopy and RDT.

Table i: Prevalence of Malaria Parasite in relation to Sex among blood donors in Port Harcourt

Sex	No. Examined	No. Infected	Percent Infected
Male	202	91	30.33
Female	98	32	10.67
Total	300	123	41

$$\chi^2 = 4.1919$$

$$P\text{-value} = 0.041$$

Table ii: Prevalence of Malaria Parasite according to Age Group among blood donors in Port Harcourt

Age Group	No. Examined	No. Infected	% Infected
18 – 19	43	18	14.63
20 – 30	202	81	65.85
31 – 40	44	21	17.07
41 – 50	10	3	2.44
51 – 60	1	0	0.00
Total	300	123	100

$$\chi^2 = 2.0992$$

$$p\text{-value} = 0.09579$$

Table iii: Prevalence of Malaria Parasite using Microscopy among blood donors in Port Harcourt

Malaria parasite (Using Giemsa Stain)	Frequency	Percentage
Positive	123	41
Negative	177	59
Total	300	100

Table IV: Prevalence of Malaria Parasite using RDT among blood donors in Port Harcourt

Malaria parasite (Using RDT)	Frequency	Percent
Positive	70	23.33
Negative	230	76.67
Total	300	100

Table V: Comparison between malaria RDT and Microscopy among blood donors in Port Harcourt

Diagnosis of Malaria Parasite	Microscopy	RDT
Positive	123 (41%)	70 (23.33%)
Negative	177 (59%)	230 (76.67%)
Total	300 (100%)	300 (100%)

$$\chi^2 = 99.1409$$

$$p\text{-value} = 0.0000000$$

IV. Discussion

The result obtained in this study showed that there is relatively higher prevalence of malaria infection among the blood donors in Port Harcourt. This could be a result of high rate of asymptomatic malaria parasitaemia, stable and intense transmission of malaria parasite in Nigeria which is among the malaria endemic area in Africa. Similar study by Kennedy and Ibinabo (2015) reported prevalence of 67.5 % among blood donors in University of Port Harcourt Teaching Hospital; Abah and Joe-cliff (2016) reported slightly lower prevalence of 28.00 % among blood donors in Port Harcourt and Agboola *et al.*, (2010) reported the same prevalence of 28.00 % malaria infection among blood donors in Lagos University Teaching Hospital, Lagos. The consequence of this result with regard to blood transfusion is enormous and this shows that blood transfusion carry the risk of transmitting malaria parasite to the recipient and majority of blood recipient are pregnant mothers and children that are actually people who are highly vulnerable to malaria (Qariet *al.*, 1993). This transmission of malaria by blood transfusion is a serious issue as the diagnosis of malaria infection is not listed among the test to satisfy the blood safe for transfusion (Kinde-Gazardet *al.*, 2000).

There were fewer women regular donors compare to men. The lower number of female observed in this study is as a result that females are naturally and culturally inhibited from commercial blood donation due to the loss of blood during monthly menstruation. Abah and Joe-Cliff (2016) reported similar observation which out of 28.00 % infected 26.5 % were male while 1.5% was female.

The age group 21 - 30 had the highest population of donor in this study, similar observation was reported by Abah and Joe-cliff (2016) and they attributed the reason to pecuniary gain. Also the highest infection rate occurred among 21 - 30 age-group donors. However, WHO had observed that younger people in malaria endemic areas are more susceptible to malaria infections than older people (WHO, 2003).

The result showed that the RDT test kit detected less *plasmodium* parasite than microscopy. The false negative RDT may be due to insufficient parasites to give a positive result or the use of an HRP-2 test which is

not able to detect the variant of HRP-2 produced by the stain of *P. falciparum* causing the malaria (Cheesbrough, 2010). Although rapid diagnostic test would seem the most feasible technique for diagnosis of malaria under emergency donation of blood, however this study and other studies reveal that microscopy using Giemsa-stained blood film lead to a much higher detection rate and therefore useful for diagnosis of asymptomatic *Plasmodium* parasite among blood donors

In conclusion, this study showed that there is high prevalence of malaria parasite among the blood donors in Port Harcourt and that microscopy remain the gold standard for diagnosis of malaria especially asymptomatic malaria because it is more sensitive than RDTs. It is therefore recommended that microscopic examination of giemsa-stained blood film remain the method of choice for diagnosis of asymptomatic *plasmodium* parasitaemia among blood donors especially for blood banks while in emergency situations the RDTs can be used.

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Conflict of Interest: We declare that there is conflict of interest.

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