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Prevalence of Malaria Parasites and Associated Factors among Blood Donors Attending General Hospital Minna, Niger State, Nigeria

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Abstract
The prevalence of malaria parasites among the blood donors attending General Hospital Minna was studied over a period of four (4) months. Both thick and thin films were made on a clean grease-free glass slide. 10% Giemsa was used to determine the presence of malaria parasites in the donors' blood. A total number of 200 male blood donors' samples were collected out of which 47 were malaria parasite positive, while 153 were malaria parasite negative (control), representing a prevalence rate of 23.5%. The age group 18-24 years had the highest prevalence of malaria parasite (33.3%). Donors with blood group AB had the highest prevalence of malaria parasite (42.1 %). The various factors except age, blood group and occupation in the questionnaire were significant. The prevalence of malaria parasites within the sampled hospital was high. Therefore, it is necessary that more education, enlightenment, prevention and treatment should be given to people that are positive to malaria parasites in order to eradicate malaria parasites or bring it to a minimal level.

Keywords: Malaria parasite; Blood donors; Prevalence**,** Blood group, Infected

1. Introduction

One of the greatest global public health challenges is Malaria. Malaria is an olden disease whose appellation is derived from the Italian (mal-aria) and also recognized as Roman fever and periodic fever [1]. There were several odd ideas on how malaria was spread until 1898 when Dr. Ronald Ross revealed that the female Anopheles mosquito was responsible for the spread of malaria parasites. This finding transformed malaria control, which treating the patient is by killing the malaria parasites [2]. Malaria, perhaps originated in Africa and followed human migration to the Mediterranean shores, India and arid South East Asia, before it was common in the marshy areas around Rome. Malaria is a disease frequently found in tropical and subtropical areas in sub-Saharan Africa, but also common throughout other tropical regions of China, India, Southeast Asia, South and Central America [3].

Before independence of Nigeria, the colonialists established Government Reservation Areas (GRA) in trying to build their homes distant away from the public, since travelling far distance from the breeding ground of these mosquitoes was a preventive measure against spreading the parasites. The Nigeria's effective control of malaria was inaugurated well before the WHO global malaria eradication between 1955 and 1968 [4].

National Malaria Control Committee (NMCC) was established in 1975 in order to decrease the malaria load by 25% [5]. This formed a five years plan of action that ended in 1980. However, the program documented only modest successes. It was eight years after before improvement was made. A major health system restructuring was carried out in 1988, with the adoption of a Health Policy for the country. By this Policy, malaria was to be destroyed using the concept of Primary Health Care [5].

In 1989 the Ministry of Health set procedures for malaria control. The government came out with a National Malaria Control Strategy in 1996. The previous and current malaria control programme strategies attained partial achievement in destroying the plague. However, the malaria has progressively deteriorated and now it is assessed that malaria accounts for 65% of all sicknesses stated in Nigerian health facilities and also 42% of pregnant women are diagnosed with malaria which affects the birth weight of babies [5]. Also, it is projected that at least 1 million people die of malaria each year, mostly children under 5 years of age [6]. Over 80% of the global deaths occur in sub- Saharan Africa [6]. Meanwhile in 2015, the National Malaria Control Programme (NMCP) in Nigeria accepted a specific strategy, in order to reduce 50% of the malaria burden by 2020 by attaining at least 80% coverage of long-lasting impregnated mosquito nets (LLINs), together with additional measures. 20% of households in targeted areas getting indoor residual spraying (IRS), and treatment with two doses of intermittent preventative therapy (IPT) for 100% of pregnant women who visit antenatal care clinics [7].

Based on these measures, the percentage of houses with at least one LLIN augmented to over 70% by 2017, compared to only 5% in 2015 [8]. However, earlier studies have documented a high prevalence of malaria all over Nigeria [9] and there remains a paucity of research on prevalence of malaria parasites in blood donors in the majority of the federation, particularly in Northern Nigeria, including Niger State. This information is imperative in order to identify and implement real control measures. Consequently, this study was designed to determine the prevalence of malaria parasites in blood donors in Minna, Niger State, Nigeria.

2. Materials and Methods

2.1 Study Area

This research was conducted in General Hospital Minna, Niger State. Minna is the capital of Niger State which lies on latitude of 9.35' N and longitude 6.32'E. Minna is about 150 km away from Abuja. It has a total area of 76,363 km (29.484 sqm) with a population estimate of about 3,950,249 and its major inhabitants are mostly Nupe, Hausa and Gbagyi [10]. The hospital is a tertiary health care institution that provides clinical services (including a comprehensive up-to-date laboratory services), training of medical personnel and research in medicine.

2.2 Study Population

The study was hospital-based. A total number of two hundred (200) consenting blood donors attending General Hospital Minna were enrolled in this study from January 2019 – March 2019. Questionnaires were administered to all eligible donors.

2.3 Sample Size Formula

Sample size was estimated using Krejcie Morgan method as used by Kuta et al. [11].

$$N = \frac{T^2 P(1-P)^2}{M^2}$$

Where, N is the sample size, T is the standard normal deviation at 1.96, P is the prevalence of disease, 0.24 (NGSACA), M is the marginal tolerable error at 0.05.

$$N = \frac{1.96^2 \times 0.24(1-0.24)^2}{0.05^2}$$

N = 280.28

Thus, the sample size was computed to be 280. However, a total of 200 subjects were used in this study due to number of patients who gave their consent and time limit.

2.4 Inclusion Criteria

The inclusion criteria for this study were males in the age bracket 18-65 years.

2.5 Exclusion Criteria

The exclusion criteria for this study were males out of the age bracket 18-65 years

2.6 Collection of Blood Samples

Blood samples were collected using the vein puncture technique [6]. A soft tubing tourniquet was fastened on the upper arm of the subject to enable index finger feel appropriate vein. The puncture site was sterilized with methylated spirit and vein puncture was made with the aid of a needle attached to a 2ml syringe. Two millimeters of blood was collected and transferred into a labeled ethylene-diamine-tetra-acetic acid (EDTA) container to prevent blood from clotting.

2.7 Screening for Malaria

Malaria was diagnosed microscopically by staining thick and thin blood films on a grease free glass slide to see malaria parasites using Giemsa stains. A thick film was prepared when a blood spot was enthused in a circular motion with the corner of the slide. The spot was stained with diluted Giemsa (1:20 vol/vol) for 10 min, after which it was raised in buffered water and then air-dried in an upright position and examined under a light microscope. A thin blood film was prepared by placing the smooth edge of a spreader slide in a drop of blood immediately, adjusting the angle between slide and spreader to 45º and then smearing the blood with a swift and steady sweeping along the surface. The film was then allowed to air-dry and was fixed with absolute methanol, after which the sample was stained with Giemsa (1:20 vol/vol) for 10 min, then it was raised in buffered water, air-dried in an upright position and examined under a light microscope.

Thick smear: The thick smear was not fixed in methanol to allow the red blood cells to be hemolyzed. Only the leukocytes and any malaria parasites present were the detectable elements. Although, the hemolysis led to distorted plasmodial morphology making plasmodium species differentiation difficult. So, thick smears are mostly used to identify infection and to estimate parasitemia.

Thin smear: This was fixed in methanol. Thin smears allowed the examiner to identify malaria species, quantify parasitemia and recognize parasites like schizonts and gametocytes.

2.8 Statistical Analysis

Data obtained from the study were subjected to Chi square to compare and test for relationship between the means using SPSS version16. Level of significant was accepted at $p < 0.05$.

3. Results and Discussion

3.1 Results

3.1.1 Seroprevalence of Malaria

The prevalence of malaria is presented in Figure 3.1. The result showed that only 47 respondents were positive to malaria out of the 200 blood donors sampled, while 153 (77 %) were negative within the given location. This, therefore, presents the prevalence of malaria to be 23 %, i.e., 0.23.

3.1.2 Prevalence of Malaria Parasites among the sampled subjects with respect to age

The prevalence of malaria among the sampled subjects in relation to age is presented in Table 3.1. The results showed that the age bracket, 18-24 years, had the highest prevalence of malaria (33.3 %) followed by 35-44 years (27.8 %). The lowest prevalence of malaria (19.8 %) was observed in age group 25-34 years. The Chi square analysis (χ^2 = 1.662, p = 0.645) revealed a non-significant relationship between age and the prevalence of malaria parasites.

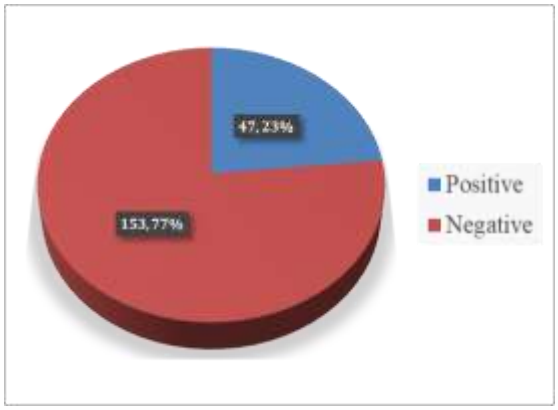

Figure 3.1: Prevalence of Malaria parasites in the Sampled Location.

Table 3.1: Relationship between Age and the Prevalence of Malaria parasite

Age (years)	Positive	Negative	Total
18-24	02(33.3)	004(66.7)	006(003.0)
25-34	19(19.8)	077(80.2)	096(048.0)
35-44	15(27.8)	039(72.2)	054(027.0)
45-54	11(25.0)	033(75.0)	044(022.0)
Total	47(23.5)	153(76.5)	200(100.0)

χ^2 = 1.662, p = 0.645

3.1.3 Influence of Respondents' location and the prevalence of Malaria

The influence of respondents' location on the prevalence of malaria is presented in Table 3.2. The result showed malaria prevalence to be 39.9 %; 37 out of 61 respondents had malaria in rural community, whereas in the urban location, only 21.3 % of the respondents had malaria. A significant relationship was observed between location and malaria was established as indicated by the chi square analysis (χ^2 = 27.720, p = 0.000).

3.1.4 Association between Marital Status on the Prevalence of Malaria parasites

Table 3.3 shows the association between marital status and prevalence of malaria parasites. The result showed that five (5) out of the forty-six (46) single respondents were positive to malaria parasite while 42 out of 154 married respondents were positive to malaria parasite. The result therefore showed that married respondents had higher malaria prevalence (27.3 %) than the singles. The Chi square values (χ2 = 5.301, p = 0.021) revealed a significant relationship (p < 0.05) between marital status and malaria parasite prevalence.

Table 3.2: Relationship between Respondents' Location and the Prevalence of Malaria

Location	Positive	Negative	Total
Urban	10(21.3)	092(78.7)	102(051)
Rural	37(39.9)	061(60.1)	098(049)
Total	47(23.5)	153(76.5)	200(100)

χ^2 = 27.720, p = 0.000

Table 3.3: Relationship between Respondents' Marital Status and prevalence of Malaria

Marital Status	Positive	Negative	Total
Single	05(10.9)	041(89.1)	046(023)
Married	42(27.3)	112(72.7)	154(077)
Total	47(23.5)	153(76.5)	200(100)

χ^2 = 5.301, p = 0.021

3.1.5 Association between Respondents' Occupation and Prevalence of Malaria Parasites

Table 3.4 shows the association between occupation and the prevalence of malaria. Out of the 41 respondents who had business as occupation, only 8 (19.5 %) of them were positive to malaria while 4 (16 %) out of the 25 civil servants were reported positive to malaria. Farmers had the highest prevalence of malaria 20 (32.8 %) out of the 61. The test of association as shown using chi square analysis (χ^2 = 4.425, p = 0.219) revealed that there was no significant (p < 0.05) relationship between occupation and malaria parasite prevalence.

3.1.6 Relationship between Respondents' Educational status and Prevalence of Malaria Parasites

The relationship between respondents' educational status and malaria parasite prevalence is presented in Table 3.5. The result showed that only 21(10.9 %) out of 125 literate respondents had malaria parasite while 34.7 % of the75 illiterate respondents were positive to malaria parasite. From the Chi square value (χ^2 = 8.323, p = 0.04), there was a significant association between educational status and the prevalence of malaria parasites.

Table 3.4: Relationship between Respondents' Occupation and the prevalence of Malaria Parasites

Occupation	Positive	Negative	Total
Business	08(19.5)	033(80.5)	041(20.5)
Civil Servant	04(16.0)	021(84.0)	025(12.5)
Artisan	15(20.5)	058(79.5)	073(36.5)
Farmer	20(32.8)	041(67.2)	061(30.5)
Total	47(23.5)	153(76.5)	200(100)

χ^2 = 4.425, p = 0.219

Table 3.5: Relationship between Educational Status and Prevalence of Malaria Parasites

Educational Status	Positive	Negative	Total
Literate	21(10.9)	104(83.2)	125(62.5)
Illiterate	26(34.7)	049(65.3)	075(37.5)
Total	47(23.5)	153(76.5)	200(100)

$\chi^2 = 8.323$, p = 0.04

3.1.7 Relationship between Blood group and the Prevalence of Malaria Parasites

The relationship between blood group and the prevalence of malaria parasites is presented in Table 3.6. The results showed that 81(40.5 %) out of the total respondents were of blood group O, while 19(9.5 %) were of blood group AB. Out of the 200 respondents, 56(28.0 %) were of blood group A while 44 (22%) of them were of blood group B. Donors with blood group AB were mostly affected with malaria (42.1 %). Donors with blood groups B and O had prevalence of 22.7% and 24.7 %, respectively. The Chi square value (χ^2 = 5.456, p = 0.141) revealed a non- significant relationship between blood group and malaria parasite prevalence.

Table 3.6: Relationship between Respondents' Blood Group and the Prevalence of Malaria Parasites

Blood Group	Positive	Negative	Total
A	09(16.1)	047(83.9)	056(028.0)
B	10(22.7)	034(77.3)	044(022.0)
AB	08(42.1)	011(57.9)	019(009.5)
O	20(24.7)	061(75.3)	081(040.5)
Total	47(23.5)	153(76.5)	200(100.0)

$\chi^2 = 5.456$, p = 0.141

Table 3.7: Relationship between Malaria Parasite prevalence and Other Factors

Factors	Positive	Negative	Total	x (p-value)
Location				
Urban	10(21.3)	092(78.7)	102(051)	
Rural	37(39.9)	061(60.1)	098(049)	27.720 (0.000)
Total	47(23.5)	153(76.5)	200(100)	
Marital Status				
Single	05(10.9)	041(89.1)	046(023)	
Married	42(27.3)	112(72.7)	154(077)	05.301 (0.021)
Total	47(23.5)	153(76.5)	200(100)	
Occupation				
Business	08(19.5)	033(80.5)	041(020.5)	
Civil Servant	04(16.0)	021(84.0)	025(012.5)	
Artisan	15(20.5)	058(79.5)	073(036.5)	04.425 (0.219)
Farmer	20(32.8)	041(67.2)	061(030.5)	
Total	47(23.5)	153(76.5)	200(100.0)	
Educational Status				
Literate	21(10.9)	104(83.2)	125(062.5)	
Illiterate	26(34.7)	049(65.3)	075(037.5)	08.323 (0.04)
Total	47(23.5)	153(76.5)	200(100.0)	

3.1.8 Relationship between Malaria Parasite Prevalence and other factors

The relationship between malaria parasite prevalence with other factors (location, marital status, occupation and education) are presented in the Table 3.7. Out of a total of 200 sampled men, 98 were from rural areas while 102 were from urban areas. This result showed malaria prevalence to be 39.9% (37 out of 61 respondents had malaria) in rural community whereas in the urban area, only 21.3% of the respondents had malaria parasite. The Chi square value showed a strong relationship between malaria parasite prevalence and location (χ^2 = 27.720, p = 0.000).

Out of a total of 200 sampled men, 154 were married while 46 were singles. The result showed that 5 out of 46 single respondents were positive to malaria while 42 out of 154 married respondents were positive. The result therefore showed that married respondents had higher malaria prevalence (27.3%) than the singles. The Chi square value (χ^2 = 5.301, p = 0.021) revealed a significant relationship (p < 0.05) between marital status and malaria parasite prevalence.

The occupation engaged in by these sampled subjects as shown in the Table 3.7 revealed that 73 were artisans, 25 were civil servants, 41 were business men while 61 were into farming. Out of 41 respondents who were into business as occupation 8 of them tested

positive to malaria parasite while 4 out of the 25 civil servants tested positive to malaria parasite. Respondents who were farmers had the highest prevalence of malaria parasites as 20 out of 61 of them tested positive. The test of association as shown using Chi square value ($\chi^2 = 4.425$, $p = 0.219$) revealed that there was no significant ($p > 0.05$) relationship between occupation and malaria parasite prevalence.

The education status of the sampled subjects as shown in the Table 3.7 revealed that 125 were literates while 75 were illiterates. Ten-point nine percent (10.9 %) of literate respondents tested positive to malaria while 34.7% of illiterate respondents were positive to malaria. The Chi square value showed a significant ($\chi^2 = 8.323$, $p= 0.04$) association between educational status and malaria parasite prevalence.

3.2 Discussion

The prevalence of malaria parasites among the blood donors attending General Hospital Minna Niger state was studied. The result revealed that among the 200 blood donors screened for malaria parasites, 47 (23%) were positive while 153 (77%) were negative. The prevalence of malaria parasites recorded in the present study was lower than those reported by other studies conducted in some states in Nigeria. For example, Hannah *et al*. [13] recorded a prevalence of 27.3% in Ilorin, Kwara state among blood donors at the University of Ilorin Teaching Hospital (UITH). Similarly, Agboola *et al*. [14] recorded a prevalence rate of 28% among the blood donors at the Lagos University Teaching Hospital, Lagos. However, the 7% prevalence recorded among the blood donors at Ahmadu Bello University Teaching Hospital, Shika, Zaria is lower than that reported in the present study [15]. This could be attributed to the fact that the use of mosquito nets and education on how to stay free from mosquitoes is yielding good results.

From this study, the age group, 18-24 years, had the highest prevalence of malaria parasites (33.3%) followed by 35-44, which had 27.8% prevalence. The lowest prevalence of 19.8% was recorded among the 25-34 age group. This result is contrary to the report by Isah *et al*. [16], which had the highest prevalence (10.9%) among the 31-40 age group. The low prevalence found among the 25-34 age group could be because this age group are sexually active and might have access to mosquito nets through their wives being given to them by the government during their antenatal periods.

This study revealed that famers had the highest number of positive cases (20, 32.8%), which is contrary to the report by Hannah *et al*. [13] with 16 (24.7%) for civil servants. This could be that the famers had no access to mosquito nets or they were not using it. Also, it could be because of the bushes surrounding their houses.

From this study, married subjects had the highest number of positive cases of malariaparasites (27.3%) compared to the singles (23.0%). This result is similar to that reported by Hannah *et al*. [13], who also had the highest number (52.9%) of positive cases for married blood donors. This could be due to availability of stagnant water around the residential houses which provide space for mosquitoes to breed.

Blood group AB had the highest percentage of positive cases than the other groups. This is contrary to the result of Abba *et al.* [17] that had the highest percentage of positive cases in blood group O. This could be because of AB blood group is a recipient from all other blood groups.

4. Conclusion

The prevalence of malaria parasites among the blood donors was 23%. The age group, 18-24 years had the highest number of malaria parasites. There was a significant relationship between educational status, marital status and location (age, occupation and blood group which showed no significant relationship) with malaria parasites. Blood donors should be routinely screened for malaria parasites, the collected blood samples should be properly labeled either negative or positive of malaria parasites, as the case may be. The recipients of the blood that are positive to malaria parasites should be given prophylactic treatment against any transfusion-related malaria.

Compliance with Ethical Standards

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Disclosure of conflict of interests

There was no conflict of interests among the authors.

Statement of ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the Maryam Abacha America University Maradi, Republic of Niger Committee on Ethics for Medical and Scientific Research and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Statement of informed consent

Informed consent was obtained from all individual participants in the study.

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