

Seroprevalence of Malaria Parasite Infection among Pregnant Women Attending Two Tertiary Health Facilities in Akure Ondo State Nigeria

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Abstract

The sequel outcomes and increased rates of maternal morbidity are partly consequences of the prevalence of malaria infections in pregnant women. This study was designed to investigate the prevalence of malaria parasite infection in pregnant mothers in State Specialist Hospital Akure. A total of 616 pregnant women aged 15-46 years who attended the major referral health facility for routine ante-natal purposes between February and April, 2012 were included in this exercise. Giemsa stained thick blood smears of the patients were examined for the presence of asexual stages of *Plasmodium* parasite. The Packed Cell Volume (PCV), genotype and blood group of the mothers were also determined using the haematocrit, electrophoresis and agglutination methods respectively. Descriptive statistics was used to determine the percentage of infections. Chi-square analysis was used to compare maternal data. Statistical comparison of malaria parasite and PCV was significant $p < 0.05$, this probably shows that malaria infection is responsible for the anaemia in pregnant women in this study. The relationship between malaria parasite and genotype was not significant ($p > 0.05$) indicating that genotype of mothers in this present study have no influence in the distribution and prevalence of malaria. Out of 616 pregnant women examined, 597 (96.92%) had malaria parasite infection while 19 (3.08%) were not infected. The total prevalence rate 96.92% observed in the sampled population examined was very high though majority were infected at low parasitaemia is indicative of the endemicity of the disease in Akure metropolis. The difference in the mean PCV of malaria infected and non-infected mothers coupled with the high rate of malaria infection suggested the involvement of malaria in maternal anaemia.

Keywords: Epidemiology; malaria parasite *Plasmodium falciparum*; pregnant women; Packed celled volume

Introduction

Malaria has always been the subject of research for medical practitioners from time immemorial. Pregnant women, children, and immune compromised individuals have the highest morbidity and mortality, and Africa bears the heaviest burden of malaria infection. WHO [1] reported that pregnant women and the unborn children are vulnerable to malaria, which is a major cause of perinatal mortality, low birth weight and maternal anaemia. Malaria in pregnancy is a significant health problem in Nigeria and it thus requires systematic studies. Antecedent studies have recorded various rates of malaria prevalence among pregnant women. These include 21% among the pregnant women in South West Nigeria, 72% of 250 women also recorded order of high rate of anaemia, clinical malaria and placental burden among 300 women were examined in Ghana [2,3].

The primary aim of this research work is to determine seroprevalence of malaria parasite infection among pregnant women in Akure Ondo State, Nigeria. This region is of special interest because of the free health care given to pregnant women during antenatal.

Materials and Methods

Akure the capital of Ondo State of South Western Nigeria is made up of 18 Local Government Areas. 616 pregnant women, who came from different Local Government Areas of Ondo State for routine antenatal visits at the State Specialist Hospital Akure between February

and April, 2012, were randomly selected for this study. Venous blood was collected from the women where age ranged between 15-46 years. Thick blood films prepared on slides were stained following the method of Cheesbrough [4]. Haemoglobin Genotype, Blood Group and Packed Cell Volume of the patients were determined as previously described by Cheesbrough [4].

Results

Prevalence of malaria parasitaemia in the different age groups

The prevalence of malaria infection was calculated by comparing the number of individuals positive for malaria by Giemsa stained thick blood smears test with the total number examined. The population was grouped into seven age categories, and for each age group of pregnant mothers, the number positive and the infection rates are shown in Table 1 and 2.

Generally, a total of 597 pregnant women representing 96.92% of those tested had malaria infection apparently indicating that infection was generally very high in the sampled population. Women aged 15-19 and those 40 years and above were all infected with malaria, the rate of infection increase steadily through the age groups starting from aged 20-24 with 95.92% up to aged 35-39 years with 99.04%. The statistical relationship between malaria parasite and age of women was not significant ($X^2=1.908E2^a$, $p=0.965$) (Table 3). The differences in the distribution of Malaria parasitaemia across the categories of age was not significant ($p > 0.05$) (Table 4).

Characterization of malaria parasite density in relation to age of positive pregnant Women

The density of malaria parasite in the different age groups of the 597 infected pregnant women was categorized as follows: (+) low, (++) moderate and (+++) high parasitemia. Result indicated that malaria with very high parasitemia was found only in pregnant women aged 30-34 (0.17%), moderate parasitemia was found in mothers aged 15-39 (6.7%) while the older ages were not infected and low parasitemia was found in all the age groups (93.17%) (Table 2).

Relationship between PCV and malaria infection in pregnant women

The Packed Cell Volume of the women included in this survey was studied in order to determine the effect of malaria on PCV among the women. On the basis of PCV women were also categorized -into two as shown in Table 5. Women having PCV<30% were all positive to malaria (47); those infected and having PCV ≥ 30% were 550 and 19 women having PCV ≥ 30% were free from the infection. Results suggest that uninfected mothers had normal PCV while 7.87% of the infected women had low PCV and majority of the infected mothers (92.13%) also have normal PCV, this is probably because of their low level of parasitaemia. The chi-square test on the effect of malaria parasite on the PCV of pregnant women was significant ($X^2=1.406E3^a$, $p=0.00$) (Table 6).

Results of prevalence of malaria infection among pregnant women with different genotype

Out of the six hundred and sixteen pregnant women examined, result indicated that malaria infection is higher among mothers having hemoglobin genotype AA 445(97.16%), followed by those with genotype AS 145(96.03%), while six of the women with genotype AC and one with genotype SS, had malaria parasites (Table 7). Attempts were made to classify the infected mothers into low, moderate and high based on their parasitemia. The majority (556) of mothers had low parasitaemia, 40 women had moderate parasitaemia and only an individual had high parasitemia. Statistical comparison of Malaria parasite and Genotype show was not significant ($X^2=77.917^a$, $p=0.996$) (Table 8). Based on the separation of means the differences in the distribution of malaria infection across the different genotype were also not significant ($p>0.05$) (Table 9).

The Prevalence of malaria infection in relation to blood group of pregnant women

The blood grouping of the pregnant women surveyed were determined for the purpose of investigating the effect of blood grouping on malaria infection in the sampled population. Results obtained are summarized in Table 10. 138 of the pregnant women

belonged to blood group A, 80 had blood group B, 12 belonged to blood group AB and 386 women had blood group O. Mothers with blood group AB were all infected and had the highest prevalence of 100%, followed by 79 of those with blood group B were infected (98.75%), 373 of blood group O mothers were infected with 96.63% and 133 of the women with blood group A were infected with 96.38%. The difference in the distribution of malaria parasites across the blood groups of mothers based on the separation of means was not significant ($p>0.05$) (Table 9)

Age group (Years)	No examined	No positive	Percentage positive
15-19	13	13	100
20-24	49	47	95.92
25-29	211	203	96.21
30-34	222	214	96.39
35-39	104	103	99.04
40-44	14	14	100
≥45	3	3	100
Total	616	597	96.92

Table 1: The Prevalence of Malaria parasite among the different Age groups of Pregnant Women

Age group (Years)	Malaria parasite density		
	Low (+)	Moderate (++)	High (+++)
15-19	12	1	0
20-24	42	5	0
25-29	187	16	0
30-34	201	12	1
35-39	97	6	0
40-44	14	0	0
≥45	3	0	0
Total	556(93.17%)	40(6.7%)	1(0.17%)

Table 2: Characterization of malaria parasite density in relation to age of Positive Pregnant women. Age long medically accepted mode of classification of malaria parasite density in patients

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.908E2a	228	.965
Likelihood Ratio	140.683	228	1.000
Linear-by-Linear Association	.128	1	.720

N of Valid Cases	597		
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Table 3: Chi-square test between Malaria parasite and Age. a. 240 cells (87.9%) have expected count less than 5. The minimum expected count is .01

Age group (years)	Malaria parasite mean/standard error
15-19	9.92 ± 3.25 ^a
20-24	7.29 ± 1.19 ^a
25-29	7.87 ± 0.67 ^a
30-34	8.26 ± 0.78 ^a
35-39	7.82 ± 0.92 ^a
40-44	6.07 ± 0.58 ^a
≥45	8.33 ± 0.88 ^a
Sig	0.418

Table 4: Comparison of mean values of malaria parasite in relation to age groups of pregnant women. Mean followed by the same letter in a column are not significantly different (p>0.05) from each other using New Duncan Multiple Range Test

Malaria status	PCV		Total
	<30	≥30	
No (%) positive	47(7.87%)	550(92.13%)	597
No (%) negative	-	19(100%)	19

Table 5: Relationship between PCV and malaria infection in pregnant women. Key: PCV<30% - Low Packed Cell Volume, PCV ≥ 30% - Normal Packed Cell Volume

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.406E3 ^a	1026	.000
Likelihood Ratio	402.218	1026	1.000
Linear-by-Linear Association	.114	1	.736
N of Valid Cases	597		

Table 6: Chi-square test between Malaria parasite and PCV. a. 1058 cells (96.9%) have expected count less than 5. The minimum expected count is .00

Genotype	Number examined	Malaria parasite density			Number Positive	Percentage Positive
		Low	Moderate	High		
AA	458	419	26	-	445	97.16
AS	151	130	14	1	145	96.03
AC	6	6	-	-	6	100
SS	1	1	-	-	1	100

Total	616	556	40	1	597	96.92
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Table 7: Result of Prevalence of Malaria infection among pregnant women with different Genotype

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	77.917 ^a	114	.996
Likelihood Ratio	69.191	114	1.000
Linear-by-Linear Association	1.498	1	.221
N of Valid Cases	593		

Table 8: Chi-Square Tests between Malaria parasite and Genotype a. 137 cells (87.8%) have expected count less than 5. The minimum expected count is .00

Genotype	Malaria parasite mean/standard error	Blood group	Malaria parasite mean/standard error
AA	7.60 ± 0.41 ^a	A	9.62 ± 1.15 ^a
AS	9.17 ± 1.14 ^a	B	8.80 ± 1.52 ^a
AC	5.33 ± 1.09 ^a	AB	6.83 ± 0.75 ^a
SS	5.00 ± 0.00 ^a	O	7.23 ± 0.41 ^a
Sig	0.309	Sig	0.288

Table 9: Comparison of mean values of Parameters with malaria parasite of pregnant women. Mean followed by the same letter in a column are not significantly different (p>0.05) from each other using New Duncan Multiple Range Test

Blood group	No examined	No positive	Percentage positive
A	138	133	96.38
B	80	79	98.75
AB	12	12	100
O	386	373	96.63
Total	616	597	96.92

Table 10: Prevalence of Malaria infection in Relation to Blood groups of pregnant women

Discussion

Distribution of malaria infection among pregnant women

The result obtained in the present study indicates that 96.92% of the population of pregnant women examined was carrying malaria parasites. The infection rate was particularly high and is suggestive that the disease is endemic in Ondo State of Nigeria. This finding and those of previous studies support the endemic picture in other part of the country. For instance, Martra [5] found *P.falciparum* affecting 92.2% of the pregnant women examined. Falade [6] found 89% malaria parasite prevalence among pregnant women attending antenatal in a Secondary health care facility in Ibadan, Nigeria. Adefioye [2] also recorded 72% prevalence rate and Chukwurah [7] recorded 63.5% of prevalence of malaria parasite in pregnant women in Akwa Ibom, Nigeria.

The high infection rate observed among women aged 15-19 and 40 years and above was probably an indication that immunity to malaria infection was low as a result of primigravidae (first pregnancy) state of the women that consequently make them more susceptible to malaria infection than others who are multigravidae [5]. Oforie [3] explained that Immunity to malaria infection diminishes significantly in pregnancy particularly in primigravidae. In first and second pregnancies women were especially vulnerable to malaria infection. McGregor [8] identify the factors responsible for susceptibility of primigravidae to malaria to be inhibition of type 1 cytokine responses (interferon, interleukin 2 and 12 and TNF). Brabin, [9] also found that the primigravidae were more susceptible to malaria infection than the multigravidae. According to Opare Addo [10] the primigravidae alongside those women in their second pregnancy were more vulnerable to malaria parasitemia. Although their findings were in contrast to those of McGregor [11] who reported a decline in malaria prevalence as age increase and that with improved host immunity susceptibility was reduced in later years. Statistical analysis, revealed that ages of pregnant women have no influence on the distribution of malaria parasite since the differences in the prevalence of infection among the various age group was not significant.

The result of this study revealed that pregnant women in the different age groups were infected at different parasitaemia densities. The low parasitaemia observed in all the age group of pregnant women could be the reason why they did not come down with malaria despite being infected. This indicated that pregnant women could be carriers of malaria parasites without showing any symptoms to the infection. The high parasitaemia observed in aged 30-34 could be as a result of co-infection with HIV which has impaired the immunity of the

mother. Marielle reported high prevalence rate in pregnant women in Gabon, with higher infection in primigravidae than multigravidae in woman within age group 36-39 years [12].

Malaria parasitemia often causes anaemia, increased uterine activity and low birth weight, among others [13,14]. According to Brabin [15] at pregnancy immunity has been altered, hence, with malaria 70-80% of pregnant women in malarious area are susceptible to anaemia. The PCV of pregnant women were grouped based on the definition of anaemia in pregnancy in our environment which is PCV of less than 30% [16]. The prevalence of malaria parasites in this study was generally high, the mean PCV 33.89 ± 3.88 among malaria infected mothers was lower than mean PCV 34.58 ± 3.06 of those without malaria parasite which can be suggestive of anaemia in pregnancy. This finding can be compare with other studies which recorded high prevalence rates observed high prevalence (76.5%) of anaemia in pregnancy in Abeokuta [17-20]. Analysis from this research probably showed that malaria infection is responsible for the anaemia in pregnant women in this study. The chi-square test indicates that the effect of malaria on PCV of women were significant ($p=0.000$).

Invasion of red blood cells (erythrocyte) by *P. falciparum* leads to very high infection rate. Anaemia in falciparum malaria is due mainly to the destruction of parasitized red cells. Uninvaded red cells are lysed during malaria attack; both parasitized cells and unparasitized cells are phagocytosed and destroyed in large numbers by the cells of the spleen and liver. It leads to folic acid deficiency and anaemia develops as loss of red blood cells may be extensive and rapid. The production of red cells in the bone marrow is also reduced and there is a slow reticulocyte response. An immune destruction of non-parasitized cells also occurs. According to Ogbodo [21] increased parasite density ultimately leads to increase in red cell breakdown and consequently anaemia. Desai [22] also reported that women with severe anaemia are at higher risk for morbidities such as congestive heart failure, fetal demise, and mortality associated with hemorrhage at the time of delivery.

Findings from this present study support the fact that sickle cell trait carriers have lower parasites densities and are more protected against death from severe malaria and the development of hyper reactive malaria splenomagalay compare with heamoglobin genotype AA and AS individuals [4]. Infection was higher in mothers having heamoglobin genotype AA which is usually reasonable because of their genetic constitution in that after the invasion by *Plasmodium*, haemoglobin genotype AA can survive till the end of the developmental cycle (erythrocytic cycle) of Plasmodium and the body identifies the haemoglobin genotype AA as normal red blood cell in nature which will not be destroyed by the spleen, thereby enabling the parasite to gain ground to multiply and thrive in the infected individual. Unlike the haemoglobin genotype AS (abnormal sickle) red blood cell in nature do not survive till the end of the erythrocytic cycle, because the body identify the sickle shaped cell as abnormal and are destroyed by the spleen. Therefore, parasitemia can be put under check in the haemoglobin genotype AS than the haemoglobin genotype AA especially when the immune system is high. This fact could be responsible for the high parasitaemia in pregnant woman having haemoglobin genotype AS because the mother was co-infected with both HIV and malaria parasite which is double tragedy. The effects of HIV antibodies in the pregnant woman could have weaken her immunity to malaria infection. The relationship between malaria and genotype of mothers showed no significant difference and this

indicates that genotype has no influence on the epidemiology of malaria among the pregnant women in this present study.

In regions highly endemic for *P. falciparum* malaria red cell polymorphisms that confer resistance to malaria are widespread, and tolerance to malaria based on inherited factors is well described [23]. It was observed from this research work that pregnant women having blood group AB had the highest malaria prevalence followed by those with blood group B while women with blood group A recorded the lowest prevalence. Statistical relationship of malaria infection among pregnant women of different blood grouping was not significant despite the high prevalence rate of infection among the women. This could probably because majority of the pregnant women had low parasitaemia. However blood groups of women in this study was not the determinant factor for the prevalence of malaria infection.

Conclusion

Malaria has become one of the most challenging infectious diseases to eradicate in Africa.

Recommendation

It is therefore recommended that all pregnant women attending antenatal clinic in Ondo State Specialist Hospital be tested for malaria parasite every month in order to detect early in case of any symptomatic or asymptomatic malaria infection so as to be treated appropriately and to prevent further morbidity and mortality associated with malaria.

There is need for Government to provide Intermittent Preventive Treatment for all pregnant women with effective anti-malarial drug during routine antenatal clinic visits. Mosquito treated net should be made available free for the pregnant women. Training on how to use the net must be given as this will decrease the exposure to infective mosquito bites.

More impressive Public announcement and awareness should be made to the pregnant women in the public to register early and attend good antenatal clinic for proper handling of their health and pregnancy from malaria

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