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MALARIA PARASITAEMIA AMONG PREGNANT WOMEN IN ORUMBA NORTH LOCAL GOVERNMENT AREA, ANAMBRA STATE, NIGERIA

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Abstract

Malaria infection particularly during pregnancy is a major public health concern in Nigeria. This study aimed to determine malaria parasitaemia among pregnant women in Orumba North Local Government Area, Anambra State from August 2022 to July 2023. Blood samples were collected for thick and thin films blood smear for microscopy. A total of 308 pregnant women participated in the study. Of the total number, 79(25.6%) were positive for malaria parasite. The highest prevalence 22(7.1%) was recorded in Ufuma, while the least 5(1.6%) was recorded in Awa. There was significant difference in malaria prevalence across communities (P<0.05). The highest malaria parasite prevalence 28(9.1%) was recorded in age group 20-24years while the least 5(1.6%) was recorded in age group 40-44years. There was no significant difference in malaria prevalence across age groups (P>0.05). The highest prevalence was recorded among the traders 61(19.8%) while the least was recorded among students 1(0.3%). There was significant difference in malaria prevalence across occupation (P<0.05). The highest malaria parasites prevalence was recorded among those whose educational level was secondary education 57(18.5%) while the least was recorded among those with no formal education. The highest malaria prevalence was observed among those in first trimester 65(21.1%) while the least prevalence was in third trimester 2(0.6%). The primigravidae had the highest malaria prevalence 73(23.7%) while the multigravidae had the least 6(1.9%). The highest malaria prevalence among them was observed during the rainy season 76(24.6) while the least was observed during the dry season 3(1.0%). Of the total 79 study participants who were positive for malaria parasite, 68(86.1%) had mild malaria parasite intensity while 11(13.9%) had moderate infection. The highest number of mild infections 24(35.3%) was observed in age group 18-24years while the least 5(7.4%) was in age group 40-44years. The highest number of mild infections 56(82.4%) was observed among the first trimester group, while the least 2(2.9%) was among the third trimester group. This study revealed that malaria parasite was prevalent among the pregnant women in the study area. Prevalence varied in age, occupation, education, trimester, gravidity and in seasons of the year.

Keywords: Malaria, Parasitaemia, Pregnancy, Trimester, Gravidity.

INTRODUCTION

Malaria is caused by protozoan parasites of the genus *Plasmodium* and transmitted by female *Anopheles* mosquitoes. There are five different human malaria species; *Plasmodium falciparum, Plasmodium vivax, Plasmodium malariae, Plasmodium ovale* and *Plasmodium knowlesi* (Gontie *et al.,* 2020). Malaria is transmitted through the bite of infected female *Anopheles* mosquitoes. *Anopheles gambiae* is the dominant and most efficient vector of human malaria in Africa based on its high abundance, longevity, high propensity for human feeding and high vectorial capacity (Autino *et al.,* 2012). It plays a prominent role in the transmission of the most dangerous malaria parasite species- *P. falciparum* (Yaw *et al.,* 2012) and this account for about 80% morbidity and 90% mortality.

Despite the existence of effective preventive measures and treatment, malaria remains endemic in 91 countries with the morbidity and mortality heavily concentrated in resource-poor areas of sub-Saharan Africa (World Health Organization, 2015). According to the World Malaria Report 2020, the estimated malaria cases in 2019 was 229 million cases which occurred worldwide resulting in 409,000 malaria-related deaths, owing the deadliest parasite (*Plasmodium falciparum)* predominantly in sub-Saharan Africa. There were 2015 million cases in 2019, mostly (94% of total cases). It continues to be a major threat to public health in parts of sub-Saharan Africa, Nigeria inclusive. About 97% of Nigeria's population is at risk of malaria where 60% of hospital outpatient visits and 30% of hospitalization among children under 5 years and pregnant women occur due to malaria (Nigeria Malaria Fact Sheet, 2011). It also contributes to an estimated 11% of maternal mortality and 10% of low birth weight (Carter *et al.,* 2005). Malaria is a leading cause of death for children under five years and pregnant women (World Health Organization, 2008).

Malaria during pregnancy is a serious public health problem in sub-Saharan Africa. It is estimated that each year approximately 25million pregnant women in sub-Saharan Africa live at risk of *P. falciparum* malaria infection (Gontie *et al.,* 2020). In Nigeria, 11% of maternal deaths are attributed to malaria (Federal Ministry of Health, 2000). While there are reports of up to 50% reduction in malaria episodes and deaths in some African countries between 2000 and 2006 (World Health Organization, 2008), reports from Nigeria has not shown significant reduction especially with regards to malaria in pregnancy (Agomo *et al.,* 2009). The disease is thought to cause as many as 10,000 cases of malaria-related deaths in pregnancy, mainly due to severe maternal anaemia, between 75,000 and 200,000 infants (children under the age of 12 months) are estimated to die annually as a result of malaria infection during pregnancy. Approximately, 11% (100,000) of neonatal deaths are due to low birth weight resulting from *P. falciparum* infections in pregnancy (Oluwagbemiga *et al.,* 2018) and 70.5% of morbidity in pregnancy in Nigeria (Abdulazeez *et al.,* 2020). It accounts for up to 15% of maternal anaemia, 5%-14% of low birth weight, 300million cases (90%) occur in Africa (Federal Ministry of Health, 2004).

In pregnancy, a woman's risk of having infection increases due to changes in her hormone levels and immune system (Ribera, 2007). They need special protective measures to ensure their survival and improve birth outcome (Agomo *et al.,* 2009). Good knowledge of malaria and its vectors and adequate preventive practices among women will help in the control of malaria in pregnancy.

The aim of this study was to determine malaria parasitaemia among pregnant women attending antenatal clinics in primary health centres in the study area. The specific objectives were to determine:

1. Prevalence and intensity of malaria parasitaemia among pregnant women attending antenatal clinics in primary health centres in the study area;
2. Prevalence and intensity of malaria parasitaemia in relation to age, occupation, education level, trimester and gravidity among pregnant women attending antenatal clinics in primary health centres in the study area;

MATERIALS AND METHODS

Description of the Study Area

The study was carried out in Orumba North Local Government Area of Anambra State Southeast Nigeria in the following communities; Amaokpala, Awgbu, Awa, Omogho, Ndikelionwu, Ndiokpalaeze and Ufuma. The area lies between latitudes $5^{0}58^{'}$N -$5^{0}60^{'}$N and longitudes $6^{0}47^{'}$E-$6^{0}.57^{'}$E. The study area has a rainforest climate with 7-8 months of wet season (April to November) and 4-5 months of dry season (December to March) with a short period of harmattan (December to January). The area has distinct rainy and dry seasons.

Study Design

The study was a cross sectional laboratory-based examination of malaria parasitaemia among pregnant women attending antenatal clinics in primary health centres in the study area.

Advocacy Visits and Community Mobilization

Advocacy visits were made with an introductory letter from the Head of Department of Biological Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli to Orumba North Local Government Area Chairman. Visits were also made to the traditional leaders of the selected communities to obtain permission to work with their people. Sensitization was done house to house in selected communities before sample collection. Pregnant women attending antenatal clinics in primary health centres in the study area were also sensitized through meetings organized in collaboration with the community opinion leaders and Officer-In-Charge (OIC) of primary health centres. The project aim and objectives were explained to them and their consent was sought and obtained. A medical laboratory scientist helped in collection of the blood samples.

Study Population for Malaria Parasitaemia Determination

The study population included apparently healthy pregnant women 20years and above resident in the study area, attending antenatal clinics in primary health care centres who willingly gave their consent to participate in the study. A total of 308 pregnant women participated in the study.

Administration of Questionnaires

A simple pretested questionnaire was administered to the pregnant women. The questionnaire sought information on age, occupation, education level, trimester and gravidity.

Collection of Blood Samples

With the help of a medical laboratory scientist, blood samples were collected by venipuncture. A tourniquet was tied around the upper arm in order to make the veins prominent as well as increase blood pressure in the vein. The area where the syringe was inserted into the body was cleaned thoroughly using a cotton swab moistened with 70% alcohol. The syringe was then inserted into the vein and 1ml of blood drawn into the syringe. The tourniquet was loosened before the needle was pulled out from the vein. The blood was put in a well labelled EDTA (Ethylene Di amine Tetra Acetic Acid) bottle and mixed thoroughly to avoid clotting. The blood samples were immediately transported to the laboratory for examination.

Preparation of Thick and Thin Blood Smears

New, clean and grease-free slides were used for preparing blood films for microscopy. Both thick and thin blood films were made on the same slide for the detection of malaria parasite life cycle stages and identification of the *Plasmodium* species present respectively. Using a micropipette, 5 µl of blood was placed on the center of a slide and another larger drop of blood, 6µl was placed to the right (WHO, 2015). The smaller drop of blood was spread using a smooth edged slide spreader to make a thin film. Without delay, the end of a plastic bulb pipette was used to spread the larger drop of blood until a circle of about 12 mm diameter was evenly covered for the thick smear. The blood films were then allowed to air-dry on flat surfaces.

Staining of the Thick and Thin Blood Smears

Staining of the blood films was done using 10% v/v Giemsa stain. Prior to that, the thin blood films were fixed by dipping that end of the slide in absolute methanol for few seconds. After that, the slides were placed in a rack, at acute angle so that the film-side faced upward and the thin film occupied the downward position. This was to prevent the thick film from being stained by methanol fumes and run-off. The slides were stained by flooding each slide separately with the diluted Giemsa stain to cover the thick and the thin blood films. This was allowed to stand for 10 minutes (Cheesbrough, 2009). After that, the slides were rinsed by flooding them with gentle flow of water until the stains were removed. The back of each slide was cleaned and placed in a draining rack for the preparation to dry.

Examination of the Blood Films

Both blood films were examined microscopically using 100x oil immersion objective lens. For each slide, the thick blood film was examined first in order to detect the presence of sexual and asexual stages of malaria parasites. This was followed by the examination of the thin blood film for identification of the *Plasmodium* species present according to Cheesbrough (2009) and WHO (2015).

Malaria Parasite Intensity Determination

Thick film was used for detection and counting of malaria parasite density. The degree of parasitaemia was graded thus: 1 to 10 parasites per thick film field view (+) as mild, 11 to 100 parasites per thick film field view (++) as moderate and above 100 parasites per thick film field view (+++) as severe. A negative result was recorded after thorough examination of fields without any parasite (WHO, 2008).

Data Summary and Statistical Analysis

Data collected were summarised using tables. Test of statistical significance was conducted using Chi square and one way Analysis of Variance (ANOVA) at $p < 0.05$. The statistical package employed was SPSS version 25.0.

RESULTS

Malaria Parasitaemia among Pregnant Women in the Study Area

Malaria parasitaemia prevalence was conducted among pregnant women in the study area. Prevalence in relation to age, occupation, education level, trimester and gravidity was also determined. In addition, prevalence across seasons was also determined and significant difference among them was noted.

A total of 308 pregnant women participated in the study. Of the total number, 79(25.6%) were positive for malaria parasite. The prevalence of malaria parasite was recorded according to communities and prevalence among the pregnant women varied across the communities in the study area (Table 1). The highest prevalence 22(7.1%) was recorded in Ufuma, while the least 5(1.6%) was recorded in Awa. Malaria prevalence among pregnant women in other communities were; Amaokpala 12(3.9%), Awgbu 9(2.9%), Omogho 7(2.3%), Ndikelionwu 11(3.6%), and Ndiokplaeze 13(4.2%). There was significant difference in malaria prevalence across communities (P<0.05).

Table 1: Prevalence of malaria parasitaemia among pregnant women attending antenatal clinics according to their communities

Communities	No. examined	No. positive	Prevalence (%)
Amaokpala	59	12	3.9
Awgbu	48	9	2.9
Awa	34	5	1.6
Omogho	36	7	2.3

Ndikelionwu	40	11	3.6
Ndiokpalaeze	38	13	4.2
Ufuma	53	22	7.1
TOTAL	**308**	**79**	**25.6**

X^2 =13.456, df=6, P=0.036 (P<0.05)

The prevalence of malaria parasite in relation to age of the pregnant women was also recorded (Table 2). Of the 308 pregnant women who participated in the study, the highest malaria parasites prevalence 28(9.1%) was recorded in age group 20-24years while the least 5(1.6%) was recorded in age group 40-44years. Malaria prevalence in other age groups were; 25-29years 18(5.8%), 30-34years 16(5.2%) and 35-39years 12(3.9%). There was no significant difference in malaria prevalence across age groups (P>0.05) (Appendix IV).

Table 2: Prevalence of malaria parasitaemia among pregnant women attending antenatal clinics in relation to age

Age (years)	**No. examined**	**No. positive**	**Prevalence (%)**
20-24	89	28	9.1
25-29	87	18	5.8
30-34	56	16	5.2

35-39	54	12	3.9
40-44	22	5	1.6
Total	**308**	**79**	**25.6**

X^2 =3.380, df=4, P=0.496 (P>0.05)

The prevalence of malaria parasite in relation to occupation of the pregnant women was also recorded (Table 3). Of the 308 pregnant women, the highest prevalence was recorded among the traders 61(19.8%) while the least was recorded among students 1(0.3%). Malaria prevalence in other occupational groups were; Farmers 13(4.2%), civil servants 2(0.6%) and unemployed 2(0.6%). There was significant difference in malaria prevalence across occupation (P<0.05).

Table 3: Prevalence of malaria parasitaemia among pregnant women attending antenatal clinics in relation to occupation

Occupation	No. examined	No. positive	Prevalence (%)
Traders	179	61	19.8
Farmers	68	13	4.2
Civil servants	41	2	0.6

Students	6	1	0.3
Unemployed	14	2	0.6
Total	**308**	**79**	**25.6**

X^2 =18.667, df=4, P=0.001 (P<0.05)

The prevalence of malaria parasite in relation to education level of the pregnant women was also recorded (Table 4). Of the 308 study participants, the highest malaria parasite prevalence was recorded among those who had secondary education as their highest qualification 57(18.5%) while the least was recorded among those with non-formal education. Malaria parasite prevalence in other educational levels were primary 12(3.9%) and tertiary 6(1.9%). There was significant difference in malaria prevalence across the different educational levels (P<0.05).

Table 4: Prevalence of malaria parasitaemia among pregnant women attending antenatal clinics in relation to their education level

Educational level	No. examined	No. positive	Prevalence (%)
Non-Formal	12	4	1.3

Primary	38	12	3.9
Secondary	164	57	18.5
Tertiary	94	6	1.9
Total	**308**	**79**	**25.6**

X^2 =26.501, df=3, P=0.000 (P<0.05)

Malaria Parasitaemia in Relation to Pregnancy Status of the Study Population

The prevalence of malaria parasite among the different trimester groups of the pregnant women was recorded (Table 5). Of the 308 pregnant women, the highest malaria prevalence was observed among those in first trimester 65(21.1%) while the least prevalence was in third trimester 2(0.6%). Pregnant women in second trimester had 2(0.6%) malaria prevalence. There was significant difference in malaria prevalence across the different trimesters (P<0.05).

Table 5: Prevalence of malaria parasitaemia in relation to trimester of the pregnant women

Trimester	No. Examined	No. Positive	Prevalence (%)

First	167	65	21.1
Second	102	12	3.9
Third	39	2	0.6
Total	**308**	**79**	**25.6**

X^2 =34.350, df=2, P=0.000 (P<0.05)

The prevalence of malaria parasite among the different gravidity groups of the pregnant women was recorded (Table 6). Among the 308 pregnant women, the primigravidae has the highest malaria prevalence 73(23.7%) while the multigravidae had the least 6(1.9%). There was significant difference in malaria prevalence across gravidity groups (P<0.05).

Table 6: Prevalence of malaria parasitaemia according to gravidity of the pregnant women

Gravidity	No. Examined	No. Positive	Prevalence (%)
Primigravidae	256	73	23.7

Multigravidae	52	6	1.9
Total	**308**	**79**	**25.6**

X^2 =3.845, df=1, P=0.050 (P<0.05)

The prevalence of malaria parasites among the pregnant women across the two seasons of the year in the study area was also recorded (Table 7). Of the 308 pregnant women, the highest malaria prevalence among them was observed during the rainy season 76(24.6) while the least was observed during the dry season 3(1.0%). There was significant difference in malaria prevalence across seasons (P<0.05) (Appendix IV).

Table 7: Prevalence of malaria parasitaemia among the pregnant women across seasons

Seasons	**No. Examined**	**No. Positive**	**Prevalence (%)**
Wet (rainy)	223	76	24.6
Dry	76	3	1.0
Total	**308**	**79**	**25.6**

X^2 =30.121, df=1, P=0.000 (P<0.05)

Intensity of Malaria Parasite among the Study Population

The intensity of malaria parasite among the study population was also recorded. They were classified into mild (+), Moderate (++) and severe (+++) infections. Of the total 79 study participants who were positive for malaria parasites, 68(86.1%) had mild malaria parasite intensity while 11(13.9%) had moderate infection. Severe infection was not recorded in any of the pregnant women. Malaria parasite intensity varied across communities (Table 8). Ufuma recorded the highest number of mild infections 19(27.9%), while Awa recorded the least number of mild infections 4(5.9%). Also, Ufuma recorded the highest number of moderate infections 3(27.3%), while Awgbu, Awa, Ndikelionwu and Ndiokpalaeze recorded the least number of moderate infections 1(9.1%) each. There was significant difference in intensity of malaria parasite across communities (P<0.05).

Table 8: Intensity of malaria parasitaemia among pregnant women attending antenatal clinics across communities

Communities	**No. examined**	**No. positive**	**Intensity of Malaria Parasites Infection (%)**

			+	++	+++
Amaokpala	59	12	10(14.7)	2(18.2)	0(0.0)
Awgbu	48	9	8(11.7)	1(9.1)	0(0.0)
Awa	34	5	4(5.9)	1(9.1)	0(0.0)
Omogho	36	7	5(7.3)	2(18.2)	0(0.0)
Ndikelionwu	40	11	10(14.7)	1(9.1)	0(0.0)
Ndiokpalaeze	38	13	12(17.6)	1(9.1)	0(0.0)
Ufuma	53	22	19(27.9)	3(27.3)	0(0.0)
TOTAL	**308**	**79**	**68(86.1)**	**11(13.9)**	**0(0.0)**

X^2 =13.456, df=6, P=0.036 (P<0.05)

Intensity of malaria infection was recorded in relation to different age groups of the pregnant women who participated in the study. The highest number of mild infections 24(35.3%) was observed in age group 20-24years while the least 5(7.4%) was in age group 40-44years. The highest number of moderate infections was also recorded in age group 18-24years 4(36.4%) while none 0(0.0%) was observed in age group 40-44years (Table 9). There was no significant difference in intensity of malaria parasites across age groups (P<0.05).

Table 9: Intensity of malaria parasitaemia among pregnant women attending antenatal clinics in relation to age

Age (years)	No. examined	No. positive	Intensity of Malaria Parasites Infection (%)		
			+	++	+++
20-24	89	28	24(35.3)	4(36.4)	0(0.0)
25-29	87	18	16(23.5)	2(18.2)	0(0.0)
30-34	56	16	14(20.5)	2(18.2)	0(0.0)
35-39	54	12	9(13.2)	3(27.3)	0(0.0)
40-44	22	5	5(7.4)	0(0.0)	0(0.0)
Total	**308**	**79**	**68(86.1)**	**11(13.9)**	**0(0.0)**

X^2 =3.380, df=4, P=0.496 (P>0.05)

Intensity of malaria infection was recorded in relation to occupation of the pregnant women who participated in the study. The highest number of mild infections 53(77.9%) was observed among traders, while the least 1(1.5%) was among students. The highest number of moderate infections was also recorded among traders 8(72.7%) while none 0(0.0%) was observed among civil servants, students and the unemployed groups (Table 10). There was significant difference in intensity of malaria parasites in relation to occupation (P<0.05).

Table 10: Intensity of malaria parasitaemia among pregnant women attending antenatal clinics in relation to occupation

Occupation	No. examined	No. positive	Intensity of Malaria Parasites Infection (%)		
			+	++	+++
Traders	179	61	53(77.9)	8(72.7)	0(0.0)
Farmers	68	13	10(14.7)	3(27.3)	0(0.0)
Civil Servants	41	2	2(2.9)	0(0.0)	0(0.0)
Students	6	1	1(1.5)	0(0.0)	0(0.0)
Unemployed	14	2	2(2.9)	0(0.0)	0(0.0)
Total	**308**	**79**	**68(86.1)**	**11(13.9)**	**0(0.0)**

X^2 =18.667, df=4, P=0.001 (P<0.05)

Intensity of malaria infection was recorded in relation to educational level of the pregnant women who participated in the study. The highest number of mild infections 51(75.0%) was observed among those whose highest education level was secondary school while the least 3(4.4%) was from those with no formal education. The highest number of moderate infections was also recorded among whose highest education level was secondary school 6(54.5%) while the least 1(9.1%) was among those with no formal education (Table 11). There was significant difference in intensity of malaria parasite across education levels (P<0.05).

Table 11: Intensity of malaria parasitaemia among pregnant women attending antenatal clinics in relation to education level

Education	No. examined	No. positive	Intensity of Malaria Parasites Infection (%)		
			+	++	+++
Non-Formal	12	4	3(4.4)	1(9.1)	0(0.0)
Primary	38	12	10(14.7)	2(18.2)	0(0.0)
Secondary	164	57	51(75.0)	6(54.5)	00.0)
Tertiary	94	6	4(5.9)	2(18.2)	0(0.0)
Total	**308**	**79**	**68(86.1)**	**11(13.9)**	**0(0.0)**

X^2 =26.501, df=3, P=0.000 (P<0.05)

Intensity of malaria infection was recorded in relation to trimester of the pregnant women who participated in the study. The highest number of mild infections 56(82.4%) was observed among the first trimester group, while the least 2(2.9%) was among the third trimester group. The highest number of moderate infections was also recorded among the first trimester group 9(81.8%) while none 0(0.0%) was recorded among the third trimester group (Table 12). There was significant difference in intensity of malaria parasites across trimesters (P<0.05) (Appendix IV).

Table 12: Intensity of malaria parasitemia among pregnant women attending antenatal clinics in relation to trimester

Trimester	No. Examined	No. Positive	Intensity of Malaria Parasites Infection (%)		
			+	++	+++
First	167	65	56(82.4)	9(81.8)	0(0.0)
Second	102	12	10(14.7)	2(18.1)	0(0.0)
Third	39	2	2(2.9)	0(0.0)	0(0.0)
Total	**308**	**79**	**68(86.1)**	**11(13.9)**	**0(0.0)**

X^2 =34.350, df=2, P=0.000 (P<0.05)

Intensity of malaria infection was recorded in relation to gravidity of the pregnant women who participated in the study. The highest number of mild infections 63(92.6%) was observed among the primigravidae, while the least 5(7.4%) was among the multigravidae. The highest number of moderate infections was also recorded among the primigraviade 10(90.0%) while the least number 1(10.0%) was among the multigravidae (Table 13). There was no significant difference in intensity of malaria parasites across gravidity groups (P<0.05).

Table 13: Intensity of malaria parasitaemia among pregnant women attending antenatal clinics in relation to gravidity

Gravidity	No. Examined	No. Positive	Intensity of Malaria Parasites Infection (%)		
			+	++	+++
Primigravidae	256	73	63(92.6)	10(90.0)	0(0.0)
Multigravidae	52	6	5(7.4)	1(10.0)	0(0.0)
Total	**308**	**79**	**68(86.1)**	**11(13.9)**	**0(0.0)**

X^2 =6.532, df=1, P=0.011 (P>0.05)

DISCUSSION

In this study, an overall malaria prevalence of 25.6% was recorded among the pregnant women who participated in the study across the various communities in the study area. The observation was lower than the prevalence rates observed among pregnant women in some other studies.

Umeanaeto *et al*. (2022) reported malaria prevalence of 27.5% in Enugwu-Ukwu, Anambra State. Imakwu *et al*. (2019) reported 41.7% in North eastern part of Ebonyi state. An overall prevalence of 52.5% was also reported in Omoku Rivers State (Ozougwu *et al*., 2020). Also, prevalence of 28.5% was reported in Port Harcourt Metropolis, Rivers State, Nigeria. On the other hand, malaria parasite prevalence rates lower than the observation in this study has been reported in some places in Nigeria. A lower prevalence of 18.7% has been reported in Iwo, Osun State, Southwest Nigeria (Oladosu and Adeniyi, 2023).

The highest prevalence 7.1% was recorded in Ufuma community, while the least 1.6% was recorded in Awa community. This observation demonstrated that malaria prevalence among pregnant women varied from community to community in the study area due to several unique factors peculiar to communities. Malaria transmission is muchly dependent on availability of the vectors in an area. Several studies have observed that malaria vectors are not evenly distributed in all communities. (Ikpo *et al*., 2021a; Ikpo *et al*., 2021b; Irikannu *et al*. 2020; Irikannu *et al*., 2021; Onwuzulike *et al*., 2021a and Onwuzulike *et al*., 2021b). On the other hand, it has been reported that pregnant women who live in locations where malaria transmission is low or unstable have little or no immunity to the disease and are at 2 to 3 times higher risk of acquiring severe disease (Muhammad and Muhammad, 2022). In our study area, the level of availability of malaria vector population in the different communities determined the malaria prevalence rate in that community.

In relation to age, the highest malaria parasites prevalence 9.1% was recorded in age group 20-24years while the least 1.6% was recorded in age group 40-44years. Other studies have made similar observations in younger and older age groups. In a study in Enugwu-Ukwu, Anambra State, malaria prevalence was highest in the younger age group 15–20 years, while age group of 36–40 years had the least prevalence of malaria (Umeanaeto *et al*., 2022). Among pregnant women attending a State Hospital in Iwo, Osun State, Southwest Nigeria, prevalence was also least in age group 15-20 years (Oladosu and Adeniyi, 2023). In Port Harcourt Metropolis, Rivers State, it was reported that age 46-55 years as had the highest malaria prevalence while age 26–35 years had the least (Okafor *et al*., 2020). These observations showed that malaria parasites are more prevalent in younger people. It also suggests that several exposures of the parasite to humans' overtime may reduce prevalence in older age people due to increased immune response.

In relation to occupation, the highest prevalence was recorded among traders (19.8%) while the least was recorded among students (0.3%). Oladosu and Adeniyi (2023) also made same observation where traders had more malaria prevalence than students. Imakwu *et al*. (2020) also made same observation among pregnant women in Ebonyi State, Nigeria. This observation demonstrates that the occupation of the pregnant women has a role to play on the exposure to malaria parasite. In our study area, the rural women engage in trading of farm produce in market places. Most times, they trade from dusk to dawn outdoors into malaria vectors biting hours. This may explain why traders recorded more malaria parasites than other occupations.

In relation to education level, the highest malaria parasite prevalence was recorded among those whose highest education level was secondary education (18.5%) while prevalence was much lower among those with tertiary education (1.9%). Although, those with non-formal education recorded only (1.3%) prevalence which was the least prevalence rate, it is important to note that only few persons in that category participated in the study. In another study, it was also observed that those with secondary education had more malaria parasite infection than those with tertiary education (Oladosu and Adeniyi, 2023). Imakwu *et al*. (2020) observed in their study that literacy appeared to be a more predisposing factor to malaria infection. They also noted that there was decreased infection rate as the literacy level increases. This study also agrees with their observation, that the low infection rates observed among women with tertiary education could be attributed to their high living standards, awareness of the epidemiological factors associated with malaria disease, and adequate preventive measures towards malaria infection. This is so, as lack of knowledge on the cause of malaria is known to play a vital role in the prevalence and spread of the parasite and the disease.

It has been observed that the susceptibility and severity of malaria infection in pregnant women vary widely and are influenced by several biological parameters such as immunological and humoral alterations, parity, maternal age, gestational age, and transmission intensity (Muhammad and Muhammad, 2022). In this study, the highest malaria prevalence was observed among those in first trimester (21.1%) while the least prevalence was in third trimester (0.6%). Similar observation has been made in other studies where pregnant women in their first trimester recorded the highest malaria prevalence while those in second trimester recorded the least (Imakwu *et al*., 2019; Umeanaeto *et al*., 2022; Muhammad and Muhammad, 2022; Ozougwu *et al*., 2020). Imakwu *et al*. (2019) observed that the attitude of the woman not starting pre-natal care early in pregnancy may also have contributed to the highest prevalence as some of the woman began pre-natal care either at the end of first trimester or mid second trimester.

In this study, the primigravidae had the highest malaria prevalence (23.7%) while the multigravidae had the least (1.9%). This is in tandem with the observation of some studies earlier mentioned. Umeanaeto *et al*. (2022) observed that the primigravidae had the highest malaria prevalence, while the multigravidae had the least among pregnant women attending General Hospital, Enugwu-Ukwu, Southeastern Nigeria, a nearby community to our study area. In contrast, Muhammad and Muhammad (2022) observed the highest malaria parasite prevalence among the multigravida attending Kwadon Primary Health Care, Yamaltu-Deba Local Government Area, Gombe State, Nigeria.

In relation to seasons, the highest malaria prevalence was observed during the rainy season (24.6%) while the least was observed during the dry season (1.0%). Imakwu *et al* (2019) also noted that malaria transmission occurs year-round in their study area with significant seasonal prevalence, with higher rate during the rainy season than the dry season. This is due to the availability of the malaria vectors in optimum population during the rainy season as a result of favourable climatic factors (Irikannu *et al*., 2021; Egbuche *et al*., 2020). Hence, malaria parasite transmission skyrockets during the rainy season than in dry season.

Of all the pregnant women who were positive for malaria parasite, 86.1% had mild malaria parasites intensity while 13.9% had moderate infection. The highest number of mild infections, 82.4% was observed among the first trimester group, while the least, 2.9% was among the third trimester group. Similarly, the highest number of mild infections, 92.6% was observed among the primigravidae, while the least, 7.4% was among the multigravidae. Our observation agreed with the opinion of Enock *et al*. (2020) who observed that malaria infection rates are higher in pregnant woman in their first trimester and first pregnancy with lower rate in later trimesters and pregnancies. This was because immunity accumulates with successive pregnancies provided there is exposure to malaria infection (Beeson *et al*., 2005). Similarly, other studies reported that through frequent and repeated malaria infections, pregnant women produce more antibodies to malaria parasites and therefore gain higher immunity over time, protecting them against generation of high parasite densities below detectable levels and clinical symptoms subsequently (Ikegbunam *et al*., 2022; McLean *et al*., 2015). These reports and observations correspond with the findings in this study.

CONCLUSION

This study showed that malaria parasitaemia was prevalent among pregnant women in the study area; a prevalence of 25.6% was recorded. Prevalence varied in age, occupation, education level, trimester, gravidity and in seasons of the year. Prevalence and intensity of malaria parasitaemia varied across communities in the study area. Malaria parasite intensity revealed that severe infection was not recorded among the pregnant women but mild and moderate infections were recorded. This indicates that there is stable malaria transmission in the study area.

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