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Epidemiology and risk factors of malaria among pregnant women attending antenatal clinics in Osun State, Nigeria

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Abstract

Globally, malaria in pregnancy leads to severe complications such as abortion, stillbirth, premature delivery, low birth weight, and fetal underdevelopment. This study examined the prevalence and risk factors of malaria among pregnant women attending antenatal care in Osun State, Nigeria. Between July and December 2020, 555 pregnant women from ten primary health centres in Osogbo, Ejigbo and Ilobu Local Government Areas participated in the study. Employing pre-tested questionnaires, qualitative data on the demographic and risk behaviours of participants were obtained. Malaria prevalence, determined by rapid diagnostic tests and blood smear microscopy was 15% caused by *Plasmodium falciparum*. The highest malaria prevalence was found among women who didn't use insecticides (23.1%), followed by those who did not use insecticide-treated nets (16.5%). The lowest prevalence was among women in their second and third trimesters who had taken Intermittent Preventive Treatment (IPT) (6.3%). The highest prevalence occurred among women aged 17-24 years (17.4%), while the lowest was among women aged 25-34 years (12.9%). All participants were aware of malaria but their knowledge about transmission (67%), symptoms (64%) and prevention (44%) varied. The study highlights the vulnerability of pregnant women who do not use insecticide-treated nets and emphasizes the need for improved malaria preventive practices. Control efforts should focus on the distribution of insecticide-treated nets, health education during antenatal visits and increased usage of IPT as recommended by the World Health Organization.

Introduction

Malaria is a deadly disease that has been causing a devastating effect on man's life for thousands of years (Cowman *et al* 2016). WHO (2010) documented that above 40% of the world's population live in malaria-infected areas mostly in the tropical and the subtropical regions of the world where the climatic condition favours not only the vector, female *Anopheles* mosquitoes but also the development of *Plasmodium* parasite. A higher infectious rate is seen in pregnant women than in their non-pregnant counterparts because of decreased immunity and hence increased susceptibility to many infections including malaria with a reported 50% mortality rate (Osaro *et al* 2019). Also, *Plasmodium*-infected red blood cells secreted into the intravillus spaces of the placenta hinder it from functioning properly, which adversely affects foetal growth (Azizi 2020). With about 25-30 million women becoming pregnant annually across countries in Africa, the high burden of malaria experienced in this group may be the direct or indirect consequence of increased body surface and peculiar pheromone secretion resulting in increased exposure in areas where vector and parasite are already endemic (Okafor 2019).

The impact of malaria in pregnancy had been earlier reported to include severe outcomes such as stillbirth, spontaneous abortion, neonatal death, low birth weight, poor development, behavioural problems, short stature, and neurological deficit (Desai *et al* 2007; Osaro *et al* 2019). In addition, complications such as anaemia, pulmonary edema, acute renal failure, puerperal sepsis and post-partum hemorrhage can occur and lead to death if effective treatment is not promptly administered (Nosten *et al* 1999, Idro *et al* 2010, Walker *et al* 2017).

A number of risk factors such as illiteracy, young maternal age, low educational status, joblessness, poor use

of ITN, poverty and inconsistent antenatal care visit have been shown by previous studies to be drivers of malaria infection among pregnant women (Agomo *et al* 2009; Mario *et al* 2013; Amuta *et al* 2014; Fana *et al* 2015).

In 2020, 3.3 billion people were reported at risk with 241 million malaria cases and 627 000 malaria deaths worldwide (WHO 2021). Globally, malaria is responsible for over 10,000 maternal deaths and 200,000 neonatal deaths yearly (Madziyire *et al* 2016). According to World Malaria Report, Nigeria bears the greatest burden of malaria in the world accounting for 27% of cases and 23% of mortality (WHO 2021). Nigeria is highly endemic with almost 100% of its population at risk, especially young children and pregnant women (Okafor *et al* 2019). Pregnant women residing in these endemic areas experience 1-4 malaria episodes during the gestation period (Desai *et al* 2007). The study of Amuta *et al* (2014) revealed that 11% of the total maternal deaths and 70.5% of morbidity during pregnancy in Nigeria are caused by malaria infection.

Malaria in pregnancy is a serious challenge in Nigeria as a large number of pregnant women who present themselves for antenatal care have malaria parasitemia along with its attendant anaemia (Oladepo *et al* 2010). Osun State is not an exception as there have been reported cases of malaria among pregnant women (Ojurongbe *et al* 2013). This study provides information on the risk factors of malaria and also captures the burden of the disease among pregnant women in Osun State.

Materials and methods

Study area

The study was conducted in 10 selected primary health centres in Osun State between July and December 2020. Osun is a culturally inclined inland state located in the southwestern part of Nigeria and its capital is Osogbo. The state lies within the tropical rainforest ecological topography with peak rainy period between July and September.

Study population and recruitment

This was a cross-sectional study conducted to determine the prevalence of malaria and risk factors among pregnant women attending antenatal clinics. A total of 555 pregnant women were recruited for the study using convenience sampling. The inclusion criteria for study participants were pregnant women attending antenatal clinics at all stages of pregnancy. The benefits and risks of the study were fully explained in both English and Yoruba to the women, and their verbal consent was sought. The study only included women who gave their informed consent.

Sample size determination

The sample size for this study was calculated using the formula described by Pourhoseingholi *et al* (2013):

$$n = 1.962p(1-p)/d2$$

where 'n' represents the total number of study participants, 'p' represents the estimated prevalence of *P. falciparum*, and 'd' represents the desired precision or margin of error.

In this study, the prevalence of *P. falciparum* for each Local Government Area (LGA) was estimated to be 35% based on the average value reported in various publications for the same geographical area (Ojurongbe *et al* 2018). The minimum sample size for each LGA was determined to be approximately 200.

Ethical approval and consent to participate

Ethical clearances were obtained from the Ministry of Health, Abere in Osun State (OSHREC/PRS/569T/192), and the Head of each health institution where pregnant women were interviewed. Thus, written and signed-printed informed consent was obtained from all the pregnant women before starting the survey.

Blood sampling and examination

Approximately 2-3ml of venous blood was drawn from each participant into an EDTA tube. A drop of blood was used to perform a rapid diagnostic test for malaria. Thick and thin blood films were also prepared and stained with diluted Giemsa stain and then examined microscopically for the presence of malaria parasites. Before a slide of the thick film was considered negative, 200 fields were examined under a ×1000 magnification. For positive slides, parasite species and stages were assessed and parasitaemia (parasite density) was determined by counting only the asexual stages against 300 white blood cells (WBC) and then multiplying by 25, assuming the mean total WBC count of individuals is 7500 cells/µl of blood. The level of parasitaemia was recorded as low (<1000 parasites/µl of blood), moderate (1000–9999 parasites/µl of blood) and severe (≥10,000 parasites/µl of blood).

Parasitological examination

Thick and thin blood films were used for the microscopic examination and diagnosis of malaria by an experienced microscopist according to methods described by Cheesbrough (2006).

Questionnaire administration

Standardized open-and-closed ended questionnaires, written in English and translated to Yoruba were employed to obtain information from the pregnant women on their demographic characteristics, knowledge and risk factors of malaria.

Data analysis

The collected data were entered into Excel 2016 sheet and analyzed using Statistical Packages for Social Science (SPSS) software. The data generated from this study were presented using descriptive and inferential statistics. Chi-square analysis was done to test for variables that were significantly associated with malaria.

Results

A total of 555 women across 10 Primary Health Centres (PHCs) participated in the study. The age of the respondents ranged from 16-45 years with a mean age of 26.7± 5.5. The highest proportion of participants (34.2%) fell within the age range of 21-25 years. The majority of participants were married (84%). Looking at their occupation, the majority were traders 73.3% while the highest form of education was secondary 78% (Table 1).

Prevalence and distribution of malaria

An overall malaria prevalence of 15% (83/555) was recorded across the ten PHCs where the study was conducted. Prevalence by age showed that pregnant women within the age bracket of 21-25 years had the highest while age ≥ 36 years was the lowest (Table 2). There was no significant difference in the prevalence of malaria between age groups (p=0.08).

Prevalence of malaria parasite in blood samples of pregnant women by Primary Health Centres

The prevalence of malaria among pregnant women was highest at the Oke Abesu PHC (26%) and lowest at Anwo PHC (5%). There was a significant difference(p=0.00) in the prevalence of malaria across the PHCs (Table 3).

Table 1: Demographic characteristics of all participants

Parameters	Frequency	Percentage (%)
Age-groups		
16 - 20	77	13.9
21 - 25	190	34.2
26 - 30	179	32.3
31 - 35	62	11.2
≧ 36	47	8.5
Total	555	100
Level of Education		
No Education	2	0.4
Primary	32	5.8
Secondary	433	78
Tertiary	88	15.8
Total	555	100
Occupation		
Civil Servant	30	5.4
Farmer	30	5.4
Artisan	18	3.2
Housewife	21	3.8
Student	17	3.1
Teacher	32	5.8
Trader	407	73.3
Total	555	100

Prevalence of malaria parasite in pregnant women by marital status, level of education and occupation

Single women had higher malaria prevalence than married women. There was a significant difference in prevalence between single and married pregnant women (p=0.00).

Table 2: Prevalence of malaria by age

Parameters	Number examined	Number of Malaria positive (%)	χ^2	p
Age-groups			8.29	0.08
16 - 20	77	17(21)		
21 - 25	190	27(33)		
26 - 30	179	25(30)		
31 - 35	62	4(5)		
≧ 36	47	10(12)		
Total	**555**	**83(15)**		

Table 3: Prevalence of malaria parasite in pregnant women by Primary Health Centres (PHC)

LGA	PHC			χ^2	p
Ejigbo	Aato	50	11(22)	580.99	0.00
Ejigbo	Agurodo	50	8(16)		
Ejigbo	Inisha	50	8(16)		
Ejigbo	PoPo	50	8(16)		
Ilobu	Anwo	80	4(5)		
Ilobu	Aromire	75	13(17)		
Osogbo	Isale Agbara	50	4(8)		
Osogbo	Oke Abesu	50	13(26)		
Osogbo	Oke Baale	50	8(16)		
Osogbo	Owode	50	9(18)		

Table 4: Prevalence of malaria by marital status, level of education and occupation

Marital status			χ^2	p
Married	467	67(14.4)	570.88	0.00
Single	88	16(18.2)		
Total	555	83(15)		
Level of Education			575.76	0.00
No Education	2	1(50)		
Primary	32	7(22)		
Secondary	433	67(16)		
Tertiary	88	8(9)		
Total	555	83(15)		
Occupation			575.74	0.00
Civil Servant	30	5(17)		
Farmer	30	7(23)		
Artisan	18	2(11)		
Housewife	21	3(14)		
Student	17	3(18)		
Teacher	32	1(3)		
Trader	407	62(15)		
Total	**555**	**83(15)**		

Prevalence was found dependent on educational status. Women with no education had a higher prevalence (50%) than those with some form of education. Progression in educational status resulted in reduced prevalence. Those with tertiary education had the lowest prevalence (9%). The difference in prevalence was significant (p=0.00). Also, with respect to the level of occupation, farmers had the highest prevalence (23%) while teachers had the lowest

prevalence (3%). Others were civil servants (17%), artisans (11%), housewives (14%), and students (18%). The difference in prevalence among the different occupations was also found to be significant (p=0.00).

Risk factors of malaria during pregnancy

Pregnant women who do not use ITN have a higher prevalence (19.8%) of malaria when compared to those who use ITN (15.5%). This was found to be significant (p=0.00). There was a significant association between insecticide use (pyrethroids) and malaria prevalence (p=0.00). Those who didn't use insecticide had a higher prevalence (30.0%) than those who used (9.2%). The use of IPT was also found to be significantly correlated with malaria prevalence (p=0.00). Pregnant women who didn't take IPT had a higher prevalence (25.9%) than those who already took IPT (10.3%; Table 5).

Prevalence of malaria by parity

Pregnant mothers who have had 4 or more births had the highest prevalence (21.1%), followed by first-time mothers (15.3%). The difference in prevalence between the groups was insignificant (p=0.63; Table 6).

Knowledge and prevalence of malaria among pregnant women

Results showed that there was no significant relationship between knowledge and malaria prevalence (p=0.08). (Table 7).

Table 5: Prevalence of malaria according to bed net, insecticide and IPT usage

Parameters	Number examined	Malaria positive (%)	χ^2	p
Use ITN			571.09	0.00
No	227	45 (19.8)		
Yes	245	38 (15.5)		
Insecticide (Pyrethroids) usage			593.71	0.00
No	190	57 (30.0)		
Yes	282	26 (9.2)		
Use IPT			584.12	0.00
No	220	57 (25.9)		
Yes	252	26 (10.3)		

ITN: Insecticide Treated Net; IPT: Intermittent Preventive Treatment

Table 6: Prevalence of malaria by parturition experience

Parameters	Frequency	Malaria positive (%)	χ^2	p
Number of children			1.75	0.63
0-1*	308	47 (15.30)		
2-3	228	32 (14.00)		
≧4	19	4 (21.10)		
	555			

0-1* (0 implies first-time pregnant mothers)

Table 7: Knowledge and prevalence of malaria among pregnant women

Do you know about malaria?	Frequency	Yes, I know about malaria (%)	Malaria positive (%)	χ^2	p
Number of children				0.774	0.856
0-1*	308	299 (97.10)	43(14.4)		
2-3	228	220 (96.50)	27(12.3)		
≧4	19	19 (100)	4(21.1)		
	555	538	71(13.2)		

0-1* (0 implies first time pregnant mothers)

Discussion

Malaria during the course of pregnancy has serious negative effects on mothers. Pregnant women are among those reported to have the highest risk of developing the severe presentation of malaria in addition to infants, children below the age of 5 years and immunocompromised patients (Musa *et al* 2020).

The prevalence of malaria infection observed amongst pregnant women (15%) in this study is relatively low when compared with the 41.6% prevalence reported by Fana *et al* (2015) in Northwestern Nigeria, 68.3% reported among pregnant women attending antenatal clinics in Makurdi by Amuta *et al* (2014), 19.6% reported by Boudova *et al* (2015) in Malawi, and the 18.7% reported by Cisse *et al* (2014) in Bobo-Dioulasso (Burkina Faso). The low prevalence reported in this study could be a result of improvement in the distribution of Long-lasting Insecticidal Nets (LLIN) in the state, knowledge and improved use of ITNs, insecticide and IPT use. According to the report of Fasasi *et al* (2020) in Osogbo, level of awareness of LLINs was 92.8% and also 60.8% of the sampled households were reported to frequently make use of their LLINs. Notwithstanding, the prevalence of 15%

reported in this study calls for concern, although it is not farfetched, considering that Osun State is a forest belt, which provides good breeding sites for mosquitoes for most part of the year (Oduola *et al* 2012). In addition to the several risk factors identified in the present study, the fact that this study was conducted during peak of the rainy season when there is abundant water for larval development might also have contributed to the observed prevalence.

In the present study, the use of ITN was found to significantly influence malaria infection among pregnant women since malaria prevalence was higher among women who do not use ITN compared to those who use it. This finding also corroborates the reports by Fana *et al* (2015), Nega *et al* (2015) and Gontie *et al* (2020). They all reported that non-usage of ITN increases the odds of developing malaria during pregnancy. A strong association between insecticide use, IPT usage and malaria infection was also observed. Pregnant women who do not use insecticides and have not used IPT were found to have a higher prevalence of malaria infection. ITN use and IPT are some of the recommended interventions by WHO and this study further confirms their effectiveness in reducing the malaria burden in pregnant women.

Marital status and malaria infection were observed to have a significant correlation. Single women were found to be more susceptible to malaria infection than married women. It is unclear how marital status could be a factor capable of influencing malaria transmission by itself, but perhaps it is more of a reflection of socio-economic status. In these climes, single women who get pregnant are likely to be socio-economically disadvantaged. National population-based surveys have consistently proven that malaria is a disease of poverty, with prevalence increasing as the people drop down the wealth quintile ladder (NMEP/NPC 2022).

Another factor that strongly correlated with malaria infection was the educational status of these women. There was a significant decline in malaria prevalence as their educational status progressed. Those with no formal education had the highest prevalence while those with tertiary education had the lowest prevalence. The findings of this study contradict the report of Agomo *et al* (2009) that educational status had no impact on malaria prevalence among pregnant women in Lagos. However, the findings of Fana *et al* (2015) in Northwestern Nigeria, as well as nationwide population-based surveys conducted by the National Malaria Elimination Programme in 2015 and the National Population Commission and International Classification of Functioning, Disability and Health (ICF International) in 2018, support the findings of the present study. This study is evidence that the more educated the population, the higher the possibility of taking precautionary measures against malaria infection.

In the present study, occupation is another risk factor that had a significant relationship with the prevalence of malaria among pregnant women, evidenced in the observed highest prevalence (23.0%) among farmers while teachers had the lowest prevalence (3.0%). Education could have a confounding effect on the role of occupation as a factor since in this environment, farmers are likely to be uneducated compared with teachers who are more likely to understand the importance of taking precautionary measures against malaria and comply with recommendations given by their local health workers.

There was no significant relationship between parity and malaria prevalence. This is a deviation from the findings of Okafor *et al* (2012), Nega *et al* (2015) and Kapisi *et al* (2017) where it was reported that, there exist a strong correlation between increasing gravidity and decreased malaria prevalence. In their findings, the prevalence was significantly higher in first-time mothers (primigravidae) over those who have multiple parturition experiences (multigravidae). The gravidity-dependent variations were thought to be connected to the development of placental malaria-specific immunity in subsequent pregnancies.

In the age group category, there also was no strong relationship between the age of pregnant mothers and malaria infection. This suggests that all age groups have an equal degree of susceptibility to malaria infection. This finding is similar to that of Nega *et al* (2015) and Ishag *et al* (2005) but differs greatly from the findings of Bouyou-Akotet *et al* (2003) where age was positively correlated with the prevalence of malaria. The observed differences in age-dependent variations in malaria prevalence may depend on the demography of the population. Where the sample contains younger, single, poor and under-nourished pregnant girls as well as older, more educated, economically stable, and better-nourished women, the differences would likely stand out.

Conclusion

Malaria during pregnancy has considerable negative effects on pregnant mothers, hence deserves utmost attention. Several risk factors have been identified to be responsible for the high prevalence among pregnant women. Lack of formal education, marital status, ITN usage, insecticide and IPT usage and occupation are some of the risk factors implicated in this study predisposing pregnant women to malaria infection. Control efforts should be intensified by improving the distribution of ITNs; health education should be given by health care workers to pregnant women at every antenatal visit and IPT usage should also be improved as recommended by WHO. Osun State is therefore advised to reinforce the existing prevention and control methods.

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