Original

Prevalence and Associated Factors of Asymptomatic Malaria among Pregnant Women Attending Care in a Semi-Urban Government Hospital in South-South Nigeria

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Abstract

Background: Malaria in pregnancy contributes to adverse maternal and perinatal outcomes. Pregnant women can be asymptomatic in the presence of malaria parasitemia, and its role in poor perinatal outcomes will remain undetected. Detection and treatment of the asymptomatic pregnant woman provides an opportunity to improve maternal and perinatal outcomes. The study determined the prevalence of asymptomatic malaria parasitemia and the associated factors amongst pregnant women making their first antenatal clinic visit to a secondary health facility in South-South Nigeria.

Method: This was a cross-sectional study involving 186 pregnant women. Blood samples collected from the consenting women were examined for malaria parasite and used to determine packed cell volume. Socio-demographic and clinical characteristics of the participants were extracted using a pretested data proforma. Data analysis was done to document proportions, associations, and statistical significance. Analysis was conducted with IBM SPSS version 25.

Results: Of the 186 women, 114 (61.3%) had malaria parasitemia. Significant associations with malaria parasitemia were found in women with low level of education (OR=2.3. P=0,013), not using insecticide-treated nets {(ITN), (OR=10.0. P=0.01)}, and with anemia (OR=13.0, P=0.01). Mosquito nets were used by 15.5% of the women and 4.8% of them had anemia.

Conclusion: This study revealed a high prevalence of asymptomatic malaria parasitemia and confirmed the protective role of education, use of ITN, and adequate hematocrit against malaria in pregnancy. These findings provide an opportunity for interventions to improve pregnancy outcome.

Keywords: Asymptomatic Malaria, Pregnant Women, South- South Nigeria.

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Introduction

Malaria poses a significant public health challenge worldwide with pregnant women and children under the age of 5 years having the highest risk of severe disease and mortality.[1] The World Health Organization reported that in 2021, approximately 247 million new cases of malaria occurred worldwide with an estimated 619,000 deaths, 95% of new cases and 96% of the deaths respectively, occurring in sub-Saharan Africa.[1] Nigeria alone is known to contribute 26.6% and 31.3% of global malaria cases and deaths, respectively.[1]

Malaria is a disease transmitted by the bite of infected female Anopheles mosquitoes. The four species that are mainly responsible for human malaria infestation are Plasmodium falciparum, Plasmodium malariae, Plasmodium ovale, and Plasmodium vivax. To this list has been added a 5th species called Plasmodium knowlesi, currently predominant in South-East Asia. Plasmodium falciparum is found in most of the tropical regions of the world and is associated with the most serious disease.[1]

Acute malaria presents with symptoms and signs, but some cases remain asymptomatic. This may be due in part to acquired immunity to malaria found in regions of holoendemic transmission. However, sections of the population made up of pregnant women and infants often lack the required immunity to curtail asymptomatic malaria parasitemia. Hence pregnant women remain at risk of acute malaria and may develop serious complications.[2,3]

Malaria in pregnancy is a significant public health problem that poses a great risk to the pregnant woman, the fetus, and the newborn. Asymptomatic malaria has been associated with severe maternal anemia and low birth weight.[4] It also increases the risk of stillbirths, spontaneous abortion, premature delivery, and need for intensive postnatal care.[4,5] In areas endemic for malaria, the highest risk for disease and mortality in pregnancy is reported among women in their first and second pregnancies, adolescents and those with immunodeficiency diseases like HIV.[6] Pregnant women are three times more likely to suffer from severe malaria compared with their non-pregnant counterparts and may have a mortality rate from severe disease that approaches 50%.[7]

It has been postulated that the uteroplacental vascular space apparently provides a site for parasite sequestration and development which may account for the increased susceptibility of pregnant women to malaria.[8] Current prevention and treatment strategies for malaria in pregnancy relies on providing pregnant women with insecticide-treated mosquito nets (ITN), intermittent preventive treatment with antimalarial medication, and early identification of the infected pregnant woman for prompt treatment.[1] These measures are recommended to reduce the adverse effects of malaria in pregnancy.

Considering that identifying asymptomatic pregnant women provides an opportunity to intervene and eliminate the consequences of malaria in pregnancy, this study was designed to document the prevalence of asymptomatic malaria in our region and to identify its associated factors. The findings are expected to improve future recommendations for combating malaria in pregnancy.

Method

Study setting

This study was conducted at the Department of Obstetrics and Gynecology of Central Hospital, Agbor, a 250-bedded hospital. Agbor is a semi-urban town in the South–South region of Nigeria. Central Hospital, Agbor has a busy obstetric attendance, with antenatal care (ANC) booking of about 200 women per month, and the delivery rate in the past 5 years has been approximately 1100/year with a CS rate of 28%. The postnatal clinic attends to an average of 50 women per week.

The ANC clinic is held twice a week. Women for ANC booking get registered by the record officers and have their blood samples taken for the basic antenatal investigations and other indicated tests. Thereafter, they are seen by the medical officers who classify them into high and low risk categories for further management.

Study design

A cross-sectional study was conducted from April to August 2023. Healthy pregnant women attending ANC booking were recruited for the study. Patients who had positive malaria parasite tests were given Artemisinin combination therapy while those who tested negative were given Sulphadoxine-Pyrimethamine (S-P) chemoprophylaxis. Routine antenatal care was continued subsequently for all patients. It is noteworthy that the hospital has continued to benefit from insecticide-treated mosquito net supply from Management Science for Health (MSH), which is distributed free to all pregnant women.

Ethical consideration

Ethical approval for the study was obtained from the Research and Ethics Committee of the hospital in March

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2023, with protocol no: E. Comm/C/0/AMZ/091/23. The study was executed in accordance with the guidelines of the Declaration of Helsinki, 2013. The authors are available and ready to supply the data upon any request.

Inclusion and exclusion criteria

All consenting pregnant women presenting for booking who did not have any of the exclusion criteria were recruited. Women were excluded if they reported fever, other symptoms suggestive of malaria, treatment for malaria within the last month, or refused to give consent.

Sample size calculation

The study sample size was derived from the formula: $N= Z^2PQ/e^2$, where N=minimum required sample size, Z=standard variate (1.96), P=estimated prevalence (0.087) based on a prevalence rate of 8.7% obtained from the study by Oyeroba et al,[9] Q=(1-p), and e^2=acceptable error at 0.05. $N= (1.96)^2 \times 0.087 \times 0.913/ (0.05)^2=122$. The minimum sample size was increased by 10% attrition (12.2), giving a total sample size of 122+12.2=134.2. The sample size was further increased to 186 women who met the inclusion criteria and consented to participate in the study to further increase the power and improve the external validity of the study.

Data collection

Socio-demographics and possible factors associated with asymptomatic malaria parasitemia were generated. These factors included age, occupation, education, use of ITN, gestational age, gravidity, parity, packed cell volume and genotype. In the present study, asymptomatic malaria parasitemia was defined as the presence of asexual forms of the parasite in the blood without symptoms of illness along with a temperature of <37.5℃. An anonymous pre-tested semi-structured questionnaire was developed for the study. The questionnaires were essentially self-administered, after full explanation of the relevant sections by the clinic staff. However, for non-literate women, the questions were explained in the local language by the clinic staff, who also assisted them in completing the questionnaire. The clinic staff were adequately trained on the content and proper administration of the questionnaire before the commencement of the study. The questionnaires were administered after the pregnant women were attended to by the doctors.

Laboratory procedure

About 2.5ml of peripheral venous blood was aseptically collected from each participant into EDTA tubes by a trained laboratory technician. Malaria parasites were tested using microscopy. The standard thick and thin films were prepared with Giemsa staining and viewed with x1000 microscopy for parasite density and speciation respectively, as described in the WHO Standard Operating Procedures for malaria microscopy evaluation.[10] The slides were prepared and read by two trained laboratory scientists. Where there were conflicting findings, the samples were reassessed by a more senior laboratory scientist. Finding any parasite was considered positive. As part of the routine investigations for ANC, the packed cell volume and genotype of each woman were also determined.

Data analysis

The information retrieved was used to derive a database which was analyzed using IBM SPSS version 25. Continuous variables were summarized using descriptive statistics such as mean and standard deviation. Categorical variables were documented using frequencies and percentages. The influence of socio-demographic characteristics and other clinical variables of the study participants on the prevalence of asymptomatic malaria parasitemia was assessed using the Chi-square test or Fisher's exact test as appropriate. P value less than 0.05 was deemed statistically significant.

Results

Of 250 patients approached to join the study, 191 completed questionnaires that were available for analysis. Of the 191 returned questionnaires, 186 had complete information and these were included in the final analysis. Malaria parasite was seen in 114 (61.3%) of the participants while 72 (38.7%) tested negative.

The mean age of participants was 29.26 ± 5.68 years with almost a third contributed across age groups <26 years, 26 to 30 years, and 31 to 35 years (31.0%, 29.0%, and 26.9% respectively). Nulliparity was recorded in 43% of the women, multiparity made up 53.2%, while 3.8% of the women were grand-multiparous. Nearly all the participants (98.9%) had attained a form of formal education. More than 95% of the women had either secondary or tertiary level of education. The group with civil servants, professionals and business executives made the smallest proportion of 8.0% while a combination of artisans, owners of small and medium scale businesses were in majority (68.3%). (Table 1). Most (93.6%) of them were married, and they were predominantly of the Christian Faith (99.8%).

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Table 1: Sociodemographic characteristics of the participants

Characteristics	Number (186)	Percentage
Age		
<25	58	31.2
26-30	55	30.0
31-35	50	26.9
>35	23	12.4
Parity		
Nullipara	80	43.0
Multipara	99	53.2
Grand multipara	7	3.8
Education		
None	2	1.1
Primary	6	3.2
Secondary	88	47.3
Tertiary	90	48.4
Occupation		
Professionals	11	5.9
Civil servants/Teachers	4	2.1
Business owners	79	42.5
Artisans	48	25.8
Home managers/Students	44	23.7

Table 2 documented the association between the participants' sociodemographic characteristics and the presence of malaria parasitemia in the study. Only educational status had a significant association with malaria parasitemia. Women with less education were 2.3-fold more likely to have asymptomatic malaria parasitemia than women with tertiary level of education (odds of 2.43 vs 1.05; P = 0.013). Age (P=0.124), parity (P=0.09), and occupation (P=0.15) were not significantly associated with malaria parasitemia. Over 99% of the women practiced Christianity and 93.6% were married, but none of these had significant association with malaria parasitemia (P=0.528 and P=0.132, respectively).

Table 3 showed the clinical parameters associated with malaria parasitemia among the patients studied. Patients recruited in the 2nd Trimester had 73.3% risk of having malaria parasitemia compared to just over 50% recorded in women who were either in their 1st or 3rd Trimester. However, this difference was not statistically significant (P=0.08). Just over 15% of the women reported that they slept under ITN. Many of them got the ITN from the free distribution in the antenatal clinic during their previous pregnancy. The reasons given by participants for not using ITN included discomfort and heat, non-affordability, and difficulty in hanging the net.

The 69% risk of malaria parasitemia amongst 158 women who did not use mosquito nets was significantly higher than the 17% risk of malaria parasitemia in 28 women who used mosquito nets. The women who did not report the use of ITN were 10-fold more likely to have malaria parasitemia than those who reported the use of ITN [(odds 2.22 vs 0.22; P = 0.01); Table 3]. Whereas asymptomatic malaria parasitemia was seen in all women who had anemia at the time of recruitment, the rate in women with normal hematocrit was 59%. Women who had anemia were 13-fold more likely to have asymptomatic parasitemia than women without anemia, and this association was statistically significantly [(odds 19.0 vs 1.5; P = 0.01); Table 3].

Table 2: Association between malaria parasitemia and sociodemographic characteristics

Characteristics	**Test Negative Number 72 (%)**	**Test Positive Number 114 (%)**	**P value**
Age			
<25	20 (27.8)	38 (33.3)	0.12
26-30	27 (37.5)	28 (24.6)	
31-35	20 (27.8)	30 (26.3)	
>35	5 (6.9)	18 (15.8)	
Parity			
Nullipara	31(43.1)	49(43.0)	0.09
Multipara	41(57.0)	58(50.9)	
Grand multipara	0(0.0)	7(6.1)	
Education			
None	0(0.0)	2(1.8)	0.01
Primary	0(0.0)	6(5.3)	
Secondary	28(39.0)	60(52.6)	
Tertiary	44(61.1)	46(40.4)	
Occupation			
Professionals	0(0.0)	11(9.7)	0.15

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Civil servants/Teachers	1(1.4)	3(2.6)	
Business owners	36(500)	43(37.7)	
Artisans	19(26.4)	29(25.4)	
Home managers/Students	16(22.2)	28(24.6)	
Marital status			
Married	70(97.2)	104(91.2)	0.132
Unmarried	2(2.8)	10(8.8)	
Religion			
Christians	72(100)	112(98.3)	0.528
Moslems	0(0.0)	1(0.9)	
Traditional	0(0.0)	1(0.9)	

Table 3: Association between malaria parasitemia and clinical characteristics

Characteristics	Test Negative 72	Test Positive 114	P value
	Number (%)	Number (%)	
Trimester of booking			
First trimester	33(45.8)	34(29.8)	0.08
Second trimester	23(31.9)	63(55.3)	
Third trimester	16(22.2)	17(14.9)	
Genotype			
AA	41(56.9)	56(49.1)	0.27
AS	12(16.7)	15(13.2)	
Unknown	19(26.4)	43(37.7)	
Packed cell volume			
≥30%	0(0.0)	9(7.9)	0.018
<30%	72(100)	105(92.1)	
Use of ITN			
Yes	23(31.9)	5(4.4)	0.01
No	49(68.1)	109(95.6)	

ITN insecticide-treated net

Discussion

This study found a high prevalence of asymptomatic malaria (61.3%) among pregnant women, which is significantly associated with lower level of education, low utilization of insecticide-treated nets (ITNs) and anemia. This prevalence is notably higher than those reported in several other studies.

Previous research has shown varying rates of asymptomatic malaria in pregnant women, mostly lower but with a few marginally higher rates than in the present study. For instance, a study in Benin City, Edo State, Nigeria by Akinbo et al[11] found a prevalence of 44.9% by microscopy. Other authors got rates of 38.8% from Abuja[12] and 41.8% from Ibadan.[13] Similarly, a study from Ethiopia found a prevalence of 7.2% by microscopy and 4.7% by rapid diagnostic test.[14] Another Ethiopian study reported rates of 5.7% by microscopy and 3.4% by rapid diagnostic test.[15] Furthermore, a systematic review of studies in sub-Saharan Africa found prevalence rates ranging from 2.3% to 10.8%.[16]

In contrast, many studies in Nigeria and neighboring West African states have reported similar or slightly higher prevalence rates. For example, Ogbodo et al[17] reported a prevalence of 59.9% asymptomatic parasitemia among pregnant rural dwellers in South-East Nigeria. A much higher rate of 71% was reported from Lagos[18] while 67.4% prevalence rate was reported from Enugu.[19] Outside of Nigeria, a study from Burkina Faso also reported 66.0% asymptomatic malaria prevalence rate.[20]

The high prevalence of 61.3% observed in this study is concerning and suggests a significant burden of undetected malaria infections in the studied population. This aligns with the understanding that asymptomatic malaria is common in endemic areas and can serve as a reservoir for transmission.[16] The varying proportions of asymptomatic malaria parasitemia in the different populations studied appear to follow the reported trend in urban versus rural prevalence of malaria generally, which also reflects the expectation for asymptomatic malaria. The rates from Benin City, Ibadan and Abuja,

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which are largely urban environments tended to be lower. However, Lagos and Enugu, which are also urban areas, reported quite high rates of asymptomatic parasitemia. This unpredictable relationship between malaria rates and the type of environment is a suggestion that other factors are important in determining the burden of parasitemia beyond the dichotomy of urban and rural environmental influence. The present study was conducted in a semi-urban environment, which may partly explain the rate that we found.

It has been shown that women with high level of education may be better informed about measures that can help prevent malaria like the use of window nets and insecticide spraying which may modify the exposure to the parasite and thus affect the prevalence of malaria parasitemia.[21,22] The varied educational attainment of the obstetric populations in the different studies may partly explain the variation in the prevalence of asymptomatic malaria parasitemia observed across the studies. In the present study, educational status of the participants was significantly associated with the prevalence of asymptomatic malaria parasitemia. Women with low level of education were more likely to be infected with the malaria parasite.

The association found between asymptomatic malaria and low ITN usage is consistent with previous findings which showed that pregnant women who do not use ITNs are at significantly higher risk of malaria infection.[14,15,23] For example, one study found that women who never used ITNs had 18.2 times higher odds of infection compared to those who were consistent with them.[16] However, the work by Akinbo et al[11] did not show benefit from using only indoor spraying with insecticides as a strategy to reduce the burden of asymptomatic malaria in pregnancy. In the present study, only 15.1% of the participants were using ITNs. In the study by Gontie et al[24] in Ethiopia, 81.3% of their participants had proper use of ITNs. The prevalence of malaria parasitemia in their study was much lower at 10.2%.

Some of the reasons given by the participants in the present study for not using the ITN were discomfort, difficulty hanging the net and affordability. This underscores the need for continued health educational intervention to foster a positive effect on the acceptance and use of ITNs by pregnant women.[25] There is need for government at all levels and donor agencies to continue to support the free distribution of ITN especially to pregnant women. Although ownership of a bed net does not always translate to its utilization, wide distribution is important for universal coverage and reduction of the burden of malaria in pregnancy.[26] Early pregnancy booking, access to ITN and education on its proper use, may serve as key interventions in reducing the burden of malaria.

The link between asymptomatic malaria and anemia in pregnant women is also well-established in the literature. Pregnant women with asymptomatic malaria infections are more likely to be anemic compared to non-infected women.[15,16,27] This is particularly concerning as anemia during pregnancy can lead to adverse outcomes for both mother and fetus. A combination of malaria and anemia in pregnancy is particularly demanding on the health of the mother and fetus, especially in sub-Saharan Africa and South-East Asia, where inadequate nutrition and sanitary conditions further complicate the process, with increased chance of maternal and perinatal morbidity and mortality.[28]

In the present study, women who had anemia detected at the time of recruitment were 13 times more likely to have asymptomatic malaria parasitemia than those with normal hematocrit. These findings underpin the importance of active screening for asymptomatic malaria in pregnant women, especially in high-transmission areas. They also highlight the need for increased efforts to promote ITN usage and address anemia in this vulnerable population who are more likely to be less educated.

Some studies have noted the significant effect of maternal age and parity of participants on the prevalence of asymptomatic malaria parasitaemia.[29,30] Young age and nulliparity were found in the present study to be associated with increased chance of malaria infection in pregnancy, although these findings were not statistically significant. Perhaps the role of good education masked the roles of other sociodemographic factors, modifying the effect of age and parity. Older multiparous women are thought to have developed acquired immunity which reduces susceptibility to malaria during pregnancy as age and parity increase.[31]

Other factors reported to influence the prevalence of malaria parasitemia include the method of diagnosis, seasonal variation in malaria transmission and endemicity level, the timing of the study, and the wide variations in the sociodemographic characteristics of the target obstetric population.[32,33] These factors were not specifically examined in the present study.

Implications of the findings of this study

This study has established a high prevalence of asymptomatic malaria parasitemia in our pregnant

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women population. The corollary is that the negative impact of undiagnosed malaria in pregnancy will be expectedly significant. Our findings provide evidence to support the effectiveness of ITNs which suggests a role for patient education in reducing asymptomatic malaria. We believe that the findings will add to the evidence in favor of targeted policies to reduce the burden of malaria parasitemia, especially among the pregnant women population. Being single-hospital research, we advocate for a community-based study, preferably in the setting of implementation science, to strengthen our findings.

Strengths and Limitations of the Study

The main strength of the present study lies in its cross-sectional design, which ensured that the information required for analysis was complete, thereby eliminating the challenge of missing information and lack of temporality encountered in retrospective studies. Similarly, loss to follow up was not encountered as this was a one-off involvement for each participant. Considering that our study population was in a semi-urban environment, it is reasonable to expect that the findings will closely reflect the situation in other places, averaging the rates in both rural and urban populations. However, we conducted single-hospital research, and the findings may be difficult to generalize to other populations.

Conclusion

This study found a high prevalence of asymptomatic malaria parasitemia among pregnant women in the population studied. It also demonstrated the significant effect of education on the use of ITN in reducing the odds of having malaria infestation in pregnancy. We recommend routine malaria screening at the booking clinic in this environment to identify patients for treatment. This should complement the roles of already established strategies like environmental sanitation, universal use of ITNs, intermittent preventive treatment, and adequate treatment of acute malaria.

Declarations

Ethical Consideration: Ethical approval for the study was obtained from the Research and Ethics Committee of the hospital in March 2023, with protocol no: E. Comm/C/0/AMZ/091/23. The study was executed in accordance with the guidelines of the Declaration of Helsinki, 2013. The authors are available and ready to supply the data upon any request.

Authors' Contribution: Both authors contributed equally. Conceptualization, and study design were by MNR. Data collection and analyses, drafting and review of the manuscript were done by the two authors MNR and ENO. Both authors reviewed and approved the version for publication

Conflict of interest: We do not have any conflict of interest to declare.

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