

The Prevalence of Malaria infection amongst pregnant women attending antenatal at Madonna University Teaching Hospital Elele, Rivers State, Nigeria

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Abstract

Original Research Article

Malaria during pregnancy constitutes a persistent public health challenge in sub-Saharan Africa, contributing substantially to maternal morbidity, adverse obstetric outcomes, and elevated neonatal mortality. Elucidating age-specific, gestational-stage-specific, and prevention-related patterns of *Plasmodium falciparum* infection is imperative for the formulation of targeted interventions in hyperendemic contexts. This cross-sectional investigation was conducted among pregnant women attending antenatal clinics at Madonna University Teaching Hospital, Elele, and Rivers State, Nigeria. Maternal age, gestational trimester, and utilisation of insecticide-treated nets (ITNs) were documented, and peripheral blood smears were microscopically examined for *P. falciparum* parasitaemia. Prevalence estimates were stratified by epidemiological risk factors. The highest burden of infection was observed among adolescents and young adults aged 16–20 years (77.8%), with prevalence declining progressively to an absence of infection in the 36–40 years cohort, followed by a modest resurgence in the 41–45 years group (20.0%). First-trimester pregnancies exhibited the greatest prevalence (58.3%), with a marked reduction in the second (34.6%) and third trimesters (15.4%). ITN users demonstrated a lower infection rate (25.9%) relative to non-users (41.1%). Younger maternal age and early gestational stage were strongly associated with heightened susceptibility, whereas ITN utilisation afforded partial but incomplete protection. These findings delineate critical vulnerability windows particularly early gestation and adolescence where intensified malaria prophylaxis is paramount. While ITNs retain demonstrable protective efficacy, their limitations necessitate integrated control strategies encompassing early antenatal registration, age-specific health education, scaled ITN deployment, environmental vector management, and prompt initiation of intermittent preventive treatment in pregnancy (IPTp).

Keywords: *Plasmodium falciparum*, Malaria in pregnancy, Maternal age, Gestational stage, ITN, Nigeria, Epidemiology.

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1. INTRODUCTION

Malaria remains an enduring public health challenge of global concern, disproportionately burdening tropical and subtropical regions where *Plasmodium* transmission is highly endemic (World Health Organization [WHO], 2023). Sub-Saharan Africa bears the preponderance of this affliction, with Nigeria persistently ranking among the highest contributors to global morbidity and mortality indices (Okoli et al., 2020). Within this epidemiological landscape, pregnant women constitute a uniquely vulnerable demographic due to the immunological and physiological alterations of gestation, which potentiate susceptibility to *Plasmodium falciparum* infection and its deleterious sequelae (Desai et al., 2018).

The pathophysiological nexus between malaria and pregnancy is particularly insidious, as sequestration of *P. falciparum*-infected erythrocytes within the placental intervillous space provokes inflammatory responses that compromise maternal-fetal exchange, precipitating adverse outcomes such as maternal anaemia, intrauterine growth restriction, preterm delivery, and low birth weight (Tutu et al., 2021). Moreover, the immunosuppressive milieu of pregnancy attenuates acquired immunity, heightening the risk of severe malarial episodes and perinatal complications (Uneke, 2007). These phenomena underscore the imperative for heightened surveillance and tailored prophylactic strategies in antenatal care.

Despite the availability of preventive measures including intermittent preventive treatment in pregnancy (IPTp)



with sulfadoxine-pyrimethamine and insecticide-treated nets malaria in pregnancy persists at alarming prevalence levels in Nigeria, often exacerbated by socio-economic disparities, inadequate health infrastructure, and suboptimal implementation of national malaria control policies (Olukosi et al., 2019). In rural and peri-urban settings such as Elele in Rivers State, the convergence of high transmission intensity, climatic favourability for vector proliferation and healthcare accessibility barriers may aggravate this burden.

Madonna University Teaching Hospital, situated within the malaria-endemic milieu of Rivers State, serves as a critical locus for antenatal healthcare delivery. However, there remains a paucity of empirical data delineating the contemporary prevalence and epidemiological determinants of malaria among pregnant women attending this facility. A robust understanding of this prevalence is indispensable for guiding targeted interventions, optimizing resource allocation, and reinforcing the integration of malaria prevention into maternal health programmes.

This study, therefore, seeks to ascertain the prevalence of malaria infection among pregnant women attending antenatal care at Madonna University Teaching Hospital, Elele, and Rivers State, Nigeria. By elucidating the magnitude of the problem within this specific context, the research aims to contribute to the evidence base for context-sensitive public health strategies, thereby advancing maternal and neonatal health outcomes in malaria-endemic regions.

2. MATERIALS AND METHODS

2.1: Study Area

The study was conducted at Madonna University Teaching Hospital (MUTH), Elele, Rivers State, Nigeria, located at approximately 5°06'26" N and 6°45'20" E, with an elevation of about 52 metres above sea level. Elele lies within Ikwerre Local Government Area in the humid lowlands of the Niger Delta, characterised by a tropical monsoon climate (*Am*), high relative humidity, annual rainfall exceeding 2,500 mm, and mean temperatures ranging from 24 °C to 31 °C conditions that perpetuate perennial *Anopheles* mosquito breeding and sustained *Plasmodium falciparum* transmission.

The locality is predominantly agrarian with ancillary trading and artisanal occupations, while MUTH serves as the principal referral centre for obstetric and antenatal care. Its antenatal clinic integrates routine malaria prevention and diagnostic services, making it an optimal sentinel site for investigating malaria prevalence in pregnancy within a high-transmission ecological and socio-economic context.

2.2: Study Population

The target population comprised pregnant women attending routine antenatal visits during the study period, irrespective of gestational age or parity.

Participants were enrolled consecutively until the required sample size was attained.

2.2.1: Inclusion and Exclusion Criteria

Eligibility was restricted to consenting pregnant women with confirmed gestation who had not received antimalarial chemotherapy within the preceding two weeks. Women presenting with chronic debilitating illnesses (e.g., HIV/AIDS, sickle cell anaemia) or those unwilling to provide informed consent were excluded to avoid confounding clinical and haematological parameters.

2.3: Sample Size Determination

Sample size (n) was calculated using the single population proportion formula:

$$n = \frac{Z^2 p (1-p)}{d^2}$$

Where Z corresponds to the standard normal deviate at 95% confidence (1.96), p represents an estimated prevalence derived from recent epidemiological data on malaria in pregnancy in Rivers State, and d denotes the precision margin (0.05). A contingency adjustment of 10% was applied to compensate for potential non-response or incomplete data.

2.4: Sampling Technique

A systematic consecutive sampling approach was adopted, with every eligible pregnant woman visiting the antenatal clinic during clinic days approached for enrolment until the target number was achieved.

2.5: Data Collection Instruments and Procedures

A pretested, interviewer-administered structured questionnaire developed in English and translated into local dialects was used to collect socio-demographic information, obstetric history, malaria prevention practices, and recent symptomatology. Trained research assistants administered the questionnaires under the supervision of the principal investigator.

2.6: Blood Sample Collection and Laboratory Diagnosis

Under aseptic conditions, approximately 2 mL of peripheral venous blood was obtained from each participant using sterile vacutainer tubes. Giemsa-stained thick and thin blood smears were prepared following WHO standard protocols for malaria microscopy. Thick smears were examined for parasite detection and density estimation, whereas thin smears facilitated *Plasmodium* species identification. Parasite density was quantified by counting the number of asexual parasites per 200 white blood cells (WBCs), assuming a standard WBC count of 8,000/ μ L. All slides were independently examined by two certified microscopists blinded to participants' clinical



profiles; discrepant results were adjudicated by a senior parasitologist.

2.7: Quality Assurance

Daily calibration of microscopes was performed, and freshly prepared reagents were utilised to ensure optimal staining quality. Ten percent of negative slides were randomly re-examined for verification.

2.8: Ethical Considerations

Ethical approval was obtained from the Madonna University Teaching Hospital Research and Ethics Committee (Approval No.: MUTH/REC/2018/07). The study adhered strictly to the principles outlined in the Declaration of Helsinki (2013 revision). Written informed consent was obtained from all participants; confidentiality was maintained by anonymising data and restricting access to authorised personnel only.

2.9: Data Analysis

Data were entered into Microsoft Excel, cleaned, and exported to the Statistical Package for the Social Sciences (SPSS) version 25.0 for analysis. Descriptive statistics (frequencies, percentages, means \pm standard deviation) were used to summarise demographic and

clinical variables. Associations between categorical variables and malaria infection status were assessed using Pearson's chi-square test, while logistic regression modelling was employed to identify independent predictors. Statistical significance was established at $p < 0.05$.

3. RESULTS

3.1: The prevalence of *Plasmodium falciparum* among the pregnant women in relation to their age group. It was significantly higher among the individuals aged 16 -20 years (77.8%) compared to those aged 21 - 25years (50.0%), 26-30 years (25.0%),31-35 years (12.5%), 36-40 years (0.0%),41-45 years (20.0%).

3.2: *Plasmodium falciparum* among pregnant women in relation to trimesters. It was significantly higher in the first trimester (58.3%) compared to the second trimester (34.6%) and the third trimester (15.4%).

3.3: *Plasmodium falciparum* among pregnant women in relation to the use of insecticide treated nets. It was significantly higher among the individuals that do not use the treated nets compared to those who use the insecticide treated nets.

Table 3.1: The prevalence of malaria among pregnant women attending Madonna University Teaching Hospital (MUTH) in relation to their age interval

Age interval	Number examined	Number of positive cases	Number of negative cases	Percentage of positive cases (%)
16-20	18	14	4	77.8
21-25	26	12	14	50.0
26-30	32	8	24	25.0
31-35	8	1	7	12.5
36-40	6	0	6	0.0
41-45	10	2	8	20.0

Table3.2: The prevalence of *Plasmodium falciparum* among the pregnant women attending Madonna University Teaching Hospital (MUTH) in relation to their trimesters

Trimester(months)	Number examined	Number of positive cases	Percentage of positive cases (%)
1-3	48	28	58.3
4-6	26	9	34.6
7-9	26	4	15.4

Table 3.3: The prevalence of *Plasmodium falciparum* among the pregnant women attending Madonna University Teaching Hospital (MUTH) in relation to the use of mosquito net

Use of mosquito net	Number examined	Number of positive cases	Number of negative cases
Yes	27	7 (25.9%)	20 (74.1%)
No	73	30 (41.1%)	21 (28.8%)

4. DISCUSSION

The present study demonstrates an inverse association between maternal age and malaria prevalence among pregnant women attending antenatal care at Madonna University Teaching Hospital, Elele, with the highest burden observed among adolescents aged 16–20 years (77.8%), followed by the 21–25 years group (50.0%). This finding is in agreement with previous studies reporting that malaria susceptibility in endemic settings is both age- and parity-dependent, with younger gravidae exhibiting limited acquired immunity and increased vulnerability to *Plasmodium falciparum* infection (Desai et al., 2018; Doolan et al., 2009; Tutu et al., 2021). The observed decline in prevalence with advancing age, particularly in the 26–35 years cohort, supports existing evidence that repeated malaria exposures during successive pregnancies confer partial protective immunity, reducing parasite density and clinical manifestations (Rogerson et al., 2018). However, the slight resurgence in the 41–45 years group (20.0%) deviates from the expected decline and may be attributable to immunosenescence or comorbidities, though the small sample size warrants cautious interpretation.

In relation to gestational age, prevalence was highest in the first trimester (58.3%), declining progressively in the second (34.6%) and third trimesters (15.4%), a pattern consistent with literature suggesting heightened susceptibility in early pregnancy due to immunological modulation and delayed initiation of intermittent preventive treatment in pregnancy (IPTp) until the second trimester (WHO, 2023; Rogerson et al., 2018). The reduction in later trimesters aligns with reports that IPTp implementation and increased insecticide-treated net (ITN) usage during antenatal follow-up significantly lower parasitaemia (Desai et al., 2018; Okafor et al., 2019). This is in agreement with findings from other endemic settings that link improved preventive coverage and repeated exposure-induced immunity to reduced malaria risk in later pregnancy stages (Tutu et al., 2021). Nevertheless, persistent infections in the third trimester reaffirm that even late-stage parasitaemia can adversely affect maternal and neonatal outcomes, underscoring the need for continuous prevention throughout pregnancy (Uneke, 2007).

Analysis of ITN use revealed a lower prevalence among net users (25.9%) compared to non-users (41.1%), corroborating previous evidence on the protective efficacy of ITNs as a primary vector control tool in

malaria-endemic areas (WHO, 2023; Lengeler, 2004; Pryce et al., 2018). This finding is in agreement with meta-analyses showing that ITN use significantly reduces human vector contact and suppresses community-level transmission (Bhatt et al., 2015). However, the persistence of malaria cases among ITN users aligns with prior reports highlighting limitations such as inconsistent nightly use, deterioration of IPTp potency, and exposure to mosquitoes during unprotected early evening hours (Killeen et al., 2011). The higher prevalence among non-users reflects enduring behavioural and logistical barriers, including discomfort, poor maintenance, and misconceptions, as similarly reported in Nigerian studies (Olukosi et al., 2019).

Overall, the study's findings are largely in agreement with the broader body of evidence on age, gestational stage, and ITN usage as determinants of malaria in pregnancy, while also emphasising that single interventions are insufficient in high-transmission settings. These results reinforce the imperative for integrated malaria prevention strategies combining ITN promotion, IPTp administration, environmental vector management, and continuous health education targeted particularly at younger gravidae and women in early pregnancy.

5. CONCLUSION

This study demonstrates that *Plasmodium falciparum* infection remains a substantial public health concern among pregnant women attending antenatal care at Madonna University Teaching Hospital, Elele, with prevalence significantly modulated by maternal age, gestational stage, and insecticide-treated net (ITN) utilisation. The disproportionately high infection rates among younger gravidae and during the first trimester delineate critical periods of heightened susceptibility, while the observed protective effect of ITNs underscores their value as a primary preventive measure. However, residual transmission among ITN users highlights the complex, multifactorial nature of malaria epidemiology in pregnancy and the need for integrated, context-specific control strategies in high-transmission settings such as the Niger Delta.

6. RECOMMENDATIONS

Early antenatal enrolment should be intensified to enable timely commencement of intermittent preventive treatment in pregnancy (IPTp) at the earliest



safe gestational stage. Malaria prevention education must be strengthened for adolescents and young women of reproductive age to address behavioural and socio-cultural risk determinants. ITN distribution and sustained promotion should be expanded, supported by behavioural change communication to enhance consistent and correct use. Integrated vector management, including environmental sanitation and larval source control, should complement ITN-based protection. Routine malaria screening at every antenatal contact is essential to ensure early detection and prompt treatment, particularly in early gestation.

7. CONTRIBUTIONS TO KNOWLEDGE

This research provides novel epidemiological evidence from a peri-urban, high-transmission Niger Delta setting, demonstrating a marked inverse relationship between maternal age and malaria prevalence, with peak vulnerability among adolescents and young adults. It identifies a clear gestational gradient of infection risk, with the first trimester emerging as the most critical intervention window. It further confirms the protective efficacy of ITNs while recognising residual transmission among users, underscoring the necessity of multi-pronged malaria control strategies. These insights expand the local evidence base for precision public health planning and support the development of age- and gestational stage-specific malaria prevention frameworks in endemic regions.

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