A Cross-Sectional Study on Malaria Prevalence and Associated Risk Factors among Pregnant Women in Nasarawa-South, Nigeria

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ABSTRACT

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| **Aims:** This study evaluated the prevalence of *Plasmodium* parasite among pregnant women attending antenatal care in selected healthcare facilities in Nasarawa-South Senatorial District, Nasarawa State, Nigeria.  **Study design:** Cross-sectional study.  **Place and Duration of Study:** Department of Microbiology, Nasarawa State University, between June 2024 and September 2024.  **Methodology:** A total of 414 blood samples of the pregnant women attending the secondary facilities in the study area were collected and *Plasmodium* parasite were examined from the samples collected using thick blood film microscopy techniques.  **Results:** The study found an overall parasite prevalence of 10.9% (45/413) among pregnant women. Prevalence was highest in younger women aged 17–20 years (23.3%, 19/82) and lowest in those aged 33–36 years (1.9%, 1/54). Education level also influenced infection rates, with the highest prevalence among women with primary education (16%, 13/81) and the lowest among uneducated and tertiary-educated women (4.3%, 1/23). Marital status and location further impacted prevalence, with single women (44.4%, 4/9) and rural residents (25.9%, 7/22) showing higher infection rates compared to married women (10.1%, 41/405) and urban dwellers (9.8%, 38/387).  **Conclusion:** The prevalence of the parasite was low and the socio-demographic factors, blood groups and the genotypes of the pregnant women were not significantly associated with the prevalence of the parasite. |

***Keywords:*** *Plasmodium, Malaria, Pregnancy, Prevalence*

1. INTRODUCTION

Malaria is a life-threatening vector-borne disease caused by *Plasmodium* parasites [1]. While over 200 species exist, five are major human pathogens: *Plasmodium falciparum* and *Plasmodium vivax* (the most widespread), followed by *Plasmodium malariae*, *Plasmodium ovale*, and *Plasmodium knowlesi*. Among these, *P. falciparum* is the deadliest, responsible for significant annual mortality [1]. The success of *Plasmodium* species in regions like Africa may be linked to the hot and humid climate, which favors their transmission. *Plasmodium falciparum* (*P. falciparum*) and *Plasmodium vivax* (*P. vivax*) are transmitted through the bites of infected female *Anopheles* mosquitoes [1]. Although preventable and treatable, malaria remains a major global health concern, severely affecting the well-being and livelihoods of populations worldwide [1]. Initial symptoms—such as fever, headache, and chills—typically emerge 10–15 days after infection and can be mild, making early diagnosis challenging. Without prompt treatment, *P. falciparum* malaria can rapidly progress to severe complications, leading to death within 24 hours [2].

According to the World Health Organization (WHO), an estimated 228 million malaria cases occurred globally in 2018, with the majority concentrated in Africa. Notably, Nigeria alone accounted for nearly a quarter (24%) of all malaria-related deaths worldwide that year [3].

Malaria infection during pregnancy poses significant risks due to immunosuppression, increasing the likelihood of severe disease. Pregnant women face a threefold higher risk of severe illness, with mortality rates approaching 50% [4]. This risk is influenced by maternal age and parity. In high-transmission regions, up to 25% of pregnant women may contract malaria [5], which can lead to adverse outcomes such as intrauterine growth restriction, congenital malaria, low birth weight, spontaneous abortion, and stillbirth. Disease severity and clinical manifestations depend on the mother’s immunity and local transmission intensity [6].

Malaria in pregnancy imposes a significant burden, leading to adverse outcomes, extended hospitalization, and emotional distress for both affected women and healthcare workers [7].

Pregnant women in Nigeria face heightened vulnerability to malaria due to limited healthcare access, socioeconomic disparities, and demographic factors [8]. The burden is most severe in rural areas, where poverty restricts the ability to obtain preventive measures like insecticide-treated nets and antimalarial drugs [9]. Poor healthcare infrastructure also results in underdiagnoses and inadequate treatment, increasing the risk of severe complications for both mothers and unborn children [9, 10].

Current data on malaria prevalence among pregnant women attending healthcare facilities in Nasarawa-South Senatorial District, Nasarawa State, Nigeria remains limited. Expanding research across multiple healthcare centers is essential to generate updated epidemiological evidence. The findings from this study will support the development of targeted, evidence-based strategies for malaria control and prevention programs in the region.

2. material and methods

**2.1 Study Area**

This research work was conducted in three secondary healthcare facilities (SHF) and one tertiary healthcare facility (THF), all in Nasarawa-South Senatorial District, bounded by Kaduna State, Plateau State, and Benue State. The HFs were: General Hospital Doma (GHD), General Hospital Keana (GHK), General Hospital Obi (GHO) and Dalhatu Araf Specialist Hospital, Lafia (DASHL).

**2.2 Study Population**

The target population was pregnant women that were accessing healthcare services in the tertiary and secondary hospitals in Nasarawa South senatorial district.

**2.3 Sample collection**

A total of 414 venous blood samples (89 from DASHL, 180 from GHD, 75 from GHK and 70 from GHO) were collected from pregnant women attending the above facilities into ethylenediaminetetraacetic acid (EDTA)-coated bottles and transported to the laboratory in each of the facilities for analysis.

**2.4** **Microscopic Examination of Malaria parasite with thick film**

A 6 µl blood sample was pipetted onto the large circle of a transparent film preparation template. Using a spreader, the blood was immediately mixed with circular motions to evenly distribute it within the 12 mm diameter circle.

For staining, Giemsa solution was prepared as a 1:10 dilution (10 ml Giemsa + 90 ml distilled water). Labeled thick blood films were arranged on a staining rack, then completely covered with the diluted Giemsa stain using dropwise application. Slides were stained undisturbed for 20 minutes.

After staining, each slide was individually rinsed with distilled water, drained, and air-dried. Finally, stained films were cover slipped with immersion oil and examined under 100× oil immersion microscopy

3. results and discussion

**3.1 Overall Prevalence**

The prevalence of *Plasmodium* parasite among pregnant women attending selected healthcare facilities determined using descriptive statistics was 45(10.9%). The facility-related prevalence of the parasite decreased in the order: DASHL (15.7%) > GHO (11.4%) > GHD (10%) > GHK (6.7%) as shown in Figure 1. The prevalence of the parasite was insignificantly associated with the selected facility (P= 0.29560).

**3.2 *Plasmodium* parasiteprevalence in respect to socio-demographic Characteristics**

Table 1 presents *Plasmodium* parasite prevalence in relation to socio-demographic characteristics of pregnant women attending the study facilities. Age-specific prevalence peaked in the 17-20 year group (23.3%, 19/82) and was lowest in 33-36 year-olds (1.9%, 1/54), with no cases detected in women aged 37-39 or ≥40 years.

Educational attainment showed significant association with infection rates (χ²=23.292; *P*=0.003), being highest among primary-educated women (16%, 13/81) and lowest in both uneducated and tertiary-educated groups (4.3%, 1/23).

Marital status and location demonstrated significant epidemiological patterns:

Singles showed higher prevalence (44.4%, 4/9) than married women (10.1%, 41/405; *P*=0.010, CI=0.021-0.745)

Rural residents had greater infection rates (25.9%, 7/22) versus urban counterparts (9.8%, 38/387;*P*=0.018, CI=0.117-0.932)

**3.3 *Plasmodium* parasite prevalence in relation to preventive measures and pregnancy trimester**

Table 2 displays *Plasmodium* parasite prevalence in relation to preventive measures and pregnancy trimester. Women who reported no ITN use showed higher infection rates (12.3%, 22/179) compared to ITN users (9.8%, 23/235). Similarly, those not taking prophylactic agents had significantly greater prevalence (36.2%, 38/105) versus those who did (2.3%, 7/309).

Trimester-specific analysis revealed highest infection rates in first-trimester pregnancies (26.9%, 21/78), declining substantially in later trimesters (7%, 23/327). Fisher's exact test demonstrated:

Significant associations between parasite prevalence and both prophylactic agent use (*P*<0No significant association with ITN use (p=0.515)

Table 3 presents malaria parasite prevalence stratified by hematological parameters (genotype and blood group) among pregnant women in Nasarawa South Senatorial District, Nigeria. The highest infection rates were observed in women with:

* AA genotype (12.5%, 36/295)
* AB blood group (15.8%, 3/19)

No infections were detected in participants with SS (0/4) or AC (0/3) genotypes. The lowest prevalence among blood groups occurred in group B (9.1%, 9/99). Statistical analysis revealed no significant associations between parasite prevalence and either genotype (*P*=0.664) or blood group (*P*=0.681).

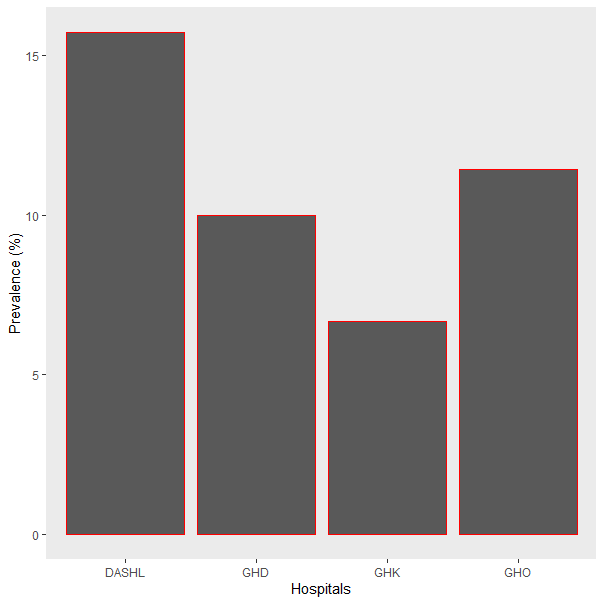


Figure 1: Prevalence of *Plasmodium* parasite from pregnant women attending selected healthcare facilities in Nasarawa-south senatorial district, Nigeria.

*DASHL=Dalhatu Araf Specialist Hospital Lafia; GHD=General Hospital Doma; GHK=General Hospital Keana; GHO=General Hospital Obi*

Table 1: Prevalence of *Plasmodium* parasite in Relation To Socio-Demographic Factor

|  |  |  |  |
| --- | --- | --- | --- |
| **Socio-demographic factor** | **No. of Samples** | **Prevalence (%)** | |
| **Age** |  | |  |
| 17-20 | 82 | | 19 (23.2) |
| 21-24 | 60 | | 9 (15.0) |
| 25-28 | 115 | | 11 (9.6) |
| 29-32 | 78 | | 5 (6.4) |
| 33-36 | 54 | | 1 (1.9) |
| 37-39 | 20 | | 0 (0.0) |
| ≥40 | 5 | | 0 (0.0) |
| Total | 414 | | 45 (10.9) |
| **Level of Education** |  | |  |
| Uneducated | 23 | | 1 (4.3) |
| Primary | 81 | | 13 (16.0) |
| Secondary | 287 | | 30 (10.5) |
| Tertiary | 23 | | 1 (4.3) |
| Total | 414 | | 45 (10.9) |
| **Marital status** |  | |  |
| Single | 9 | | 4 (44.4) |
| Married | 405 | | 41 (10.1) |
| Total | 414 | | 45 (10.9) |
| **Location** |  | |  |
| Rural | 27 | | 7 (25.9) |
| Urban | 387 | | 38 (9.8) |
| Total | 414 | | 45 (10.9) |

Table 2: Prevalence of *Plasmodium* parasite in Relation To History of Preventive Majors and Trimester of Pregnancy

|  |  |  |
| --- | --- | --- |
| **History of Preventive Majors/Trimester of Pregnancy** | **No. of Samples** | **Prevalence (%)** |
| **ITN** |  |  |
| Yes | 235 | 23 (9.8) |
| No | 179 | 22 (12.3) |
| Total | 414 | 45 (10.9) |
| **Prophylaxis** |  |  |
| Yes | 309 | 7 (2.3) |
| No | 105 | 38 (36.2) |
| Total | 414 | 45 (10.9) |
| **Trimester** |  |  |
| 1st trimester | 78 | 21 (26.9) |
| 2nd trimester | 327 | 23 (7.0) |
| 3rd trimester | 9 | 1 (11.1) |
| Total | 414 | 45 (10.9) |

Table 3: Prevalence of *Plasmodium* parasite In Relation to Haematological Parameters

|  |  |  |
| --- | --- | --- |
| Blood group | No. of sample | Prevalence (%) |
| A | 81 | 11(13.6) |
| AB | 19 | 3(15.8) |
| B | 99 | 9(9.1) |
| O | 215 | 22(10.2 |
| Total | 414 | 45(10.9) |
| Genotype |  |  |
| AA | 295 | 36 (12.2) |
| AC | 3 | 0 (0.0) |
| AS | 112 | 9 (8.0 |
| SS | 4 | 0 (0.0) |
| Total | 414 | 45 (10.9) |

Malaria remains a leading cause of morbidity and mortality especially among pregnant women and children in the developing countries especially in sub-Saharan countries [11]. The overall prevalence of *Plasmodium* parasite in our present was 10.9% and slightly like 10.8% prevalence in the study conducted by [12] in Ghana, this lower than 12.3%, 20.8%, 53.9% and 43.5% reported by [13], [11] in Ethiopia, Liberia, [14] and [15] in South-Western and South-Eastern Nigeria. The prevalence of malaria parasite among the pregnant women attending the antenatal care in our present study represents a considerable level of risk to the mother and foetus which may likely lead to infant mortality. The low prevalence of malaria parasite in our present in comparison with other studies conducted in South-Eastern Nigeria, South-Western Nigeria and other parts African countries [13]; [15]; [11, 14] may be linked to the success of both pharmaceutical and non-pharmaceutical intervention for the control of malaria in the study area.

The results of present study on the prevalence of *Plasmodium* parasite in relation to the socio-demographic factors of the pregnant women were significantly associated with the age, marital status and level of education but insignificantly associated with their location and this suggests that age, marital status and level of education may likely be a predisposing factor for the prevalence of the parasite. The result of study shows that the prevalence of the parasite in relation to the age of the pregnant women was relatively high in age group; 17-20 yrs and 21-24 yrs and this seems to corroborate with the high prevalence of the parasite in 21-30 yrs (47.0%), 18-25 yrs (34.0%) and 26-35 yrs (48.2%) in the study reported by [11]and [13] which was higher than 23.2% and 15.7% in our present study. The factor driving the high prevalence of the parasite among the young pregnant women in our study is unclear but previous literatures opined that adolescents and young adult pregnant women were more susceptible to malaria than older pregnant women, because of continuous development of malaria immunity in older women [13].

The high prevalence of the *Plasmodium* parasite among pregnant women with primary level of education in our present study corroborate with the study conducted by [12], although the percentage prevalence of the parasite was lower than 42.8%. Furthermore, the high prevalence of the parasite among pregnant women with primary level of education contradict with the results of the study conducted by [13] who reported high prevalence of the parasite among the pregnant women with secondary level of education. The result of present study shows that the prevalence of the parasite was low among pregnant women with secondary and tertiary level of education, and this suggests that the above level of education could guarantee better access to information about malaria prevention and seeking early medical care.

The striking results of our findings shows that location of the pregnant women was not significantly associated with the prevalence of the parasite and this suggests that the location of the pregnant women may not determine the prevalence of the parasite due to the endemic nature of parasite in sub-Sahara Africa where both people living in the urban and rural area are more prone to the transmission of the parasite via the vector.

The association of the prevalence of the parasite and the history of use of insecticides treated net (ITN) and use of prophylactic agents was statistically significant in our present study, and this implies that the above factors may likely drive the prevalence of the parasite among the pregnant women in the study area. The high prevalence of the parasite among the pregnant women without history of use of ITN in our present study also corroborate with previous study [13] [12]. The high prevalence of the parasite among pregnant women with first trimester of pregnancy observed in this study is also consistent with previous studies [14], [12], although the percentage prevalence of the parasite among pregnant women with first trimester in our present study were less than the 71.6% and 73.0% reported by [14] and [12] respectively. In addition, the results of present study on high prevalence of the parasite among pregnant women with first trimester is not in agreement with previous studies that reported high prevalence of the parasite among women with second trimester of pregnancy [11, 13, 14]. The high prevalence of the parasite among the women in first trimester of pregnancy suggest that may be more prone to complications like anaemia, respiratory distress, deaths and risk of preterm labour.

The prevalence of the parasite among the pregnant women in relation to their haematological parameters such as ABO blood group and genotypes shows that the prevalence of the parasite was not significantly associated with the ABO blood group and the genotypes of the pregnant women although the parasite was more prevalent among those with blood group B and genotype SS. The high prevalence of the parasite among pregnant women with blood group B is corroboration with the study conducted by [12] The insignificant association of blood group and the prevalence of the parasite among the pregnant women in our present study also contradict with the study conducted by [12] who reported significant association of the parasite the blood group of the pregnant women. Insignificant association of the blood group and the prevalence of the parasite suggest that blood group is may not be a determinant of the prevalence of malaria parasite and this finding is not in agreement with the previous literatures that linked antigen A, B and O on the surfaces of red blood cells of blood groups that facilitate the resetting of parasitized erythrocytes and cytoadherence which further contributes to the pathogenesis of severe malaria by obstructing microvascular blood flow [16, 17].

The prevalence of *Plasmodium* parasite in our present was low and the prevalence was not significantly associated with the socio-demographic factors, genotype and blood groups of the pregnant women in the study area.

4. Conclusion

This study reveals a 10.9% prevalence of *Plasmodium* parasite among pregnant women in Nasarawa South Senatorial District, Nigeria.  Key risk factors included younger age (17–24 years), primary education level, and non-use of preventive measures (ITNs/prophylactics), while trimester-specific vulnerability was highest in first-trimester pregnancies. Strikingly, location (urban/rural) showed no significant association with infection rates, likely due to malaria’s endemicity across sub-Saharan Africa. Hematological parameters (blood group/genotype) also demonstrated no epidemiological significance, contradicting some existing literature on blood group–malaria linkages.

Consent

All authors declare that ‘written informed consent was obtained from the patient (or other approved parties) for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editorial office/Chief Editor/Editorial Board members of this journal.

Ethical approval

Appropriate ethical committee approval was obtained prior to start of the research and is available for review.

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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