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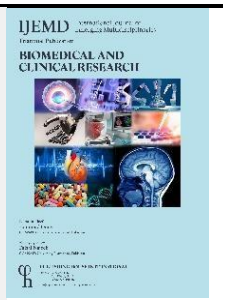

Risk Factors Behind Malaria Prevalence in Pregnant Women: Insights from Sabon-Gari, Zaria, Nigeria

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Abstract:

Malaria remains a pervasive threat to pregnant women, significantly impacting maternal and fetal health. This study explores the socio-demographic and clinical factors associated with the prevalence of Plasmodium falciparum malaria among pregnant women in Sabon-Gari, Zaria, Kaduna State, Nigeria. We collected 200 blood samples from women attending antenatal care clinics using a purposive sampling approach, analyzing these samples through microscopic blood film examination. A structured questionnaire facilitated the collection of crucial socio-demographic and anthropometric data, which was evaluated with Epi Info software.The results indicated a notable malaria prevalence of 31.0% (95% CI: 0.60–1.99). The analysis highlighted several key risk factors: increasing maternal age (Adjusted Odds Ratio (AOR) 95% CI: 1.25 - 4.37), low levels of education (AOR 95% CI: 3.48 – 16.51), multiple pregnancies (AOR 95% CI: 1.28–4.79), residence in rural areas (AOR 95% CI: 1.28–4.48), and being in the first trimester of pregnancy (AOR 95% CI: 1.96–9.09). P. falciparum was the only malaria species detected, emphasizing the critical need for informed public health strategies tailored to address these vulnerabilities.

This research underscores the urgent requirement for targeted interventions to reduce malaria infection rates among pregnant women, particularly in high-risk groups identified by our findings in Sabon-Gari, Zaria.

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Key words: Malaria, risk factors, Plasmodium falciparum, pregnant women, public health.

INTRODUCTION

Malaria is caused by intracellular parasites of the genus Plasmodium and transmitted by female Anopheles mosquitoes. In Nigeria *P. falciparum* is the most prevalent and virulent specie, accounting for about 95 % of malaria cases. In 2022, the global malaria cases are estimated to be about 249 million cases with 608,000 deaths in 85 countries, African region accounts for the largest with 94% (233 million) cases and 95% (580,000) deaths [18]. Nigeria is reported to carry 25% of the malaria burden in Africa [19], [18].

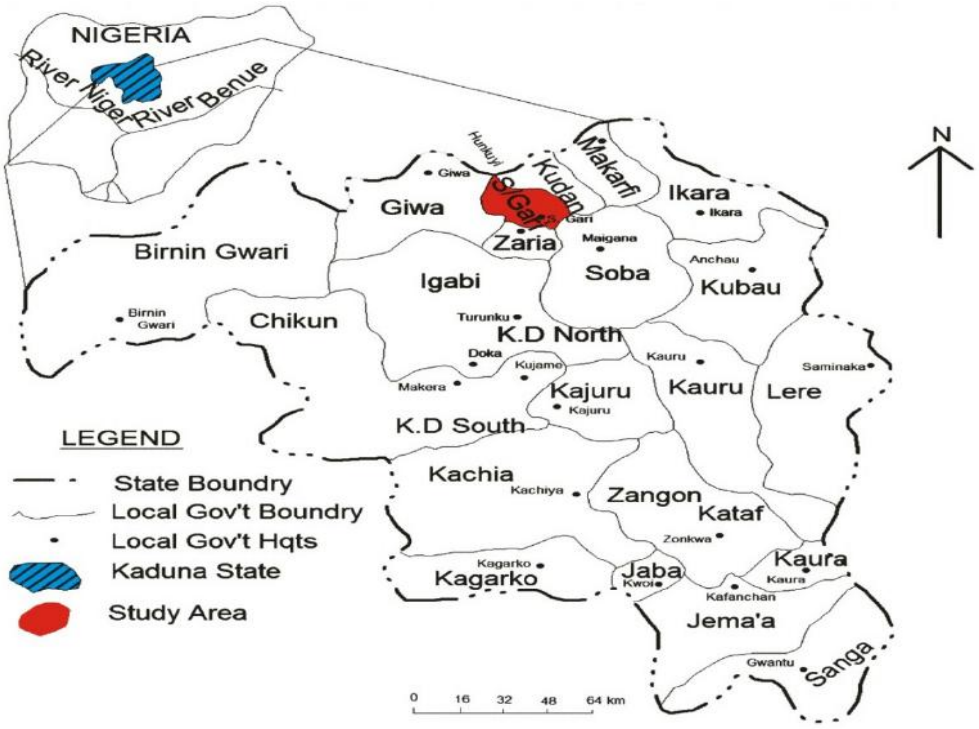
Malaria is diagnosed via microscopy, rapid diagnostic tests and molecular techniques. Microscopic technique using blood is still the widely used method in most health centers across the globe [10], [20]. The infection during pregnancy poses a high risk to the mother, fetus, and infants due to lowered immunity and sequestration of infected red blood cells in the placenta. It can result in stillbirths, spontaneous abortion, premature delivery, maternal anemia and low birth weight [9], [5].

This study has assessed the prevalence and associated factors of malaria in pregnant women in two medical centers in North-Western Nigeria, thereby providing comprehensive data planning and policy formulation.

MATERIALS AND METHODS

Study Design

A descriptive cross-sectional study was conducted at two health facilities (Almadina Hospital GRA, Zaria and ABU medical center, main campus, Zaria) in Kaduna State, Northwestern Nigeria from September to December 2023. The health centers were chosen based on convenience and the study was carried out among 200 pregnant women attending the hospitals for anatenal care ANC. The women were selected randomly without prior information on their clinical and family history. The health facilities are located in Sabon-Gari Local Government in Zaria town of Kaduna state. It is located at Latitude: 11° 06' 60.00" N and Longitude: 7° 43' 59.99" E, its average temperature is 32 ^{o}C [15]. Women that participated in the research were enrolled at any of the four (4) ANC visits using a purposive sampling technique. At the same visit, samples of blood and biodata were collected and analyzed to generate data [12].



Legend Showing the Study Area Coordinates

Ethical Approval:

Ethical approval was obtained from the Ahmadu Bello University Teaching Hospital in Shika, Zaria. Oral consent was obtained from the pregnant women attending ANC at the two selected health centres.

Socio-demographic and Anthropometric Data Collection:

A structured questionnaire was used to collect data from the participants regarding their age, level of education, gravity, gestational age, place of residence, and anthropometric measurements.

Laboratory Investigations:

A 5 ml blood sample was collected from each participant in EDTA containers for thin and thick microscopic examination as described by [3].

Blood Films:

Thick and thin blood films were prepared and air-dried. Methanol was used to fix the thin films. A 10% Giemsa solution was used to stain the films, and the stain was allowed to stay for 20 minutes, then washed with clean water, and left to air-dry. The films were viewed under 100x magnification lenses under oil immersion to identify malaria parasites(mp) based on their physical features and the appearance of the red blood cells they infect [8].

Data Analysis:

Statistical analysis was performed using the Epi info software to determine the significant odds of infection by age, educational level, gravity, gestational age, residency, and anthropometric measurements.

RESULTS

Among the 200 pregnant individuals involved in the research, 62 (31%, 95% CI: 0.60 - 1.99) were found to be infected with malaria parasites, all of whom were infected with Plasmodium falciparum (Table 1). An analysis of the samples tested for malaria parasites in pregnant women by age group indicated that the age bracket of 36-45 years (56.9%) exhibited the highest prevalence. The likelihood of infection was statistically significant (95% C.I: 1.25 – 4.37) (Table 2). The outcomes indicated that pregnant women residing in rural areas had a higher incidence of malaria cases (33/23.4%) in comparison to those in urban areas, with statistically significant variances at (95% C.I. 1.28 – 4.48) (Table 3).

The prevalence among participants based on their educational background revealed that individuals with no formal education (68.4%, C.I. 3.48 – 16.51) and those who completed primary school only (57.1%, 95% C.I. 3.26 – 8.30) demonstrated a higher prevalence for malaria parasites, with statistically significant odds of infections compared to individuals with higher educational attainment (Table 4). The findings across different gestational trimesters highlighted that pregnant women in the initial and second trimesters exhibited a higher prevalence of malaria parasites 20/34 (58.8%) and 86/30 (34.9%) respectively, with statistically significant odds of infection. Conversely, during the third trimester, the results indicated 80/12 (15.0%) positive cases for malaria, with statistically insignificant odds of infections (Table 5).

Moreover, the results suggested a relationship between the number of pregnancies and malaria infection. Positive cases were observed among primigravidity 20/64 (31.25%), second gravidity 18/84 (21.43%), and multigravidity 24/52 (46.2%), respectively, with statistically significant odds of infections among primigravidity (95% C.I. 1.28 – 4.79) (Table 6). The findings regarding the prevalence of *P. falciparum* infection based on anthropometric measurements of the participants indicated no significant differences in malaria prevalence across weight (95% C.I. 0.70 – 1.46), height (95% C.I. 0.69 – 1.44), and BMI (95% C.I. 0.71 – 1.41) categories, respectively.

Table 1: Overall prevalence of malaria among pregnant women in the study population.

Total No.	No. of positive (P falciparum)	No. of Negative	Percentage (%)	95% confidence interval Lower	Upper
200	62	138	31%	0.60	1.99

Table 2: Prevalence of malaria among pregnant women by age group.

Age group (years)	Number Examined	No. of positive	Percentage (%)	95% confidence interval Lower	Upper

15 -25	87	27	35.5	0.55	1.00
26 -35	49	17	26.8	0.63	1.25
36 -45	64	28	56.9	1.25	4.37
Total	200	62	31.0	0.98	2.03

Table 3: Prevalence of malaria among pregnant women by educational level.

Educational level	**Number Examined**	**No. of Positive**	**Percentage (%)**	**95% confidence interval**	
				Lower	**Upper**
No education	38	26	68.4	3.48	16.51
Primary	28	16	57.1	3.26	8.30
Secondary	44	10	22.7	0.26	1.28
Tertiary	90	10	11.1	0.04	0.20
Total	200	62	31.0	0.67	0.95

Table 4: Prevalence of malaria among pregnant women by gravity.

Gravity	**Number Examined**	**No. of Positive**	**Percentage (%)**	**95% confidence interval**	
				Lower	**Upper**
Primig	64	20	31.25	0.53	1.93
Second	84	18	21.43	0.23	0.84
Multi	52	24	46.2	1.28	4.79
Total	200	62	31.0	0.69	1.44

Table 5: Prevalence of malaria among pregnant women by gestational age.

Gestational age	**Number examined**	**No. of Positive**	**Percentage (%)**	**95% confidence interval**	
				Lower	**Upper**
1st trimester	34	20	58.8	1.96	9.09
2nd trimester	86	30	34.9	1.92	6.82
3rd trimester	80	12	15.0	0.17	0.72
Total	200	62	31.0	1.11	2.31

Table 6: Prevalence of malaria among pregnant women by residency.

Residence	**Number examined**	**No. of Positive**	**Percentage (%)**	**95% confidence interval**	
				Lower	**Upper**
Rural	66	29	43.9	1.28	4.48
Urban	134	33	24.6	0.22	0.79
Total	200	62	31.0	0.65	1.53

Table 7: Result for height of pregnant women.

Height (cm)	Number examined	No. of positive	Percentage	95% confidence interval Lower	Upper
≤1.50	44	14	31.8	0.51	2.16
1.51 – 1.60	92	28	30.4	0.52	1.73
≥1.61	64	20	31.2	0.54	1.93
Total	**200**	**62**	**31.0**	**0.69**	**1.44**

Table 8: Result for weight of pregnant women

Weight(kg)	Number examined	No. of positive	Percentage	95% confidence interval Lower	Upper
≤60	54	21	38.9	0.85	3.13
61 - 75	68	26	38.2	0.89	3.03
≥76	78	15	19.2	0.20	0.77
Total	**200**	**62**	**31.0**	**0.70**	**1.46**

Table 9: Result for the body mass index (BMI) of pregnant women

Maternal features BMI (kg/m2)	Number examined	No. of positive	Percentage	95% confidence interval Lower	Upper
Underweight	50	15	30.0	0.47	1.88
Overweight	36	12	33.3	0.52	2.46
Adequate	100	31	31.0	0.55	1.82
Obase	14	04	28.6	0.27	2.93
Total	**200**	**62**	**31.0**	**0.71**	**1.41**
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Total	**200**	**62**	**31.0**	**0.71**	**1.41**

DISCUSSION

The prevalence of malaria during pregnancy in tropical and subtropical countries is a public health issue. This study was conducted in two hospitals in Zaria, Nigeria and found that 31% of the 200 samples collected from pregnant women showed malaria infection. A similar study in Nigeria also indicated high susceptibility and severe complications due to malaria during pregnancy, contributing to maternal anaemia, miscarriages, stillbirths, and low birth weight [2].These findings align with global patterns reported by the [18], emphasizing the need for effective prevention and control measures in malaria-endemic regions.

The study revealed that there is a difference in the prevalence of malaria among different age groups. The age group 36 – 45 years was found to have the highest prevalence of malaria at 56.9%. There was a significant association between the prevalence of malaria and the age group of pregnant women, this finding aligns with a study conducted by [7] in eastern Sudan. However, the specific reasons behind this association are still unknown.

The data from various studies supports our observation that pregnant women residing in rural areas have a higher prevalence of malaria compared to those in urban areas. A study in Cameroon found that malaria prevalence was significantly higher in rural settings (57.6%) compared to urban areas (46.8%) [13]. Similarly, research in Nigeria highlighted the vulnerability of urban populations to malaria, emphasizing the need to improve preventive measures, such as Intermittent Preventive Treatment during pregnancy, particularly in low-income regions [1]. These findings collectively underscore the persistent challenge of malaria in rural areas and the importance of tailored interventions to address this disparity.

The findings of this research and data from various researchers indicate a high prevalence of malaria among primigravidae, with rates ranging from 36% to 61.1% [1], [17]. This vulnerability might be attributed to their lack of immunity to pregnancy-specific variants of Plasmodium falciparum. Furthermore, educational status plays a significant role in malaria prevalence, with those without formal education having the highest rates of infection, followed by individuals with primary education. The statistically significant odds of infection among those with lower educational attainment suggest a potential lack of knowledge regarding preventive measures against malaria, highlighting the importance of targeted health education interventions to improve awareness and reduce the burden of malaria among the study population. Furthermore, pregnant women in their first and second trimesters have been found to have the highest prevalence of malaria respectively. This finding is likely due to delayed treatment of pregnant women with intermittent preventive treatment (IPTp) of malaria during pregnancy with sulfadoxine-pyrimethamine (SP), as recommended by [18].

The study's findings on anthropometric measurements among pregnant women and the prevalence of *P. falciparum* infection showed no statistically significant association between weight, height, and body mass index (BMI kg/m^2). This suggests that these anthropometric measurements may not be directly

associated with the risk of parasitic infection during pregnancy. Other factors beyond basic anthropometric indices may play a more significant role in determining susceptibility to *P. falciparum* infection among pregnant women

CONCLUSION

The research identified key social-demographic factors influencing P. falciparum infection, including age groups, trimester of pregnancy, educational level, parity, and residency. These findings suggest that particular attention should be given to pregnant women who are vulnerable to these factors, as they may be at higher risk for infection.

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Conflict of interest
The authors have no conflicts of interest to declare relevant to this article's content.

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