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Malaria Prevalence and its Associated Factors Among Pregnant Women Attending Antenatal Clinic at General Hospital Dutse, Jigawa State, Nigeria

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Abstract

Research into the frequency of malaria among pregnant women is still insufficient due to multiple challenges. Despite these difficulties, this study aimed to evaluate the prevalence of malaria and its associated factors among pregnant women visiting antenatal clinics at Dutse General Hospital in

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Jigawa State. This study adopted a quasi-experimental design involving 50 pregnant participants who provided consent. A questionnaire was administered, blood samples were collected, and laboratory analysis was performed following established and standard protocols. The data collected underwent analysis utilizing the Statistical Package for the Social Sciences (SPSS) version 20, employing ANOVA with a significance level set at P<0.05. The study revealed a malaria prevalence of up to 22%. The age groups of 18-24 and 25-34 exhibited no significant difference (P >0.05) in malaria prevalence, both showing the highest rates at 36.36%. Conversely, the 35-45 age group displayed the lowest prevalence at 27.27%. Factors such as pregnancy stage, participant age, and socio-economic status were found to influence malaria prevalence in the study area. Owing to the results obtained in this study, it can be concluded that malaria infection among pregnant women in Dutse was relatively low. The study recommends that healthcare providers should provide comprehensive health education on malaria prevention during antenatal clinics.

Keywords: *Anopheles gambiae*, *Plasmodium falciparum*, Blood sample, Trimester, Dutse.

INTRODUCTION

Malaria remains a significant global health issue, representing one of the most widespread parasitic infections worldwide according to the World Health Organization (WHO, 2023). According to the WHO report, malaria is endemic in 87 countries in the world (WHO, 2020). Of these deaths, 76 percent were among children under the age of 5. This equates to a daily toll of over one thousand young children. Therefore, malaria constitutes an urgent priority for public health (UNICEF, 2022).

Sub-Saharan Africa typically bears the heaviest burden of malaria yearly, with no less than 94 percent of all reported cases in 2022 occurring in this region, totaling 233 million cases (WHO, 2023). Furthermore, Sub-Saharan Africa accounted for 95 percent of malaria-related deaths in the same period, amounting to 580,000 fatalities (WHO, 2022). Notably, four African countries collectively contributed to more than half of the global malaria-related deaths. Nigeria led this tally with 26.8 percent, followed by the Democratic Republic of the Congo (12.3 percent), Uganda (5.1 percent), and Mozambique (4.2 percent) (WHO, 2022).

Malaria, a disease caused by intracellular parasites belonging to five species within the *Plasmodium* genus—namely, *Plasmodium falciparum*, *P. vivax, P. ovale, P. malariae*, and *P. knowlesi* (Oddoux *et al.,* 2011; Almaw *et al*., 2022) is transmitted to humans through the bite of female *Anopheles* mosquitoes. These mosquitoes require blood for survival and egg production (CDC, 2020). During a blood meal, an infected female *Anopheles* mosquito introduces the infective sporozoites of the *Plasmodium* parasite from its salivary gland into the human bloodstream (White, 2018). Once inoculated, these parasites circulate within the bloodstream, with some reaching the liver for initial development (Antia *et al*., 2007). Subsequently, they infect and reproduce within red blood cells, leading to the characteristic signs and symptoms of malaria (Crutcher and Hoffman, 1996; Antia *et al*., 2007; White, 2018; Venugopal *et al.,* 2020)). Clinical manifestations typically include fever, joint pain, chills, headache, and vomiting, often emerging 10 to 15 days following the bite of an infected *Anopheles* mosquito (Almaw *et al.* 2022). Moreover, malaria can also be transmitted through blood transfusion and congenitally (Lagerberg, 2008; Almaw *et al*., 2022).

In Nigeria, *Plasmodium falciparum* is predominant among malaria parasites, although *P. vivax, P. ovale,* and *P. malariae* are also present (Herman *et al*., 2023). Furthermore, *Anopheles gambiae s.s* and its closely related counterpart, *An. colluzi*, are acknowledged as the primary malaria

vectors in the country (Adeogun *et al*., 2023; Adesoye *et al*., 2024). Malaria diagnosis in Nigeria relies heavily on histidine-rich protein 2 (HRP2) rapid diagnostic tests (RDTs), which specifically target *P. falciparum*. These tests constituted 86.3% of all diagnostic examinations administered to individuals with suspected malaria infections in 2020 (WHO, 2021; The DHS Program, 2022).

Malaria affects individuals of diverse genders, ages, and socio-economic statuses (Falade *et al*., 2007; Workineh *et al*., 2021). Nonetheless, the investigation into the prevalence of malaria among pregnant women remains inadequate due to various obstacles (Workineh *et al*., 2021). These challenges include insufficient understanding of malaria's prevalence, associated factors, and their significance during pregnancy compared to other health issues (Falade *et al*., 2007; Workineh *et al*., 2021). Consequently, this study was conducted to assess malaria prevalence and its related factors among over 50% pregnant women attending antenatal clinics at the General Hospital in Dutse, Jigawa State.

MATERIALS AND METHODS

Study Area

The study was conducted at General Hospital Dutse, situated in Dutse, Jigawa State, Nigeria. Dutse lies within the Northwest geopolitical region of the country, positioned between longitudes 11.00^0N to 13.00^0N and latitudes 8.00^0E to 10.15^0E. Its population was estimated at 153,000 individuals, making it the most populous town in Jigawa State, followed by Hadejia (111,000), Gumel (43,000), and Birnin Kudu (27,000) (NBS, 2006). Located in the Sahelian Savannah region, Dutse boasts a unique geographical setting.

Study Population

Fifty pregnant women were recruited and they offered their participation in the exercise as it was reported that an average of 60 pregnant women visit the same clinic every month (Ocheje and Dogara, 2016). Samples were taken every day from 8 a.m. to 4 p.m. and examined in the hospital's parasitology laboratory. Sampling was purposeful since it was carried out according to the people's availability at a specific time.

Study Design and Sampling

The study design was cross sectional in nature. The subjects included pregnant women of all ages reporting to the hospital. They were directed to the hospital laboratory for blood screening for malaria parasites. The study novelty is in the specific samples size of 50 pregnant women which is more than 50% of the average monthly pregnant women attendee of the clinic.

Inclusion Criteria

Any participant of this study must be a medically confirmed pregnant woman attending antenatal clinic at the general hospital Dutse, Jigawa State, Nigeria. Fifty pregnant women was included in the study. They all consented and they were duly informed of the significance of the study. The study was carried out between August and December, 2023.

Ethical Clearance

Ethical approval was sought and obtained from Jigawa State ministry of Health research ethics committee.

Questionnaires Administration
Each pregnant women's infection status, demographic information, socioeconomic status, and other malaria-related risk factors were recorded using questionnaires. To attain a 100% return rate, these questionnaires distributed through in-person interviews were quickly gathered and returned. Included in the questionnaires are enquiries on educational status, pregnancy stage, and environmental conditions (Ocheje and Dogara, 2016).

Collection of Blood Sample
The patient's upper arm was taped off with a soft tubing tourniquet so that the index finger could feel a suitable vein. The puncture site was then cleaned with methylated spirit (methanol) and venepuncture was performed using a 21 g needle attached to a 5 ml syringe. This procedure was used to collect blood samples in accordance with WHO (2010) guidelines.

Laboratory Analysis
The collected blood samples were analyzed within 3-6 hours of collection. Thin blood films were prepared according to the technique outlined by Ocheje and Dogara (2016) after which microscopy was done. The analyses include the following procedures:
a. **Thin blood film preparation:** A drop of each blood sample was placed in the center of a grease-free clean glassslide and labeled accordingly. The thin films were fixed with methanol and all films were stained with Leishmanstain as recommended by WHO (2012).

b. **Leishman staining technique:** 7-8 drops of the stain were added on the slide and it was left to stand for 1-2minutes. Then, 12-15 drops of buffered water were added, it was mixed thoroughly and left to stand for 4-8 minutes. The stain was washed off with clean water. The slide was allowed to dry and was examined microscopically.

c. **Microscopy:** The stained films were examined under a microscope using X100 objective. The examination was made using standard keys of Edington and Gills (1976).

Data Analysis
Data are presented as percentages and Mean ± Standard error of mean (SEM) and then presented in Tables. Data was subjected to analysis of variance (ANOVA) and significant means were separated via and Duncan multiple range test (DMRT) at $P<0.05$ significant level using Statistical packages for Social Sciences (SSPS) 20th version.

RESULTS
In Table 1, it is evident that both the 18-24 and 25-34 age groups exhibited insignificantly different ($P > 0.05$) malaria prevalence and the highest rates of malaria prevalence at 36.36%. Conversely, the 35-45 age bracket displayed the lowest prevalence at 27.27%. Up to 22% of the participants othis study were positive for malaria

Table 1. Prevalence of malaria in relation to age

Age	No examined	No positive	X^2	p- value
18-24	15(30.00)	4(36.36)		
25-34	20(40.00)	4(36.36)		
35-45	15(30.00)	3(27.27)	0.272	0.873
TOTAL	50(100.00)	11(22.00)		

Table 2 displays the prevalence of malaria and relative intensity concerning trimesters. It's noteworthy that women in the third trimester displayed the highest prevalence rate at 54.54%, followed closely (with no significant difference, P > 0.050) by those in the first trimester at 27.27%. Conversely, women in the second trimester exhibited the lowest malaria prevalence rate at 18.18%.

Table 2. Prevalence of malaria in relation to trimester

Trimester Level	No Examined	No Positive	X^2	P-Value
First Level	20(40.00)	3(27.27)		
Second Level	10(20.00)	2(18.18)		
Third Level	20(40.00)	6(54.54)	1.340	0.512
Total	50(100.00)	11(22.00)		

Table 3 presents the prevalence of malaria categorized by marital status. Married women exhibited the highest rate at 90.90%, followed by single women at 9.0%. Conversely, divorced and widowed women showed 0.00%. prevalence rate.

Table 3. Prevalence of malarial in relation to marital status

Marital Status	No Examined	No Positive	X^2	P-Value
Single	4(8.00)	1(9.09)		
Married	42(84.00)	10(90.90)		
Divorced	3(6.00)	0(0.00)		
Widow	1(2.00)	0(0.00)	1.229	0.746
Total	50(100.00)	11(22.00)		

Table 4 illustrates the prevalence of malaria according to educational attainment. Participants with a secondary level of education displayed the highest malaria prevalence at 63.63%, followed by those with tertiary education at 27.27%. Conversely, individuals with primary school education exhibited a prevalence rate of 0.00%.

Table 4. Prevalence of malaria in relation to educational status

Educational status	No examined	No Positive	X^2	P-Value
Primary	1(2.00)	0(0.00)		
Secondary	19(38.00)	7(63.63)		
Tertiary	17(34.00)	3(27.27)		
No formal education	13(26.00)	1(9.09)	4.460	0.216
Total	50(100.00)	11(22.00)		

Table 5 depicts the prevalence of malaria in relation to environmental and anthropogenic factors. Among respondents with good water drainage, a prevalence of 18.18% was recorded. Those with an open system of drainage had a prevalence of 90.00%, while those with a closed system had 9.09%. Regarding water storage methods, respondents using drums had the highest prevalence at 54.54%, followed by those using water tanks at 36.36%, and those using buckets at 18.18%. Respondents living without bushes around them had a prevalence of 81.81%, while those living with bushes had 18.18%. Furthermore, respondents engaged in farming had the highest prevalence at 63.63%, whereas those not involved in farming had a prevalence of 36.36%.

Table 5. Prevalence of malaria in relation to environmental and anthropogenic factors

ENVIRONMENTAL AND ANTHROPOGENIC	Response	No examine	No positive	X^2	P-Value	OR
EAF1	Yes	22(44.00)	2(18.18)			
	No	28(56.00)	9(81.81)	3.815	0.051	0.211
	Total	50(100.00)	11(22.00)			
EAF2	Open system	32(64.00)	10(90.00)			
	Close system	15(30.00)	1(9.09)	3.443	0.064	6.364
	Total	47(94.00)	11(22.00)			
EAF3	No (Farm)	20(40.00)	4(36.36)			
	Yes (farm)	30(60.00)	7(63.63)	0.078	0.078	0.821
	Total	50(100.00)	11(22.00)			
EAF4	Reservoir	6(12.00)	0(0.00)			
	Drum	19(38.00)	6(54.54)			
	Water tank	23(46.00)	4(36.36)	3.907	0.272	
	Bucket	1(2.00)	2(18.18)			
	Total	50(100.00)	11(22.00)			
EAF5	No bushes	15(30.00)	2(18.18)			
	Yes bushes	35(70.00)	9(81.81)	0.938	0.333	0.444
	Total	50(100.00)	11(22.00)			
EAF6	Yes ITNs	9(18.00)	3(27.27)			
	No ITNs	41(82.00)	8(72.72)	0.822	0.365	2.063
	Total	50(100.00)	11(22.00)			
EAF7	Yes	29(58.00)	7(63.63)			
	No	21(42.00)	4(36.36)	0.184	0.668	1.352
	Total	50(100.00)	11(22.00)			
EAF8	Yes HRW	5(10.00)	0(0.00)			
	No HRW	45(90.00)	11(100.00)	1.567	0.211	
	Total	50(100.00)	11(22.00)			

EAF: Environmental and Anthropogenic Factor; **ITNs:** Insecticide treated nets; **BRW:** House habited with roof and window

Table 6 provides a summary of malaria prevalence concerning hematological parameters. Platelet count (PLT) exhibited the highest prevalence at 400.43%, followed by mean corpuscular volume (MCV) at 151.45%, and neutrophils (NEUT) at 95.74%. Additionally, lymphocytes (LYM) showed a prevalence of 77.09%, while hematocrit (HCT) had 69.17%. Furthermore, mean corpuscular hemoglobin concentration (MCHC) had a prevalence of 66.39%, followed by mean corpuscular hemoglobin (MCH) at 49.98%. Mixed cells (MXD) displayed a prevalence of 28.44%, while hemoglobin (HGB) had 23.55%. White blood cells (WBC) exhibited a prevalence of 12.49%, with red blood cells (RBC) showing the lowest at 9.3%.

Table 6. Prevalence of malaria in relation to haematological parameters

Haematological analysis	Positive	Negative	Total
White Blood Cell (WBC)	6.27 ± 0.67	6.22 ±0.25c	12.49
Red Blood Cell (RBC)	4.83 ± 0.19	4.47±0.14c	9.3
Platelets (PLT)	213.55 ± 16.95	186.88±15.00a	400.43
Haemoglobin (HGB)	12.89 ± 073	10.66± 0.43c	23.55
Hematocrit Test (HCT)	36.55 ±1.25	32.62± 1.02b	69.17
Mean Corpuscular Volume (MCV)	76.75± 1.29	74.70 ±0.84a	151.45
Mean Corpuscular Haemolobin (MCH)	26.01 ± 0.55	23.97± 0.53c	49.98
Mean Corpuscular Haemolobin Concentration (MCHC)	34.30± 1.17	32.09± 0.51b	66.39
Lymphocytes (LYM)	36.91± 2.23	40.18 ±1.92b	77.09
Mixed of Monocytes Basophils and Eosinophils (MXD)	15.18± 1.41	13.26± 0.69c	28.44
Neutrophils (NEUT)	47.64± 3.10	48.10± 2.39b	95.74

Values with the same superscript on the same column are not significantly different at P >0.05

DISCUSSION

Results of this study revealed that malaria is prevalent in the Dutse area of Jigawa State. Prevalence of malaria in Dutse under present study was recorded as 22%. This result suggests that malaria has remained a major public health problem in the area. However, the malaria prevalence rate reported in this study differs from the 51% prevalence reported by Ocheje and Dogara (2016) in the same location.. This could be attributed to the use of insecticide treated nets (ITNs) campagna being sponsored by the federal government of Nigeria to minimize human exposure to mosquito vectors within the last decade (Onyeneho, 2013; Solanke *et al.,* 2023). Therefore, Malaria remains a public-health concern in Dutse according to the present study and in Nigeria as whole (WHO, 2010). This is in agreement with the assertions of Nwele *et al.* (2022) that malaria is endemic and stable in Nigeria.

The elevated occurrence of malaria within the 18-24 age bracket in the current investigation might have originated from the heightened exposure of individuals in this age range to malaria. This increased exposure could result from various factors, including engagement in outdoor activities, travel to locations where malaria is endemic, occupational circumstances, and exposure related to socioeconomic disadvantage. Tairou *et al.* (2020) and Awosolu *et al.* (2020) elaborate on these contributing factors mentioned.

In the current study, a greater incidence of malaria was noted among participants in their first trimester of pregnancy. This phenomenon could be linked to immune suppression during pregnancy, along with environmental aspects such as residing in areas with increased mosquito density or limited availability of preventive measures like mosquito nets or insecticides (Kawuki *et al.,* 2023). Moreover, delayed diagnosis and treatment, stemming from the potential overlap of pregnancy-related symptoms and malaria symptoms, may contribute to the heightened prevalence (Tamir *et al.,* 2023). Additionally, poor nutritional status has also been associated with an increased likelihood of malaria occurrence during the first trimester of pregnancy (Jugha *et al.,* 2023).

The present study revealed a heightened prevalence of malaria in regions marked by the presence of bushes and agricultural activities. This correlation is undoubtedly tied to substandard sanitation practices, fostering environments conducive to the breeding of malaria vectors (Adesoye *et al.*, 2023; Adesoye *et al.*, 2024).

CONCLUSION

In Dutse, the occurrence of malaria infection among pregnant women was comparatively low. However, factors such as the respondents' age, usage of insecticide-treated nets (ITNs), socio-demographic aspects, trimester period, and education on sanitation and malaria prevention methods were significantly associated with malaria infection. It is imperative for healthcare providers to offer comprehensive health education on malaria prevention during antenatal clinics, particularly targeting pregnant women with identified risk factors. Moreover, employing more sensitive diagnostic techniques like PCR and blood film microscopy in future research is recommended to ensure early detection of malaria infections.

Conflict of interest

The authors declare that there is no conflict of interest

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