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ORIGINAL RESEARCH ARTICLE

Malaria Prevalence and Associated Risk Factors among Pregnant Women Attending Wadata and Lafia North Primary Health Care Centers Lafia, Nasarawa State, Nigeria

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ABSTRACT

Plasmodium infection in pregnant women poses significant public health challenges, potentially leading to adverse outcomes for both mothers and their babies. This study investigated the prevalence of malaria and associated risk factors among 144 pregnant women attending a prenatal clinic at Wadata and Lafia North Primary Health Care Centers in Lafia, Nasarawa state, Nigeria. Using thick and thin blood smears and structured questionnaires, we found that 15.79% of the women were infected with *Plasmodium*. Even though Wadata Primary Health Centre recorded a higher prevalence (15.87%) than Lafia North (15.69%), no difference was observed (χ^2= 0.0012658, df = 1, P = 0.9716). *Plasmodium* infection prevalence was highest (27.27%) in the age range 31–35 and lowest in the age ranges15-20 (7.14%), while age above 36 years recorded negative infection. The highest prevalence (19.04%) was observed in women who acquired a tertiary education, then those who acquired a primary education (18.75%) or a secondary (17.64%) or those with no formal education (4.54%), and these differences in the prevalence with respect to the educational level varied significantly (χ^2= 9.8462, df = 3, P = 0.01992). A significant difference (χ^2= 27.516, df = 4, P = 1.563×10^{-5}) was observed in civil servants (25.00%) compared to traders (15.15%), other employees (14.28%), artisans (8.00%), as well as the farmers who were never infected at all. The prevalence of malaria among women who own a net was 17.1% in Lafia and 15% in Wadata. While those sleeping under it were 5 (18.2%) in Lafia North and 3 (8.82%) in Wadata. The prevalence among women who had prior knowledge of using a treated bed net as a malaria protective measure in Lafia North was 6(13.3%), while in Wadata, it was 6(14.7%).

ARTICLE HISTORY

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Malaria, Pregnant women, associated factors, Primary Health Centers

INTRODUCTION

Malaria is a deadly, life-threatening mosquito-borne illness that claims millions of lives annually (Aluko and Oluwatosin, 2012; Maikenti *et al.,* 2022). Malaria in pregnancy is a significant public health concern, particularly in Sub-Saharan Africa (Dwumfour *et al.,* 2023). The disease poses a substantial risk to both the mother and feotus, leading to adverse outcomes such as maternal anaemia, miscarriage, and low birth weight (Gontie *et al.,*2021; Maikenti *et al.,* 2022). Africa is more susceptible to malaria for a number of reasons, such as exposure to the most pathogenic strains of the parasite, insufficient funds to handle financial fallout, and dealing with a deficiency of infrastructure to properly handle incidences (Stonely, 2023). Despite numerous efforts and campaigns by the World Health Organization [WHO] and its affiliates to lower malaria infections globally, the illness remains the major cause of death. (Stonely, 2023). Recent studies have reported varying prevalence rates of malaria among pregnant women, ranging from 5.9% in southern Laos to 52.5% in Ondo State, Nigeria (Phommasone *et al.,* 2021; Akindele *et al.,* 2020). In Ghana, the prevalence of malaria among pregnant women has been reported to be

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14.1% in the northern region and 8.9% in a multicenter study conducted in middle and southern Ghana (Amponsa-Achiano et al., 2020; Kwarteng *et al.*, 2021). This study aims to investigate the prevalence and determinants of malaria infection among pregnant women attending antenatal care at the Ejisu Government Hospital in Ghana. Approximately between 300 to 500 million people are thought to contract malaria annually, with over 90 percent of cases accounted for in Africa (Suh *et al.,* 2004). Everyone, however, is in danger of developing the disease, especially the immunocompromised. *P. vivax, P. falciparum*, *P. malariae*, and *P. ovale* are the parasite species responsible for human malaria. The *P. falciparum* parasite is the deadliest, most frequent, and dreaded species (WHO, 2010). One way of reducing the infection by *Plasmodium* is to prevent human vector contact through the use of ITNs, implementation of rapid diagnostic testing (RDT), and drug therapy with Artemisinin Combined Therapy (ACT) (Jones, 2000; Maikenti *et al.,* 2022). In Sub-Saharan Africa, the treated bed net has demonstrated excellent efficacy in mitigating malarial morbidity and mortality rates. Window screens, house sprays, zoo prophylaxis, and most especially, the use of treated mosquito net can minimize the risk of malaria or its transmission potentials by 90% (Yamamoto *et al.* 2009). Moreover, using ITNs at night can reduce all maternal anaemia, the prevalence of malaria infection, and one-fifth of child fatalities from all causes. (D'Alessandro *et al.,* 1996; Gimnig, 2003; Ter Kuile *et al.,* 2003).

Africa, Asia, Oceania, Central and South America, and some Caribbean Islands are the primary Malaria endemic regions. Africa accounts for the majority of malaria cases. However [0p-=], treatment and preventive measures are becoming more widely available. (WHO, 2005) in Africa, It is estimated that thirty million women get pregnant each year, putting children at risk for malaria and causing 200,000 neonatal deaths annually from malaria (WHO, 2003). The 2nd International Conference on ITNs report indicates that 400,000 lives of children under five years may be saved annually if they sleep inside a treated bed net.

The biggest impediment to reducing mortality due to malaria is the high cost of nets and insecticides. (Guillet, 2001). There are significant regional and even intra-national differences in malaria's transmission and disease patterns. Variations between malaria parasites and mosquito vectors are the cause of this diversity. In addition to socioeconomic variables like quality healthcare and preventive services, ecological factors that impact parasite transmission should also be considered. In order to effectively prevent and cure malaria, intentional efforts must be made to target HIV-positive people as well as pregnant women, children under five, and. Malaria prevalence rates in Africa vary from 49% to 90% (WHO, 2005).

Malaria remains a significant public health concern among pregnant women in Nigeria, particularly in the Wadata and Lafia North Primary Health Care Centers in Nasarawa State. Despite efforts to combat the disease, there is a need to understand the prevalence and associated factors influencing malaria infection among this vulnerable population. This study aims to investigate the prevalence of malaria and its associated factors among pregnant women attending the aforementioned health centers, with the objectives of determining infection rates across different age groups, educational levels, and occupations, as well as assessing the impact of bed net usage on malaria prevention.

MATERIALS AND METHODS

Study Area

The study was carried out in the Lafia metropolis, Nasarawa State. It is located at latitude 8°29'30"N, longitude 8°31'00"E. The area has a characteristically humid climate and two distinct seasons. The rainy season lasts from May to October, whereas the dry season last between November to April. The average annual rainfall is between 1,100 mm to 2,000 mm. The average temperature is 20°C to 38°C, with a relative humidity of 30%.

Ethical Approval

Nasarawa State Hospital Management Board Lafia granted this study ethical approval (NHREC protocol No. 18/06/2017). Also, informed consent was obtained from all participants.

Questionnaire Administration

Before collecting the blood sample, a structured questionnaire was given to each participant. The questionnaire which the researcher developed was structured to collect. Information on demographic factors and the malaria-associated risk factor. The questionnaire includes questions that capture information on educational status, occupation, trimester, age, possession of ITNs, sleeping under treated bed nets, and knowledge about the net. A senior professor in the department validated the questionnaire.

Collection of Blood Sample

Five mL of Venous blood was collected from each of the 114 consenting participants using a sterile syringe and needle. The blood samples were then transferred into a

sterile ethylene-diamine-tetra-acetic acid (EDTA) container for laboratory processing (Maikenti *et al*., 2022)

Preparation of Thick Blood Film

Thick blood smears were prepared by placing a drop of the blood on a well-labeled, grease-free glass slide. A spreader was used to spread the blood. The smear was air dry and stained with Fields stain A for five secondss, rinse with water, then stain with fields stain B for three seconds, and air dry (Garcia and Isenberg, 2007).

Preparation of Thin Blood Film

A drop of blood was placed on a glass slide. With another slide inclined at an angle of 45^{o}, the blood was spread to make a thin smear and allowed to air dry. The dried slide was fixed in methanol and then stained with *Leishman* stain for five minutes (Mathison and Prit, 2017).

Identification of Malaria Parasite

Plasmodium parasites were identified under the microscope using 100x objective of the light microscopy with immersion oil.

Statistical Analysis

Data obtained was analyzed using R-console software (version 4.1.1). Comparison of malaria infection with respect to age, gender, and trimester was done using Pearson's chi-square test. The P –value was set at 0.05.

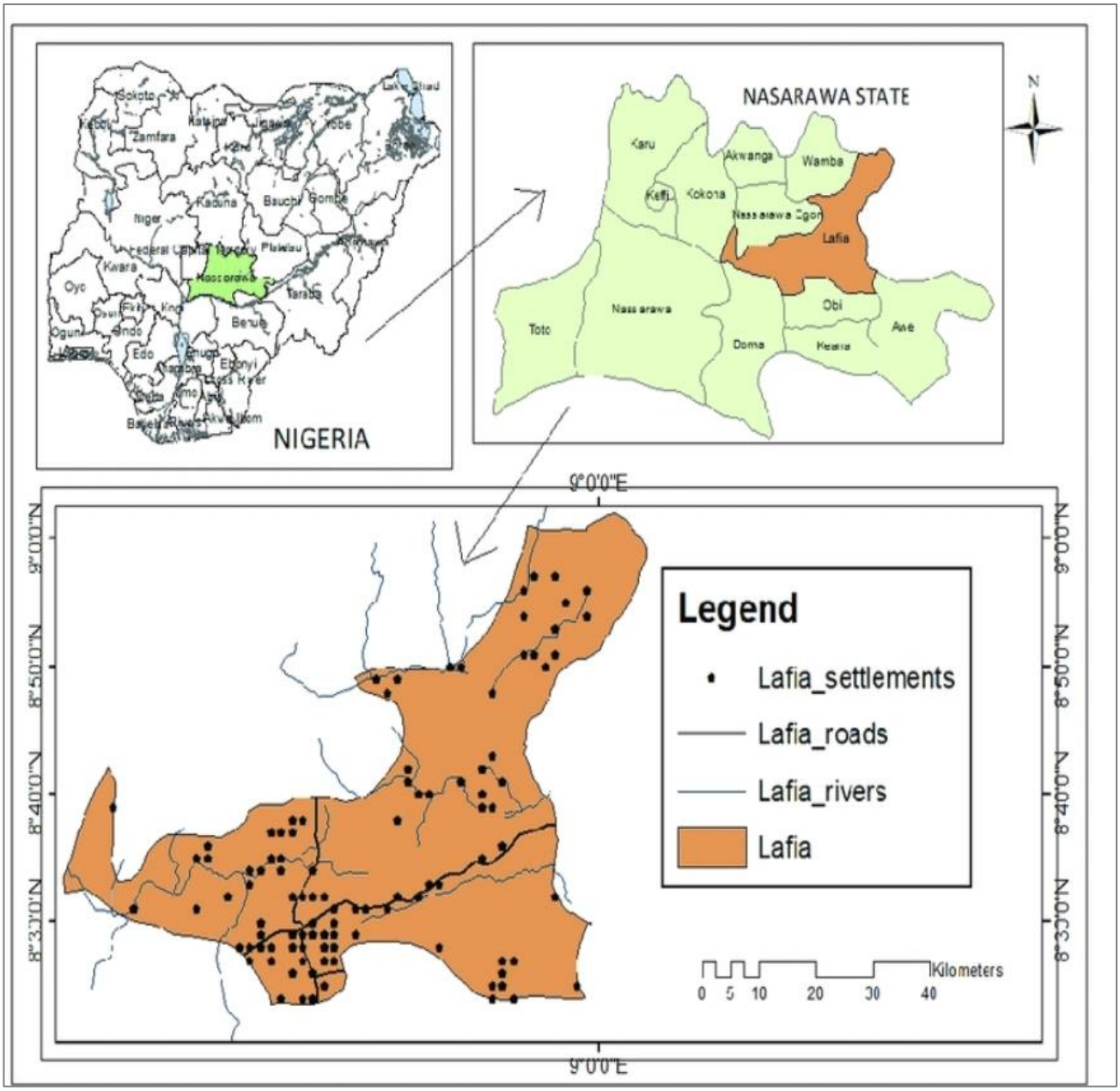

Figure 1: Map of Nasarawa State Showing the Study Area. (Source: Mineral of Lands and Survey, Lafia 2019).

RESULTS

Socio-demographic factors of the women

The 114 female participants were aged between 15 to 41 years, and a mean of 26.25 (Table 1). Women with higher education account for 36.84% of the total population, while those with only primary education account for the smallest proportion. Secondary education accounts for 29.82% of the total, while non-formal education accounts for 19.3%. Tradespeople account for 28.95% of participants, followed by civil servants (28.07), artisans (21.93), others (18.42%), and farmers (2.63%), who are the least represented group. 40 women are in their second trimester, accounting for 35.09% of participants, while 51 women are in their first trimester, accounting for 44.74%. The remaining 23 persons, or 20.18% of the population, were in their third trimester. Table 1 shows the participants' knowledge of insecticide-treated bed nets as a protective approach. Of the 114 participants polled, 79 (63.3%) are aware of insecticide-treated bed nets, while 35 (30.7%) are not. Only 81 (71.05%) women had ITNs, whereas 33 (28.95%) did not. Only 61(53.51) of individuals who own a net sleep under it.

Overall Malaria Prevalence in the Study Location

The infection rate among women visiting Wadata and Primary Health Center (PHC) Lafia North (Table 1) revealed that 18 (15.79%) of the 114 participants were infected with the malaria parasite. The prevalence of malaria infection in relation to two locations revealed a higher prevalence in Wadata clinic 10(15.87%) than in the PHC center Lafia North (15.79%). The difference in infection rate of malaria among pregnant women between the two locations showed no variation (Table 1) χ^2= **0.0012658, df = 1, P = 0.9716).**

Table 1: Socio-demographic characteristics of the of the participants

VARIABLE	FREQUENCY	PERCENTAGE
EDUCATION		
Nonformal	22	19.3
Primary	16	14.04
Secondary	34	29.82
Tertiary	42	36.84
OCCUPATION		
Artisan	25	21.93
Civil Servant	32	28.07
Farming	3	2.63
Trading	33	28.95
Others	21	18.42
TRIMESTER		
First	51	44.74
Second	40	35.09
Third	23	20.18
AGE GROUP		
15-20	28	24.56
21-25	21	18.42
26-30	34	29.82
31-35	22	19.3
36<	9	7.89
POSSESSION OF NET		
YES	81	71.05
NO	33	28.95
SLEEP UNDER NET		
YES	61	53.51
NO	53	46.49
KNOWLEDGE ABOUT NET		
YES	79	69.3
NO	35	30.7

Age-Related Malaria Prevalence in Pregnant Women Studied

The malaria infection rate in pregnant women in relation to age groups is presented in Table 3. The result reveals the highest 7 (38.89%) infection rate among the age range 26–30, followed by the age range 31–35 6 (27.27%) and 21–25 3 (14.29%). The lowest prevalence was observed among age groups aged 15-20 2(7.14), while the range from 36 and above recorded negative cases. Therefore, there was a difference in the infection with malaria parasites among participants in relation to their age groups **χ^2= 40.82, df = 4, P = 2.929x10^{-8}**.

Table 2: Overall Prevalence of Malaria in Both the Two Locations

Location	No. Examined	No. positive (%)
Wadata	63	10(15.87)
Lafia North	51	8(15.69)
Total	**114**	**18(15.79)**

χ^2= 0.0012658, df = 1, P = 0.9716) location wise prevalence of malaria

Table 3: Prevalence of Malaria in Relation to Age Groups in the Two Locations

	Wadata		Lafia North		
Age Group	**No. Examined**	**No. Positive (%)**	**No. Examined**	**No. Positive (%)**	**Total**
15-20	16	1(6.3)	12	1(8.3)	2(7.14)
21-25	11	2(18.2)	10	1(10.0)	3(14.29)
26-30	21	4(19.0)	13	3(23.1)	7(38.89)
31-35	12	3(25.0)	10	3(30.0)	6(27.27)
36<	3	0(0.0)	6	0(0.00)	0(0.00)
Total	**63**	**10(15.9)**	**51**	**8(17.7)**	**18(15.79)**

χ^2= 40.82, df = 4, P = 2.929x10^{-8} there was a very high significance variation in the infection with malaria parasite between age groups.

Table 4: Malaria Infection rate in Relation to Educational Qualification and Occupation

CHARACTERISTICS	NUMBER EXAMINED	NUMBER POSITIVE	PREVALENCE (%)
EDUCATION			
Non formal	22	1	4.55
Primary	16	3	18.75
Secondary	34	6	17.65
Tertiary	42	8	19.04
OCCUPATION			
Artisan	25	2	8
Civil Servant	32	8	25
Farming	3	0	0
Trading	33	5	15.15
Others	21	3	14.29

The malaria infection rate in relation to educational qualification was significantly different (χ^2= 9.8462, df = 3, P = 0.01992), likewise infection with respect to the occupation (χ^2= 27.516, df = 4, P = 1.563x10^{-5})

Infection with Malaria in Relation to Educational Qualification and Occupation

The malaria infection rate in relation to educational qualification reveals that those with tertiary education were the most infected 8(19.04%), followed by those having primary education (18.75%) and secondary level of education (17.65%). The lowest prevalence was recorded among subjects with no formal education (4.55%). Nevertheless, the differences in prevalence rate among the participants in relation to their educational qualifications varied (χ^2= 9.8462, df = 3, P = 0.01992) (Table 3).

Analysis of the infection rate among the women with the kind of job they do reveals a very high prevalence rate among civil servants (8.25%), followed by traders 5(15.15 %) and other occupations 3(15.29 %). The lowest prevalence was recorded among artisans 2(8.00 %), while farmers were observed to be uninfected with malaria parasites. (Table 3). Nevertheless, the infection rate in relation to the kind of job they do varied significantly (χ^2= 27.516, df = 4, P = 1.563x10^{-5}).

Malaria Infection Rate in Relation Trimester

Subjects in their second trimester were the most infected 7(17.5), followed by those in their first trimester 8(15.69). The least infection 3(13.4) was observed among women in their third trimester.

Malaria Infection Rate in association with possession of a net, use of the net, and knowledge about the net as a protective means against malaria

Figure 2 shows that women who own mosquito-treated bed nets had a 6(17.1%) prevalence in Lafia North Health Center and 6 (15%) in Wadata. The prevalence of malaria parasites among pregnant women sleeping under mosquito nets was 5 (18.2%) in Lafia North and 3 (8.82%) in Wadata PHC. The malaria infection rate among women who had prior knowledge of using a treated-bed net as a malaria protective measure in Lafia North was 6(13.3%), while in Wadata was 6(14.7%).

Table 5: Malaria Infection Rate in Relation to Trimester

TRIMESTER	N0. EXAMINED	N0. POSITIVE	PREVALENCE (%)
First	51	8	15.69
Second	40	7	17.5
Third	23	3	13.04
Total	**114**	**18**	**15.79**

There was no significant difference in the malaria prevalence in relation to the trimester. **(χ^2= 0.66623, df = 2, P = 0.7167)**

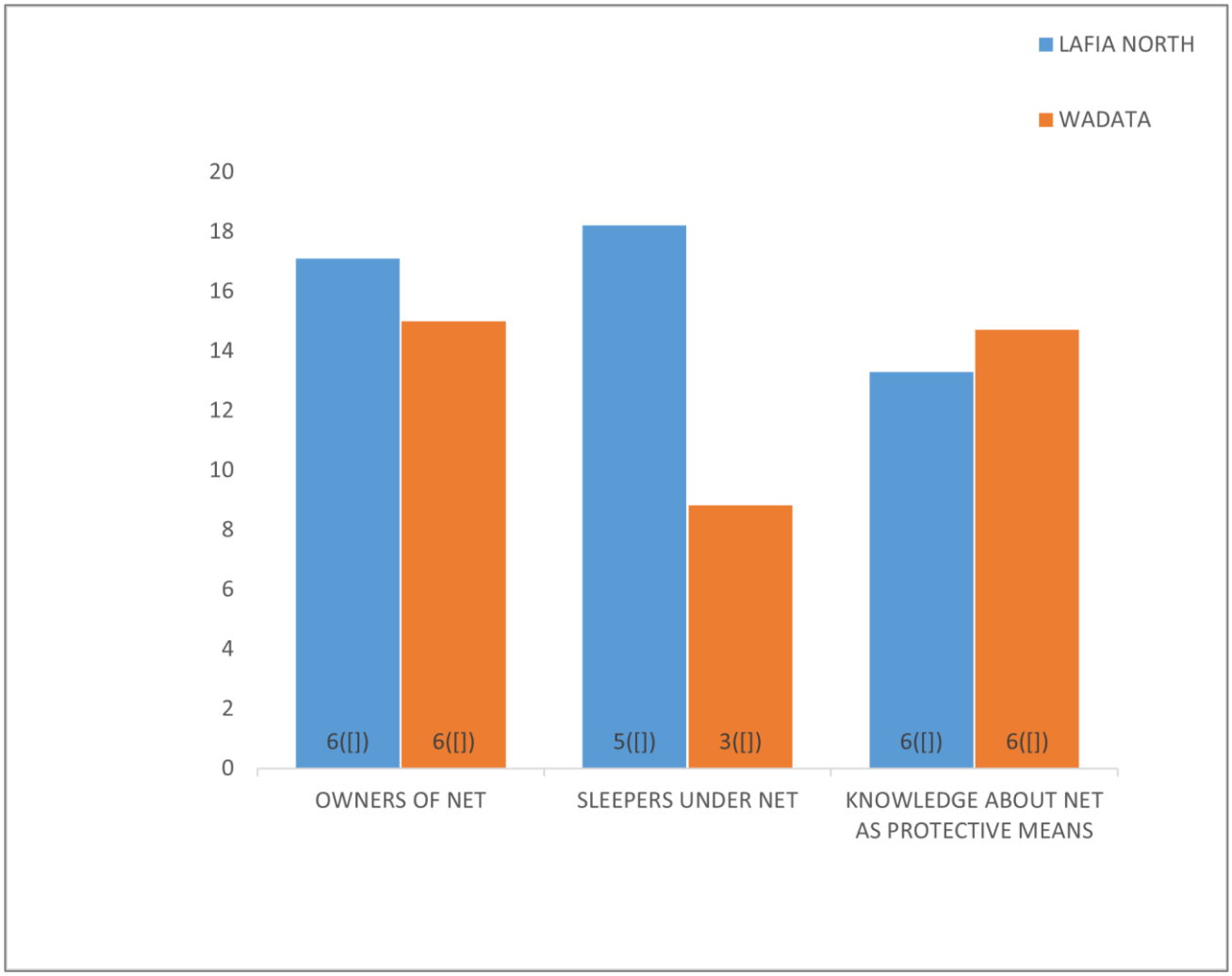

Figure 2: Malaria Infection Rate among women who own a net, sleep under a net, and have knowledge of the ITNs as a means of protection against malaria infection

DISCUSSION

Overall Prevalence of Malaria in the Study Location

The research examined the malaria infection and its associated factors among women visiting selected health centers in Lafia. The malaria infection rate in those attending Wadata PHC and Lafia North Primary Health Care was found to be lower (15.79%) compared to the study conducted in the South-western zone of Nigeria, specifically Osun and Lagos, which had 72%, 41.1%, respectively (Adefioye *et al.,* 2007; Adeneye *et al.*, 2007). Also, Aina and Ayeni (2011) and Iwueze *et al.* (2014) reported 91% and 58.0% prevalence, respectively. Other previous studies that recorded higher prevalence (36% and 91%) than this study are Edelu *et al.* (2010) and Okoye *et al.* (2011) in South-Eastern and South-Southern Nigeria.

On the other hand, this research reported a relatively higher infection rate than the rate (10.2%) reported by Gontie *et al.* (2020). This difference may result from differences in the microclimatic factors of the geographical locations. The low infection rate could be attributed to the good quality of antenatal care in the health centers, as most women are given antimalarial drugs in the clinics. The other possible reasons may be the impact of the free distribution of ITNs by the government and other nongovernmental organizations in study areas or due to the level of awareness about malaria prevention and control strategies like the use of long-lasting insecticide-treated nets (LLIN) among pregnant women.

Malaria Infection Rate in Relation to Age Groups

Women aged between 26–30 recorded the highest prevalence; this is in tandem with the findings of Wogu *et al.* (2013), Iwueze *et al.* (2014), and Gontie *et al.* 2020, but contrary to the report of Adefioye *et al.* (2007), who recorded the highest prevalence among ages 36–39, and the report of Okolo *et al.,* (2017), who recorded the highest infection rate among age groups 18–22. Although ages below 26 revealed a low infection rate, this result supports the existing knowledge of the role of immunity in the reduction of malaria among the elderly (Rogerson *et al.,* 2000; Bouyou, Akotet, *et al.,* 2003), which the pregnant women had acquired as their age increased.

Malaria Infection Rate in Relation to Level of Educational

Qualification and Occupation

This study discovered the highest infection rate in subjects with tertiary education compared to those without educational qualifications. This finding contradicts what was reported in Nigeria, Congo, and Uganda (Adefioye *et al.*, 2007; Ezire *et al.,* 2015; Muhumuza *et al.,* 2016; Inungu *et al.,* 2017). all of whom reported higher infection among individuals with no education. Gontie *et al.* (2020) recorded the highest prevalence among women with only a primary school level of education. The variation between the Gontie report and our finding may be that the women in our study were given intermittent preventive treatment during pregnancy (IPTp) or living in a better vector-controlled environment (Budu *et al.,* 2022).

A study by Budu *et al.,* (2022) shows there was high utilization of ITNs among women with no formal education than those with tertiary education. The results of this study support the assertion that women with no formal education often perceive themselves to be highly vulnerable to malaria infection, possibly receiving encouragement to utilize ITNs compared to those with formal education (Dadzie *et al.,* 2020).

This study revealed that civil servants had the highest infection rate compared to other categories of participants. A report by Asuquo *et al.* (2017) in Calabar reveals that most educated people, who mostly form the working class in Nigeria, do not like to use insecticide-treated nets; rather, they prefer to use other measures of malaria prevention against contact with mosquitoes. Their reasons are that hanging mosquito nets makes the room untidy (Ezire *et al.,* (2015). This could be the reason for the result recorded in our study.

Malaria Infection Rate in Relation to Trimester

The malaria infection rate in relation to trimester in this study recorded the second trimester (17.5%) as the most infected group; this disagrees with the finding of Ejike *et al.* (2017), who reported the first trimester as the highest prevalence rate (56.6%) in Aba South Local Government Area, Abia State, Nigeria and the results of Okolo *et al.* (2017) reported the third-trimester Anyigba in Kogi State.

Malaria infection rate among Women who owned a Net, Sleep under a Net, and who have Knowledge of the ITNs as Means of Protection against Malaria Infection

The prevalence of malaria among women who own a net in this study was 17.1% in Lafia and 15% in Wadata. This result is far less than the report of Yessin (2010), who reported a higher prevalence of 71.2% despite using the net in their study among pregnant women. This finding shows that most women either do not use the net regularly or the net has lost its efficacy in malaria control. Other factors responsible for the prevalence of this infection might be that the women had acquired the infection outside before sleeping under the nets.

A similar report was made by Anikwe *et al.* (2020), who reported a high infection rate among women who know nets in Abakalaliki. Njoroge *et al.* (2009) recorded a high number of participants who had adequate knowledge about malaria in pregnant women in Kenya. Knowledge of malaria in the present study shows maternal knowledge of using nets as a preventive measure against malaria infection. Even though the Respondents showed adequate knowledge about the importance of ITNs and other malaria-preventive strategies, factors such as finance have hindered many women from possessing ITNs (Manu *et al.,* 2017).

CONCLUSION

This study demonstrates that malaria is a significant concern among pregnant women in Nasarawa State, Nigeria, with an overall prevalence of 15.79% in Wadata and Lafia North Primary Health Care Centers. The findings reveal disparities in infection rates based on age, education level, and occupation, emphasizing the impact of education and bed net usage on malaria transmission. The study underscores the importance of health education, access to preventive measures, and antenatal care in combating malaria. To mitigate the burden of malaria and improve maternal and child health outcomes, healthcare authorities and policymakers must prioritize interventions that promote educational awareness, ensure equitable access to treated bed nets, and Strengthen antenatal care services for pregnant women.

By addressing these key factors identified in our study, we can make significant strides in reducing the burden of malaria and improving maternal and child health outcomes in the region.

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