Malaria infectious status and associated risk factors among pregnant women attending antenatal clinics in Awka metropolis, south-eastern, Nigeria.

ABSTRACT

Aims: This study aims to analyze the prevalence of malaria among pregnant women attending antenatal health centres in Awka Metropolis and to investigate the association between malaria infection status to socio-demographic factors and utilization of preventive measures.
Study design:A cross-sectional study design
Place and Duration of Study: Awka metropolis between MaytoOctober 2023.
Methodology: The study sample was estimated using the Yaro Yamane's formula. Data collection involved structured questionnaires and laboratory tests to determine malaria status. Thick and thin blood films of the samples collected were examined microscopically. The statistical analysis assessed associations between malaria infection and variables such as socio-demographic factors and use of preventive measures using the Chi-square test in SPSS statistical software version 25.
Results: The malaria infection rate among the study population was 21.3%. The age group of 20-29 years showed the highest malaria infection rate (27.6%) and the highest incidence of infection occurred in single pregnant women (36.4%). However, unemployment was associated with a higher infection rate (30.4%). Notably, the use of preventive measures such as Long-Lasting Insecticidal Nets (LLINs), Indoor Residual Spraying (IRS) and Intermittent Preventive Treatment (IPT) were correlated with lower infection rates. The findings highlight a significant prevalence of malaria among pregnant women in Awka Metropolis, with the highest infections observed in younger, single, and unemployed women. The use of LLINs, IRS, and IPT treatment showed effectiveness in reducing the risk of malaria.
Conclusion: The study emphasizes the importance of targeted interventions focusing on the identified high-risk groups and the promotion of malaria preventive measures among pregnant women in Awka Metropolis to mitigate the adverse effects of malaria on maternal and foetal health.

Keywords:*Malaria, Pregnant Women, Antenatal, Socio-Demographic Factors, Preventive Measures, Awka Metropolis.*

1. INTRODUCTION

Malaria is a life-threatening parasitic disease caused by *Plasmodium-* a genus of protozoa. Five species are known to inflict humans namely; *Plasmodiumfalciparum*, *P. vivax*, *P. ovale*, *P. malariae* and *P. knowlesi.* According to the World Health Organization [1] report, malaria is endemic in 87 countries in the world with 229 million cases and 409,000 deaths in 2019. Of this global burden, 215 million cases and 384,000 deaths occurred in Africa [1]. Nigeria accounts for onefourth of all malaria cases in the 45 endemic countries in Africa [2] and 11% of maternal deaths in the country are attributed to malaria.

Malaria in pregnancy is a major public health problem with substantial risks to the mother and the foetus because during pregnancy, there is a decline in immunity and sequestration of infected erythrocytes to the placenta [3, 4]. Maternal complications of malaria in pregnancy include anaemia, abortion, stillbirth, low birth weight, cerebral malaria, maternal and foetal death [5]. In 2020, 121.9 million pregnancies occurred in malaria was 52.9 million in the WHO South-East Asia (SEARO)region, 5.1 million in the Western Pacific (WPRO) region, 46.1 million in the Africa (AFRO)region, 11.1 million in the Eastern Mediterranean (EMRO) region and 6.7 million in the America region [6]. Most cases of malaria in pregnancy occur in areas of stable malaria transmission and are asymptomatic [7]. Depending on the endemicity of malaria in an area, it can be expected that 1-50% of pregnant women may carry malaria parasitemia, especially in the placenta, without noticing it [8]. This is attributed to anti-disease immunity acquired during previous exposure that protects against clinical malaria [9]. Pregnant women are three times more likely to suffer the effects of malaria compared with their non-pregnant counterparts and have a mortality rate that approaches 50% [8].The principal impact of malarial infection is due to the presence of parasites in the placenta, which causes maternal anaemia and low birth weight[4]. Beyond the postpartum period, the long-term consequences of malaria during pregnancy on the infant include poor development, behavioural problems, short stature, and neurological deficits [3].

Malaria diagnosis is done using Microscopic Examination, Rapid Diagnostic Tests, and Molecular Techniques. The detection of *Plasmodium* parasites by light microscopy from capillary or venous blood is still the primary method in most health facilities across the world [10]. Early diagnosis and treatment play an important role in malaria prevention and control. Artemisin-based combination therapy and sulphadoxine-pyrimethamine are first-line anti-malarial treatments for *P. falciparum and P.vivax* respectively. Oral quinine is the first-line treatment for pregnant women during the first trimester [11]. Vector control using long-lasting insecticide-treated nets, indoor residual spraying, intermittent preventive therapy (IPT) in pregnancy, and larval source management are used for prevention and control of malaria. Protection of pregnant women living in malaria-endemic countries has been of particular interest to many malaria control programmes because of this group's higher susceptibility and reduced immunity. Positively, malaria control measures have received greater attention in the last decade as increased funding has resulted in the scaling up of malaria control programmes. The use of insecticide-treated nets (ITNs) is one of the key components of malaria prevention and control as recommended by the World Health Organization [12]. The net reduces human contact with mosquitoes, thus leading to a significant reduction in the incidence of malaria-associated morbidity and mortality; as well as in the adverse effects during pregnancy in areas of intense malaria transmission. Hence, the study aimed to determine the malaria infection status and associated risk factors of malaria among pregnant women attending antenatal in health centres in Awka Metropolis.

2. MATERIALS AND METHODS

2.1 Study Area

Awka is made up of two Local Government Areas (LGAs). The study was conducted at three Health Centres in Awka which include Umuokpu Health Centre, Umudioka Health Centre, and Okpuno Health Centre. Awka is the capital city of Anambra State, Nigeria. It is located at Latitude 6.211°N and Longitude 7.072°E. Awka shares a boundary with Nibo, Nise, and Amawbia in the southwest, Mgbakwu, Awgbu, and Okpuno in the Northwest, Umuawulu in the Northeast, Isiagu and Ezinato in the South. The vegetation of Awka ranges from light rainforest to Savannah. It experiences a tropical climate characterized by two seasons namely; dry and wet seasons. The dry season usually commences from early November to late March while the wet season starts from late March to early November. During this wet season, the breeding site of mosquitoes increases thereby giving more room for the spread of malaria (NPC, 2006). The mean daily maximum temperature is usually 27°c all over the year although it could reach 34°c in March and 34.3°c during the harmattan months of December and January. The mean annual rainfall according to the local meteorological station which has maintained climatological records since 1978, revealed a mean rainfall of about 1600mm with a relative humidity of 80% at dawn. Awka is the traditional home of the Igbo (Ibo) blacksmith; early bronze artifacts have been discovered in the vicinity, and the town's artisans are still noted for their metalworking and wood carving. Awka is an agricultural trade centre (yams, cassava, maize, palm oil, and kernels) for the Igbo people of the surrounding area [13].

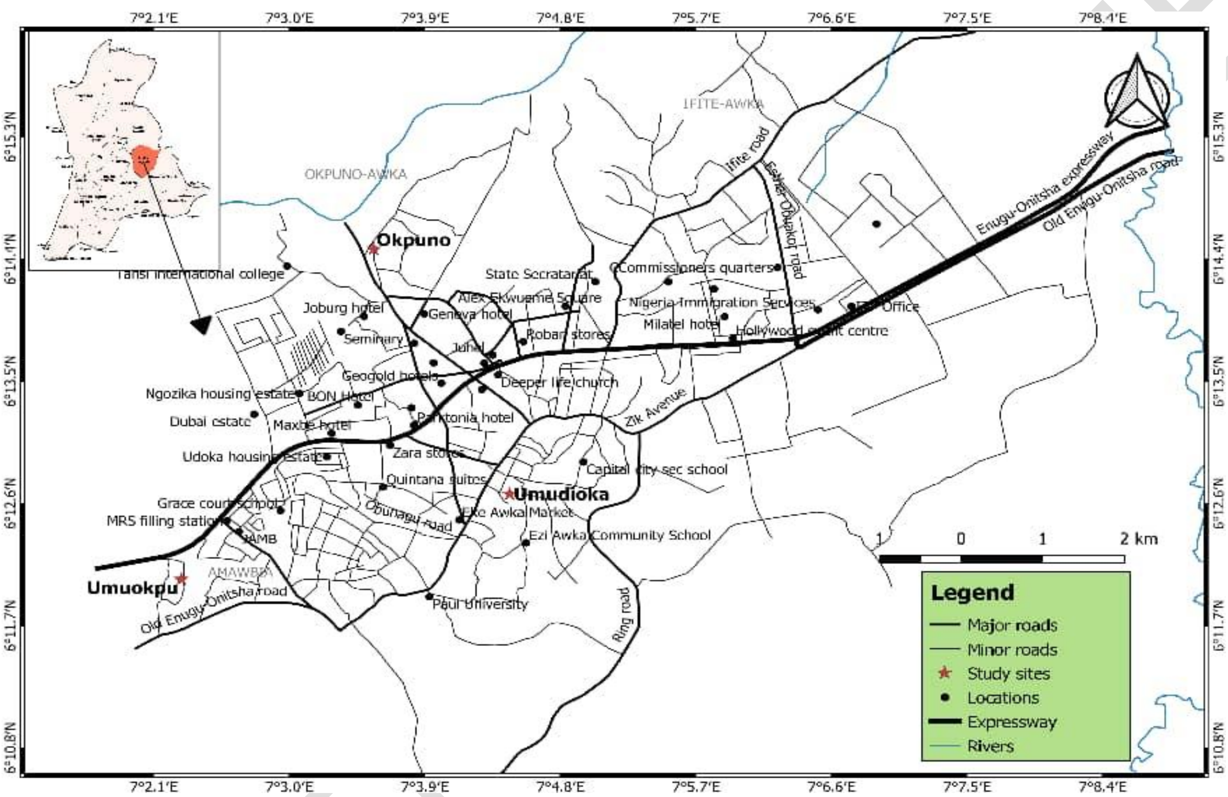

Figure 1: Map of Awka Metropolis showing the study areas.
Source: Department of Geography and Meteorological, Nnamdi Azikiwe University.

2.2 Study Design

The study was a cross-sectional survey of Antenatal women which lasted for a period of six months between May to October 2023.

2.3 Sample Size Determination

The study sample was determined using Yaro Yamane's (Yamane, 1973) formula with a 95% confidence level; $n=N/1+N(e^2)$.

2.4 Sample Size

A total of 300 pregnant women were selected from three health centres in Awka metropolis. The health centres were Umuokpu Health Centre, Umudioka Health Centre, and Okpuno Health Centre. A total of 100 samples were collected from each health centre.

2.5 Ethical Considerations and Informed Consent

A letter of introduction from the Head of the Department of Parasitology and Entomology was submitted to the management of Chukwuemeka Odumegwu Ojukwu Teaching Hospital for ethical approval, the ethical approval was taken to the management of the selected Health Centres to solicit permission to use their facilities and patients for the study. Advocacy visits to the Antenatal clinics were used to educate the pregnant women about the objectives and values of the study to obtain their informed consent to participate in the study. The advocacy visits were done weekly on every antenatal day. Only pregnant women who gave their consent to participate were registered for the study.

2.6 Determination of Malaria Infectious status among Pregnant women

Malaria infection status among pregnant women was determined using the Rapid Diagnostic test kit and microscopic examination as follows;

2.6.1 Collection of Blood Specimens

Blood specimens (5ml) were collected from each pregnant woman through venipuncture as described by [14]. The blood was transferred into specimen bottles containing anticoagulants (Ethylene diamine tetra-acetic acid) and was properly mixed to avoid coagulation. The bottle was. labelled with the participant's name, age, and date of collection. The blood specimens collected were taken to the laboratory where it was analysed.

2.6.2 Malaria detection using Rapid Diagnostic Test Kit (RDT)

The blood sample was added to the test kit, which assay buffer was added to lyse the red blood cells (RBCs). The complex migrated through the nitro-cellulose strip by capillary action, considering that the sample contained antigens, the complex on reaching the line of the corresponding immobilized antibody, and got trapped, which formed a pink pinkish purple band which confirms a reactive test result as described by [15].

2.6.3 Detection of malaria through microscopy

The blood samples were analysed using thick and thin blood films.

2.6.3.1 Preparation and staining of thick blood films

A drop of each blood sample was placed on the centre of a clean grease-free microscope glass slide. A cover slip was used to spread the blood in a circular form of about 2mm. The slides were air-dried. The blood film was stained in field stain A for 5 seconds. It was rinsed off gently in clean water and then stained in field stain B (methyl azure) for 5 seconds and then was rinsed off again in clean water. The slides were allowed to air dry and were set to be viewed on the microscope [16].

2.6.3.2 Preparation and staining of thin blood films

A drop of blood from each blood sample was placed at one end of a clean grease-free microscope glass slide with the aid of a Pasteur pipette. A spreader slide was placed in front of the drop of blood, which allowed blood to spread along the edge of the spreader slide. The spreader was held at a suitable angle of 45° and pushed along the slide, to draw blood behind it, until the whole blood was smeared. The blood smear was allowed to air-dry. It was fixed briefly in absolute methanol and allowed to dry. The thin film was stained using 10% Giemsa stain for 10 minutes, washed in clean water and allowed to dry.

2.6.4 Examination of the stained blood smears

Forthe examination of thin and thick films, a drop of immersion oil was placed at the centre of the blood films respectively. The slides were examined microscopically using ×100 objective lens. The slides were examined systematically to detect malaria parasites. Species- specific characteristics of human Plasmodium species as listed by [17] and [18] were utilized to identity the species of *Plasmodium* that was encountered.

2.7 Collection of information based on risk factors

A written pretested structured questionnaire was administered to the pregnant women to obtain their Socio-demographic factors (Age, marital status; which included single, married, separated, divorced etc; educational status and occupational status) and Use of preventive measures (LLINs, IPT, IRS, any other personal protective measures) and they responded accordingly (Appendix 1).

2.8 Data Analysis

Data generated from the study was analysed using the SPSS (Statistical Software Package for Social Sciences) version 25. The chi-square test was used to identify the relationship between malaria infection to the risk factors.

3.RESULT

3.1 The Malaria Infectious Status of the Pregnant Women Attending Antenatal in Health Centres in the Awka Metropolis

The results in Table 1 showed malaria infectious status of the pregnant women attending antenatal health centres in the Awka metropolis. The result showed that out of 300 pregnant women attending antenatal in health centres examined, only 64(21.30%) were positive while 236 (78.70%) were negative. The result showed that out of the three sites, the highest malaria infection was recorded in Umudioka 27(42.19%) followed by Umuokpu 22(34.38%) while the least was recorded in Okpuno 15(23.44%). However, there was no significant difference (P>0.05) in the malaria infection status of the pregnant women attending antenatal in health centres in the Awka metropolis

3.2 Relationship Between Malaria Infectious Status in relation to Age.

The result presented in Table 2 showed the relationship between malaria infection status to age of the pregnant women. The table showed that the highest number of respondents were in the age range 20-29(152), followed by 30-39 (84), and 40-49 (40) while the lowest were respondents between the age range 50-59 (24). Subsequently, the result showed that the highest malaria infection was observed in the age range 20-29 with a 42(27.6%) infection rate, followed by 30-39 with (18(21.4%) infection rate, while the lowest was observed in the age range 40-49 with 4(10%) infection rate. There was no malaria infection recorded in the age range between 50-59 with 0(0%) infection rate. The observed difference was statistically significant at P<0.05, (P=0.004); X^2= 13.163; df: 3.

3.3Relationship Between Malaria Infection in relation to Marital status.

The results in Table 3 showed the marital status of the respondents. The result showed that the majority of the respondents were married pregnant women attending antenatal (244), while the lowest was Divorced pregnant women attending antenatal (12). When compared to their malaria infection status, the result showed that single pregnant women attending antenatal have the highest malaria infection 16(36.4%), while the lowest was recorded in divorced 2(16.7%) pregnant women attending antenatal in Awka Metropolis. The observed difference was statistically significant at P<0.05, (P=0.031); X^2= 6.974; df: 2.

3.4 Relationship between malaria infectious status in relation to educational level.

The results in Table 4 showed the educational status of pregnant women attending antenatal in Awka Metropolis. The majority of the pregnant women attending antenatal possessed secondary education (186), while the lowest percentage of the respondents possessed tertiary education (36). The malaria infection status as it concerns educational status showed that the highest was recorded in respondents with tertiary education 10(27.8%), while the lowest was observed in respondents with secondary education 36(19.4%). However, the observed difference was not statistically significant at (P>0.05), (p=0.480); X^2= 1.466; df: 2.

3.5 Relationship between malaria infectious status in relation to occupation.

The occupational status of the respondents presented in Table 5 showed that the majority of the respondents were self-employed (122), while the lowest were students (32). The infectious status of the respondents concerning occupation showed that the highest malaria infection was recorded in unemployed pregnant women attending antenatal 28(30.4%), while the lowest was recorded in Civil Servants 6(11.1%). The observed difference was statistically significant at P<0.05, (p=0.030); X^2= 8.952;

3.6 Relationship Between Malaria Infectious Status to the Usage of Long-Lasting Insecticide Nets (LLINs)

The results in Table 6 showed the relationship between malaria infectious status to the usage of Long-Lasting Insecticide Nets (LLINs) amongpregnant women attending antenatal in Awka Metropolis. The result showed that the majority of the respondents use LLINs (156) while144 per cent of the respondents said they do not useLLINs. The relationship between malaria infection status and the use of LLINs showed that the majority of the respondents who said they did not use LLINs were positive 38(26.4%) while 26(16.7%) of the respondents who used LLINs were positive. The observed difference was statistically significant at p<0.05, (P=**0.04**); X^2= 4.217; df: 1.

3.7 The Relationship Between Malaria Infection Status to the Use of Indoor Residual Spraying (IRS)

The results in Table 7 showed that the majority of the respondents do not make use of the Indoor Residual Spraying (IRS) 214 while 86 of them make use of the IRS. The relationship between malaria infection status and the use of IRS showed that the majority of the respondents who did not make use of IRS tested positive 52(24.3%) while 12(14%) of the respondents who made use of IRS were tested positive. Statistical analysis showed that there was a significant difference (P<0.05, (P=**0.04**); X^2= 3.912; df: 1) between malaria infection status and the use of IRS.

3.8 Relationship Between Malaria Infection Status to the Use of Intermittent Preventive Therapy (IPT)

The results in Table 8 showed that the majority of the respondents make use of Intermittent Preventive Therapy (IPT) 218 while 82 of them do not make use of IPT. The relationship between IPT and malaria infection showed that 34(41.5%) of the pregnant women attending antenatal tested positive while 30(13.8%) of the respondents who said yes were positive. The observed difference was statistically significant at P<0.05, (p=**0.00**); X^2= 27.247; df: 1.

Table 1: Malaria infectious status of the pregnant women attending antenatal in health centres in the Awka metropolis.

Location	Number examined	Number Positive (%)	*P value*	X^2

Umuokpu	100	22(34.38)		
Umudioka	100	27(42.19)	0.233	2.912
Okpuno	100	15(23.44)		
Total	**300**	**64 (100)**		

P>0.05 (p=0.233) X^2= 2.912; df:2

Table 2: Relationship Between Malaria Infectious Status in relation to Age.

Age	**No. examined**	**No. Positive**	***P -value***	X^2
20-29	152	42(27.6%)		
30-39	84	18(21.4%)		
40-49	40	4(10%)	0.004	13.163
50-59	24	0(0%)		
Total	**300**	**64(21.3%)**		

P<0.05, (P=0.004); X2= 13.163; df: 3.

Table 3: Relationship Between Malaria Infection in relation to Marital status.

Marital status	**No. examined**	**No. positive**	***P-value***	X^2
Single	44	16(36.4%)		
Married	244	46(18.9%)		
Divorced	12	2(16.7%)		
Total	**300**	**64(21.3%)**	0.031	6.974

P<0.05, (P=0.031); X2= 6.974; df: 2.

Table 4: Relationship between malaria infectious status in relation to educational level.

Educational status	**No. examined**	**No. Positive**	***P-value***	X^2
Primary	78	18(23.1%)		
Secondary	186	36(19.4%)		
Tertiary	36	10(27.8%)	0.480	1.466
Total	**300**	**64(21.3%)**		

(P>0.05), (p=0.480); X^2= 1.466; df: 2.

Table 5: Relationship between malaria infectious status in relation to occupation.

Occupational Status	N	Positive	*P-value*	X^2
Self-employed	122	22(18%)		
Civil servant	54	6(11.1%)		
Student	32	8(25%)	0.0308.95	
unemployed	92	28(30.4%)		
Total	**300**	**64(21.3%)**		

P<0.05, (p=0.030); X^2= 8.952; df: 3.

Table 6: Relationship Between Malaria Infectious Status to the Usage of Long-Lasting Insecticide Nets (LLINs)

LLINs	No. Examined	No. Positive	No. Negative	*P-value*	X^2
Yes	156	26(16.7%)	130(83.3%)		
No	144	38(26.4%)	106(73.6%)		
Total	**300**	**64(21.3%)**	**236(78.7%)**	0.04	4.217

P<0.05, (P=0.04); X2= 4.217; df: 1.

Table 7: The Relationship Between Malaria Infectious Status to the Use of Indoor Residual Spraying (IRS)

IRS	No. Examined	No. Positive	No. Negative	*P-value*	X^2
Yes	86	12(14%)	74(86%)		
No	214	52(24.3%)	162(75.7%)		
Total **IPT**	**300**	**64(21.3%)**	**236(78.7%)**	0.04	3.912

(P<0.05, (P=0.04); X2= 3.912; df: 1)

Table 8: Relationship Between Malaria Infectious Status to the Use of Intermittent Preventive Therapy (IPT)

IPT	No. Examined	No. Positive	No. Negative	*P-value*	X^2
Yes	218	30(13.8%)	188(86.2%)		
No	82	34(41.5%)	48(58.5%)		
Total	**300**	**64(21.3%)**	**236(78.7%)**	0.00	27.247

P<0.05, (p=0.00); X^2= 27.247; df: 1.

4. DISCUSSION

Malaria infection during pregnancy is a significant concern due to the potential adverse outcomes, it can have on both the mother and the foetus, including maternal anaemia, low birth weight, preterm birth and increased neonatal mortality [19, 20, 21, 22]. This emphasizes the importance of public health intervention strategies that specifically target pregnant women, such as the distribution of ITNs, IPTp administration and engaging in community education programs to enhance awareness and prevention. Moreover, the study highlights the critical role antenatal care (ANC) services play in the early detection and treatment of malaria, which is essential for preventing severe complications. The ANC platform presents an excellent opportunity for healthcare workers to monitor and manage malaria infections promptly [23,24].

The result of the study showed that 21.30% of pregnant women attending antenatal clinics in the Awka metropolis were infected with malaria. The findings are consistent with studies in subSaharan Africa [19, 25], which have documented malaria prevalence rates among pregnant women ranging from 10% to 65% [26]. Also, [27] noted that the local climatic conditions, which sustain mosquito activity year-round, further exacerbate the situation in Africa. In a study conducted in Ghana, [28] revealed a prevalence rate of approximately 19%, which is quite comparable to our current findings. The findings of the study were also in line with the study conducted in Onitsha Southeast Nigeria by [29] who found that the overall *P. falciparum* prevalence was 42.6%. However, the variations in prevalence could be attributed to differences in malaria transmission intensities, the seasonality of data collection and the effectiveness of malaria control interventions across different regions [3, 30]. The relatively lower prevalence rate in this study in comparison to some regions may suggest that the malaria control strategies implemented in Awka, such as the use of insecticide-treated nets (ITNs), intermittent preventive treatment during pregnancy (IPTp) and effective case management, may be yielding positive outcomes [31]. However, the persistence of a substantial proportion (21.30%) of pregnant women with malaria highlights that more efforts are needed to further reduce the burden of malaria in this vulnerable group.

The findings on the relationship between malaria infection status and socio-demographic factors among pregnant women attending antenatal clinics in the Awka metropolis, the present study elucidates important trends and disparities that have both clinical and public health implications. The observed higher rate of malaria infection among the younger age group of 20-29 (27.6%) is in line with the findings of [32], who reported that younger maternal age is associated with a higher risk of malaria infection during pregnancy. The increased risk in the younger age group could be attributed to a combination of behavioural factors, a more active lifestyle, and potentially less acquired immunity compared to older women [3].

In terms of marital status, the higher infection rate among single pregnant women(36.4%) compared to married (18.9%) and divorced (16.7%) participants is particularly notable. This parallels with the study by [33], which indicated single women may be at increased risk of malaria. Single pregnant women may face unique socio-economic challenges, including access to health care, protective measures such as insecticide-treated nets and overall support systems that could mitigate the risk of malaria infection [26]. The higher infection rate among single pregnant women could also be associated with socio-economic factors, as suggested by studies such as those by [34], who found that unmarried status might relate to reduced access to healthcare due to potential socio-economic constraints and stigma. In comparison, the lower infection rates among divorced women could imply a different social support structure or behaviour that mitigates the risk [35].

Furthermore, educational status seems to play an unexpected role in this study, with the highest malaria infection rate observed among respondents with tertiary education (27.8%). This is counterintuitive and contrasts some literature, such as the work by [36,37], which suggested that higher education was associated with a lower risk of malaria, likely due to better knowledge and practices related to malaria prevention. Also, a deviation was reported by [38], where higher education levels usually correlate with better preventive practices and thus lower infection rates. However, one possible explanation for this study could be that women with higher education levels may have occupations that increase their exposure to mosquito bites or that this group might spend more time pursuing their careers, thereby reducing the time spent on preventive health practices [39]. Nonetheless, without a significant p-value, it could be inferred that the association between educational status and malaria infection status may not be robust and suggests that other factors, not measured here, may be playing a larger role [40].

The occupational status showed a higher infection rate amongst unemployed pregnant women, this aligns with the notion that financial constraints or the nature of their environments predispose them to higher exposure rates and fewer resources for preventive measures [41]. In contrast, civil servants, who might have more stable financial situations, greater access to health education, and live in better conditions, exhibited the least infection rates. This finding aligns with the analysis by [23], which alludes to the effect of socioeconomic status on malaria risk. Additionally, unemployed pregnant women may have limited access to prevention measures such as insecticide-treated nets (ITNs) and indoor residual spraying (IRS), which further exacerbates their vulnerability to malaria [42]. Importantly, the results concerning the high infection rates among students align with the findings from other studies [1,43] suggesting that younger age and aspects of student lifestyle, such as living in communal dwellings, may contribute to a heightened risk of malaria during pregnancy [43]. This could be due to an increased exposure to the vector and inconsistent use of preventive measures among younger women who might prioritize their educational commitments. When considering self-employed respondents, it is plausible that these individuals may have more control over their working environments and potentially more resources to invest in preventive measures compared to their unemployed counterparts, thus partially accounting for the observed lower infection rates amongst this group. Factors such as awareness and the ability to implement environmental controls, like eliminating standing water, can have substantial effects on vector exposure [44].

The relationship between malaria infection status and the use of preventive measures among pregnant women in the study area showed a noteworthy association between the utilization of preventive measures, such as Long-Lasting Insecticidal Nets (LLINs), Indoor Residual Spraying (IRS), and Intermittent Preventive Treatment (IPT), and the incidence of malaria during pregnancy [27,33]. The observed significant association (P=0.04) between the non-use of LLINs and a higher prevalence of malaria infection corroborates with existing literature [45, 46]. The observed difference reinforces the efficacy of LLINs in reducing malaria risk among pregnant women, an assertion that is supported by studies conducted in other malaria-endemic regions [47,45]. The study by [45] in Kenya found that the use of insecticide-treated nets by pregnant women was associated with a reduced risk of malaria infection. Similarly, studies across sub-Saharan Africa have consistently demonstrated the efficacy of LLINs in preventing malaria during pregnancy [48,49]. The lower infection rate among users of LLINs in the current study promotes the continued distribution and education on proper usage of LLINs as a cornerstone of malaria prevention [46].

The IRS, another vector control strategy, showed a remarkable reduction in malaria infection from 24.3% in non-users to 14% in users. This finding is in line with research by [50] which reported that IRS, when implemented effectively, markedly reduces malaria transmission. The significant difference (P=0.04) emphasizes the need to scale up IRS coverage, which has been shown to complement the protection provided by LLINs, especially in areas with high transmission [51]. Also, the critical role of the IRS as an effective measure to decrease the burden of malaria in endemic areas has been well documented in the literature [52]. The effectiveness of IPT in reducing the prevalence of malaria during pregnancy is further affirmed by this study, which records a stark contrast in infection rates: 41.5% among non-users versus 13.8% among users, with extremely significant statistical evidence ($P<0.01$). The value of IPT in the prevention of malaria during pregnancy is well-documented, as seen in the work by [53], where IPT was shown to result in better pregnancy outcomes. This supports the idea that the implementation and adherence to IPT protocols is crucial and efforts to improve the uptake should be intensified. Also, the reduction of malaria incidence associated with IPT usage highlights its importance as a recommended strategy by the World Health Organization (WHO) for the prevention of malaria in pregnant women living in areas with moderate to high transmission [1, 54]. Nevertheless, despite this strong evidence supporting preventive measures, the study signals an underutilization of these strategies. Studies indicate that factors such as lack of awareness, accessibility issues, and misconceptions may substantially hinder the adoption and consistent use of preventive measures [55,56,57]. Therefore, targeted interventions to promote the consistent and correct use of LLINs, IRS and IPT are essential [58].

5. CONCLUSION

The study conducted on malaria infection status among pregnant women attending antenatal health centres in Awka Metropolis revealed a 21.3% positivity rate for malaria. Age was a significant factor, with the 20-29 age range having the highest infection rate. Marital status also impacted infection rates, with single pregnant women experiencing the highest infection rates. In terms of education, a higher infection rate was observed among pregnant women with tertiary education, but this was not statistically significant. Unemployed pregnant women showed the highest infection rate when considering occupational status. Furthermore, the use of preventive measures was notably correlated with infection status. Women not using Long-Lasting Insecticidal Nets (LLINs), Indoor Residual Spraying (IRS), and Intermittent Preventive Treatment (IPT) had higher rates of malaria infection, underscoring the effectiveness of these interventions. Therefore, there is need for an increase focused interventions and awareness programs for pregnant women, especially those who are single, within the age range of 20-29 and unemployed, as these groups showed higher rates of malaria infection.

CONSENT AND ETHICAL APPROVAL

Consent was sort from the pregnant women attending antenatal in Awka metropolis after a proper explanation of the study had been given to them. They were equally informed that the data generated from the study will be kept confidential and used only for academic purposes.The ethical approval was obtained from Chukwuemeka Odumegwu Ojukwu Teaching Hospital Amaku, Awka (COOUTH/CMA/ETH.C/VOL1/FN:04/243)

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