FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 9 No. 3, March, 2025, pp 316 - 326
DOI: https://doi.org/10.33003/fjs-2025-0903-3282

IMPACTS OF HOME MOSQUITO VECTOR CONTROL AND INSECTICIDE TREATED NETS ON MALARIA STATUS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CARE AT POLICE HOSPITAL, DUTSE, JIGAWA STATE

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ABSTRACT

Malaria remains a critical public health challenge, particularly among vulnerable populations such as pregnant women in endemic regions. This study investigated the impact of home mosquito vector control and insecticide-treated nets (ITNs) on malaria prevalence among 50 pregnant women attending antenatal care at the Police Hospital, Dutse, Jigawa State, Nigeria. Participants' demographic characteristics, knowledge, attitudes, and practices regarding mosquito control were assessed, alongside malaria prevalence across age, marital, trimester, educational, and occupational categories. Findings revealed a malaria prevalence of 46%, with younger participants (18–24 years) and unemployed individuals showing higher rates, though statistical associations were insignificant ($p > 0.05$). Knowledge of malaria transmission was universal (100%), and ITN ownership was high (94%), yet only 86% reported consistent nightly use. Despite positive perceptions of ITNs, gaps in equitable distribution and consistent usage were identified, with 60% of ITNs purchased rather than obtained through free programs. Additionally, while 70% of participants engaged in regular mosquito control practices, community-based programs were limited, with only 18% reporting active initiatives in their areas. The study underscores the need for strengthened malaria prevention strategies, emphasizing universal access to ITNs, community-driven mosquito control programs, and targeted health education campaigns. Comprehensive approaches integrating antenatal care services and public health outreach can enhance protective measures for pregnant women, mitigating malaria's impact on maternal and fetal health.

Keywords: Malaria, Mosquito vector, Insecticide-Treated Nets, Transmission

INTRODUCTION

Malaria continues to pose a significant global health challenge, disproportionately affecting vulnerable populations in endemic regions. Sub-Saharan Africa remains the epicenter of this burden, accounting for 93% of malaria cases and 94% of malaria-related deaths, with Nigeria contributing approximately 23% of global malaria fatalities (WHO, 2022: Hassan *et al*., 2024). Despite being preventable and treatable, malaria caused an estimated 619,000 deaths worldwide in 2021, highlighting gaps in prevention and treatment interventions (WHO, 2023).

Pregnant women are particularly susceptible to malaria due to physiological changes that compromise their immunity. Malaria during pregnancy can lead to adverse maternal and neonatal outcomes, including severe anemia, low birth weight, preterm delivery, stillbirth, and neonatal death (Obeagu & Obeagu, 2024). Studies estimate that in sub-Saharan Africa, 11 million pregnancies are exposed to malaria annually, with Plasmodium falciparum accounting for the majority of cases (WHO, 2021). These consequences underscore the importance of targeted prevention and treatment strategies for this high-risk group.

Insecticide-treated nets (ITNs), particularly long-lasting insecticidal nets (LLINs), remain one of the most effective interventions for malaria prevention. Studies have shown that consistent use of ITNs reduces malaria incidence by approximately 50% and child mortality by 20% (Scates *et al*., 2020). However, challenges such as inconsistent usage, limited access, and socio-economic barriers persist, particularly in rural areas where malaria burden is highest (Ali *et al*., 2020). In Nigeria, ownership of ITNs has increased due to national distribution campaigns, but usage rates among pregnant women remain suboptimal, often influenced by cultural practices, education, and household income levels (Mehta, 2024).

Home-based mosquito control measures, such as environmental sanitation, use of insect repellents, and eliminating breeding sites, complement ITN usage. Research indicates that these strategies significantly reduce mosquito populations and malaria transmission when implemented alongside ITN campaigns (Mustapha, 2022). However, the uptake of these practices varies, with rural areas facing challenges such as inadequate infrastructure and low community engagement. Addressing these barriers requires community-driven programs and effective health education to foster behavioral change (Okumu, 2020).

Dutse, Jigawa State, is a malaria-endemic region where pregnant women face significant health risks due to high malaria prevalence. Despite national efforts to distribute ITNs and promote community-based mosquito control measures,

gaps in coverage and consistent use persist. Preliminary studies in the region suggest that while awareness of malaria prevention is high, practical application of control measures remains inconsistent, largely due to socio-economic and cultural factors (Jennifer & Dogara, 2016).

This study seeks to evaluate the impact of home mosquito vector control and ITN usage on malaria prevalence among pregnant women attending antenatal care at Police Hospital, Dutse. By examining knowledge, attitudes, and practices (KAP) related to malaria prevention, this research aims to identify gaps and provide actionable insights to enhance prevention strategies. Furthermore, the study underscores the need for integrated approaches that combine ITN distribution, environmental management, and targeted health education to reduce malaria burden in this vulnerable group (Taremwa *et al*., 2017).

Malaria remains a significant threat to maternal and child health in sub-Saharan Africa, particularly in Nigeria. Effective use of ITNs and home mosquito vector control measures are critical in mitigating this burden. However, addressing socio-economic and cultural barriers is essential to ensure the success of these interventions (Obeagu & Obeagu, 2024). This study contributes to the growing body of evidence needed to inform policies and programs aimed at reducing malaria prevalence among pregnant women in endemic regions.

MATERIALS AND METHODS

Description of Study Area

This research was conducted at the Police Hospital Dutse, located in Jigawa State, Nigeria. The hospital's mission is to provide safe and accessible healthcare services to all Nigerians. Dutse, the state capital, lies within the northwest geopolitical region of Nigeria, positioned between longitudes 11.000°N and 13.000°N and latitudes 8.000°E and 10.150°E. In 2009, Dutse had an estimated population of 153,000 people, making it the most populous area in Jigawa State, followed by Hadeija (111,000), Gumel (43,000), and Birnin Kudu (27,000), according to the National Bureau for Statistics (2006). The town is situated in the Sahelian savannah region, characterized by its arid climate and sparse vegetation.

Study Design

The study employed a cross-sectional descriptive design to examine the relationship between home mosquito vector control measures, the use of insecticide-treated nets (ITNs), and malaria prevalence among pregnant women attending antenatal care (ANC) at the Police Hospital Dutse. Blood samples were collected from participants who also completed structured questionnaires designed to capture relevant data.

Variables

The dependent variable in this study was malaria status, classified as either positive or negative. The independent variables included ITN usage, assessed in terms of frequency and condition, as well as other mosquito vector control measures such as indoor spraying and environmental sanitation. Socio-demographic factors, including age, marital status, and education level, were also considered as independent variables.

Sampling

The study was conducted among pregnant women aged 18 to 40 years attending ANC at the Police Hospital Dutse. These women were suspected of having malaria and were recruited based on specific inclusion and exclusion criteria. Women who provided informed consent and were attendees of the ANC clinic during the study period were included. However, women presenting with severe malaria were excluded from participation.

Consent Approval

Prior to their inclusion in the study, informed consent was obtained from all participants. The consent process ensured that participants fully understood the purpose of the study, the procedures involved, and their right to withdraw at any point without any consequences.

Sample Materials

The materials used in this study included laboratory items such as EDTA bottles, micropipettes, microscope slides, microscopes, syringes, needles, tourniquets, Giemsa stain, spirit swabs, and immersion oil. Administrative materials included structured questionnaires, data collection forms, access to hospital malaria diagnostic records, stationery, and logistical resources for fieldwork.

Sampling Procedure

A random sampling technique was employed to select participants, ensuring equal representation of all eligible pregnant women attending ANC during the study period. Each participant was randomly selected from a list of registered ANC attendees. To maintain fairness, a random number generator was used for participant selection.

Data Collection Methods

Data were collected using pre-tested, interviewer-administered questionnaires. The questionnaires captured socio-demographic characteristics such as age, education, and occupation, as well as knowledge and practices regarding mosquito control measures. Information on ITN usage, including frequency and proper handling, and past malaria episodes during pregnancy was also collected. Additionally, malaria diagnosis records, including microscopy results from ANC visits, were retrieved from hospital records to supplement the data.

Laboratory Analysis

Blood samples were collected from participants for microscopic analysis. The collection procedure involved cleaning the collection site with a spirit swab, drawing 2 ml of blood using a sterile syringe, and transferring the blood into anticoagulant-treated EDTA tubes. Both thick and thin blood films were prepared for microscopic examination. For the thick film, 6 µl of blood was placed on one end of a microscope slide and spread in a circular motion. For the thin film, 2 µl of blood was spread evenly at a 45° angle. The thin films were fixed with absolute methanol for species identification, and both films were stained with a 10% Giemsa solution for 20 minutes to detect Plasmodium parasites. Microscopic examination was conducted using a 100x oil immersion objective. Parasite density was calculated by counting the number of parasites against 200 white blood cells on thick films, then multiplying by the participant's total leukocyte count. A minimum of 100 high-power fields was examined before a negative result was declared.

Data Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics were used to summarize categorical variables, such as ITN usage, in terms of frequencies and percentages, while continuous variables, such as age, were reported as means and standard deviations. Inferential statistics, including chi-square tests, were used to

assess the associations between ITN usage and malaria status. Logistic regression models were applied to identify predictors of malaria prevalence, with statistical significance set at $p < 0.05$.

Ethical Considerations

Ethical approval for the study was obtained from the management of the Police Hospital Dutse. Informed consent was obtained from each participant, ensuring they understood the study objectives, procedures, and their rights as participants. Privacy and confidentiality were maintained by conducting interviews in private settings and securely storing data, which was accessible only to the principal investigator and supervisor. Participation in the study was entirely voluntary, and participants retained the right to withdraw at any point without repercussions.

RESULTS AND DISCUSSION

Demographic Characteristics of Study Participants

The study surveyed 50 pregnant women attending antenatal care at the Police Clinic in Dutse, Jigawa State, Nigeria. The majority (46%) were aged 18–24 years, followed by 25–29 years (22%). Women aged 40 and above had the lowest representation (4%). Most participants were married (76%), while singles (6%), divorced (10%), and widowed (8%) constituted the rest. More than half (54%) were in their first trimester, while 34% were in their third trimester. Educationally, 40% had secondary education, followed by primary (22%), tertiary (18%), and those with no formal education (20%). Regarding employment, over half (56%) were unemployed, 22% were self-employed, 14% were in the formal sector, and 8% were students. This demographic profile suggests that young, married, unemployed, or low-income women form the largest group attending antenatal care at the clinic. Education level and employment status may influence knowledge, attitudes, and practices toward malaria prevention. The high percentage of unemployed women suggests financial constraints, potentially impacting their ability to afford malaria prevention tools. The high proportion of first-trimester participants is significant since early pregnancy is a crucial period for malaria prevention. These characteristics provide an important foundation for analyzing malaria prevalence and intervention strategies (Table 1).

Table 1: Demographic characteristics of the study participants

Question	Response Options	Frequency (n)	Percentage (%)
Age	18-24 years	23	46.00
	25-29 years	11	22.00
	30-34 years	9	18.00
	35-39 years	5	10.00
	40 years and above	2	4.00
	Total	50	100.00
Marital Status	Married	38	76.00
	Single	3	6.00
	Divorced	5	
	Widowed	4	10.00
	Total	50	100
Trimester	First	27	54.00
	Second	6	12.00
	Third	17	34.00
	Total	50	100
Level of Education	No formal education	10	20.00
	Primary education	11	22.00
	Secondary education	20	40.00
	Tertiary education	9	18.00
	Total	50	100
Occupation	Unemployed	28	56.00
	Self employed	11	22.00
	Employed (Formal sector)	7	14.00
	Students	4	8.00
	Total	50	100

Malaria Prevalence across Age Groups

The study assessed malaria prevalence among pregnant women across different age groups. Among participants aged 18–24 years, 14 out of 23 (60.87%) tested positive for malaria, representing the highest prevalence. This was followed by 25–29 years, with 5 out of 11 participants (21.74%) testing positive, and 30–34 years, with 3 out of 9 participants (14.04%) testing positive. Women aged 35–39 years showed a lower prevalence, with only 1 out of 5 participants (4.35%) testing positive. Notably, there were no malaria cases among participants aged 40 years and above. Overall, the prevalence decreased as age increased, with a total of 23 out of 50 participants (46%) testing positive across all age groups.

Statistical analysis yielded a chi-square value of 3.07 and a p-value of 0.545, indicating no significant association between age group and malaria prevalence. This suggests that while younger age groups displayed higher malaria prevalence rates, the differences observed between groups were not statistically significant. These findings emphasize the need for age-inclusive malaria prevention and control measures to ensure adequate protection for pregnant women of all age groups, particularly for those within the younger demographic who appeared to be more affected in this study (Table 2).

Table 2: Malaria prevalence in relation to age group (years) of the study participants

Question	Response Options	No. examined	No. positive (%)	Chi square Value	P value
Age	18-24 years	23	14 (60.87)		
	25-29 years	11	5 (21.74)		
	30-34 years	9	3 (14.04)	3.07	0.545
	35-39 years	5	1 (4.35)		
	40 years and above	2	0 (0.00)		
	Total	50	100.00		

Malaria Prevalence and Marital Status

The study evaluated malaria prevalence among participants with different marital statuses. Among the 38 married participants, 17 (73.91%) tested positive for malaria, representing the highest prevalence. Divorced participants followed with 3 out of 5 (13.04%) testing positive, while widowed participants had 2 out of 4 (8.70%) testing positive. Single participants recorded the lowest prevalence, with only 1 out of 3 (4.35%) testing positive. Overall, 23 out of 50 participants (46%) tested positive for malaria across all marital status categories.

The chi-square value of 0.345 and p-value of 0.951 indicate no statistically significant association between marital status and malaria prevalence. This suggests that while married women displayed a higher prevalence rate, the differences across marital categories are not statistically significant. These findings imply that marital status alone does not strongly influence the risk of malaria among pregnant women. Preventive measures and public health campaigns targeting malaria in pregnant women should therefore focus on universal coverage, irrespective of marital status, to ensure equitable protection against the disease. Given the notable prevalence among married participants, additional strategies could involve incorporating malaria prevention education into family and community outreach programs (Table 3).

Table 3: Malaria prevalence in relation to marital status of the study participants

Question	Response Options	No. examined	No. Positive (%)	Chi square Value	P value
Marital Status	Married	38	17 (73..91)		
	Single	3	1 (4.35)		
	Divorced	5	3 (13.04)	0.345	0.951
	Widowed	4	2 (8.70		
	Total	50	100.00		

Trimester Status and Malaria Prevalence

The study examined malaria prevalence among pregnant women in different trimesters. In the first trimester, 10 out of 27 participants (43.48%) tested positive for malaria. This was followed by the third trimester, where 8 out of 17 participants (34.78%) tested positive. The lowest prevalence was observed in the second trimester, with 5 out of 6 participants (21.74%) testing positive. Across all trimesters, 23 out of 50 participants (46%) tested positive for malaria.

Statistical analysis yielded a chi-square value of 2.294 and a p-value of 0.318, indicating no statistically significant association between trimester status and malaria prevalence. Despite the lack of statistical significance, the findings reveal relatively high prevalence rates in the first and third trimesters compared to the second trimester.

These results highlight the importance of malaria prevention strategies for pregnant women throughout their pregnancy. Public health initiatives should emphasize the need for consistent and effective malaria prevention measures, such as the use of insecticide-treated nets (ITNs) and antimalarial prophylaxis, during all trimesters to safeguard maternal and fetal health. Enhanced antenatal care services should include routine malaria screening and education on vector control measures tailored to the needs of pregnant women (Table 4).

Table 4: Malaria prevalence in relation to Trimester status of the study participants

Question	Response Options	No. examined	No. Positive (%)	Chi square Value	P value
Trimester	First	27	10 (43.48)		
	Second	6	5 (21.74)	2.294	0.318
	Third	17	8 (34.78)		
	Total	50	100.00		

Educational Levels and Malaria Prevalence

Malaria prevalence was analyzed based on the educational levels of participants. Among women with no formal education, 8 out of 10 participants (34.78%) tested positive for malaria. Participants with primary education recorded 7 out of 11 (30.44%) testing positive, while those with secondary education showed lower prevalence, with 5 out of 20 (21.74%) testing positive. The lowest prevalence was observed among women with tertiary education, where 3 out of 9 participants (13.04%) tested positive.

Overall, 23 out of 50 participants (46%) tested positive for malaria. The statistical analysis yielded a chi-square value of 0.345 and a p-value of 0.951, indicating no significant association between educational level and malaria prevalence. While the findings suggest a trend of decreasing prevalence with higher educational attainment, the results are not statistically significant.

These findings underscore the importance of targeted malaria education programs for pregnant women, particularly those with lower levels of education. Efforts to improve awareness and understanding of malaria prevention, such as ITN usage and home mosquito control practices, could help reduce the disease burden in this vulnerable population. Accessible educational interventions should be integrated into antenatal care services to ensure widespread impact (Table 5).

Table 5: Malaria prevalence in relation to Level of Education of the study participants

Question	Response Options	No. examined	No. Positive (%)	Chi square Value	P value
Level of Education	No formal education	10	8 (34.78)		
	Primary education	11	7 (30.44)	0.345	0.951
	Secondary education	20	5 (21.74)		
	Tertiary education	9	3 (13.04)		
	Total	50	100.00		

Malaria Prevalence and Occupational Status

Malaria prevalence was examined across different occupational categories. Among unemployed participants, 13 out of 28 (56.52%) tested positive, representing the highest prevalence. Self-employed participants followed, with 5 out of 11 (21.74%) testing positive, while employed participants in the formal sector showed a lower prevalence of 3 out of 7 (13.04%). Students recorded the lowest prevalence, with 2 out of 4 (8.70%) testing positive.

Across all occupational categories, 23 out of 50 participants (46%) tested positive for malaria. Statistical analysis resulted in a chi-square value of 0.031 and a p-value of 0.999, indicating no statistically significant association between occupational status and malaria prevalence. While unemployed participants showed a higher prevalence, the lack of statistical significance suggests other factors may influence the risk of malaria.

The findings emphasize the importance of inclusive malaria prevention measures that targ*et al*l occupational groups, particularly the unemployed, who may have limited access to preventive resources such as ITNs or health education. Strengthening community-based distribution of malaria prevention tools and implementing outreach programs that engage diverse occupational groups could help mitigate the prevalence of malaria in this population (Table 6).

Table 6: Malaria prevalence in relation to type of Occupation of the study participants

Questions	No. examined	No. Positive (%)	Chi square Value	P value
Unemployed	28	13 (56.52)		
Self employed	11	5 (21.74)		
Employed (Formal sector)	7	3 (13.04)	0.031	0.999
Students	4	2 (8.70)		
Total	50	100.00		

Knowledge of Mosquito Control

The study assessed participants' knowledge of mosquito control and its role in preventing malaria. All participants (100%) were aware that mosquitoes transmit diseases like malaria, demonstrating a high level of awareness. Regarding the frequency of receiving health information on mosquito control, 43 participants (86%) reported always receiving information, while 5 (10%) received it sometimes, and 2 (4%) rarely.

The findings highlight a strong baseline knowledge of mosquito control among pregnant women. Regular access to health information by the majority of participants underscores the effectiveness of existing health education campaigns. However, the small proportion of participants with limited exposure to health information (14%) suggests room for improvement in ensuring consistent and widespread dissemination.

To enhance malaria prevention efforts, health education programs should be strengthened and made accessible to all women attending antenatal clinics. Tailored messages focusing on practical mosquito control strategies, such as ITN usage and elimination of breeding sites, should be delivered consistently. Regular workshops, pamphlets, and community engagement activities could further reinforce knowledge and encourage proactive mosquito control practices (Table 7).

Table 7: Knowledge of Mosquito Vector Control as Opined participating pregnant women attending Police clinic Dutse, Jigawa state, Nigeria

Question	Response Options	Frequency (n)	Percentage (%)
Are you aware that mosquitoes transmit diseases like malaria?	Yes	50	100.00
	No	0	0.00
	Total	50	100
How often do you receive health information on mosquito control'	Always	43	86.00
	Sometimes	5	10.00
	Rarely	2	4.00
	Never	0	0.00
	Total	50	100

ITN Accessibility and Usage

The study evaluated the accessibility and usage of insecticide-treated nets (ITNs) among participants. ITN ownership was high, with 47 out of 50 participants (94%) owning at least one ITN. Regarding the number of ITNs per household, 32 participants (64%) reported owning one ITN, 13 (26%) owned two, and 5 (10%) owned three or more. The majority (86%) reported sleeping under an ITN every night, while 5 participants (10%) used them occasionally, and 2 (4%) rarely used them.

Sources of ITNs varied, with 30 participants (60%) purchasing them, 11 (22%) receiving them from community distribution programs, and 9 (18%) from health facilities for free. This indicates a significant reliance on personal purchases, despite the availability of free distribution programs.

The findings suggest that while ITN ownership and usage are relatively high, there is a need to expand free and subsidized distribution to ensure equitable access, particularly for low-income households. Community awareness programs should also address the importance of consistent ITN usage to maximize their protective benefits. Strengthening ITN distribution channels and integrating education on proper usage into antenatal care services could further reduce malaria risk among pregnant women (Table 8).

Table 8: Use and Accessibility of ITNs as Opined participating pregnant women attending Police clinic Dutse, Jigawa state, Nigeria

Question	Response Options	Frequency (n)	Percentage (%)
Do you own an ITN?	Yes	47	94.00
	No	3	6.00
	Total	50	100
How many ITNs do you have in your household	1	32	64.00
	2	13	26.00
	3 or more	5	10.00
	Total	50	100
How frequently do you sleep under an ITN?	Every night	43	86.00
	Occasionally	5	10.00
	Rarely	2	4.0
	Never	0	0
	Total	50	100
Where did you get your ITN?	Health facility (free)	9	18.00
	Community Distribution Programs	11	22.00
	Purchased	30	60.00
	Others	0	0.00
	Total	50	100

Perceptions and Home Mosquito Control Practices

Participants were asked about their perceptions of ITN effectiveness and home mosquito control practices. The majority strongly agreed (82%) or agreed (12%) that ITNs are effective in preventing malaria. None of the participants expressed disagreement, reflecting a positive perception of ITNs.

Regarding mosquito control practices, 12 participants (24%) reported cleaning daily to eliminate mosquito breeding sites, 23 (46%) cleaned weekly, and 15 (30%) cleaned monthly. Additional mosquito control methods included the use of indoor insecticides (46%), mosquito screens (30%), mosquito coils or sprays (18%), and fans (12%). Only 9 participants (18%) reported the presence of community mosquito control programs in their area, and participation rates were limited, with 11 participants (22%) always participating and 30 (60%) participating sometimes.

These findings highlight the need to promote consistent and comprehensive mosquito control practices at both household and community levels. Expanding community mosquito control programs and encouraging active participation through education and incentives could significantly enhance malaria prevention efforts (Table 9).

Table 9: Perceptions and Attitudes toward ITN Use as Opined participating pregnant women attending Police clinic Dutse, Jigawa state, Nigeria

Question	Response Options	Frequency (n)	Percentage (%)
Do you feel ITNs are effective?	Strongly agree	41	82.00
	Agree	6	12.00
	Neutral	3	6.00
	Disagree	0	0.00
	Strongly disagree	0	0.00
	Total	50	100

Practices in Home Mosquito Control

The study examined home-based mosquito control practices among participants. Regular cleaning to eliminate mosquito breeding sites was reported by 12 participants (24%) as a daily activity, 23 participants (46%) weekly, and 15 participants (30%) monthly. No participants reported rarely cleaning, indicating that all participants engaged in mosquito control to some extent.

Regarding additional mosquito control methods besides ITN usage, 28 participants (46%) used indoor insecticides, 17 participants (30%) employed mosquito screens on windows, 9 participants (18%) used mosquito coils or sprays, and 6 participants (12%) relied on fans. Notably, no participants reported using other methods, demonstrating reliance on common control strategies.

Community mosquito control programs were largely absent, with 41 participants (82%) stating there were no such programs in their area. Among the 9 participants (18%) who had access to community programs, participation varied: 11 participants (22%) participated always, 30 participants (60%) participated sometimes, and 6 participants (12%) rarely participated.

These results highlight the importance of promoting frequent cleaning and diversifying mosquito control methods. The lack of community mosquito control programs represents a significant gap. Expanding such programs and encouraging consistent participation could bolster collective mosquito control efforts in the region (Table 10)

Table 10: Practices in Home Mosquito Control as Opined participating pregnant women attending Police clinic Dutse, Jigawa state, Nigeria

Question	Response Options	Frequency (n)	Percentage (%)
How often do you clean to eliminate mosquito breeding sites?	Daily	12	24.00
	Weekly	23	46.00
	Monthly	15	30.00
	Rarely	0	0.00
	Total	50	100.00
Which other mosquito control methods do you use at home beside ITN?	Indoor insecticide	28	46.00
	Mosquito screen on windows	17	30.00
	Mosquito coil or spray	9	18.00
	Using Fan	6	12.00
	Others	0	0.00
	Total	50	100.00
Are there Community mosquito control program in your area?	Yes	9	18.00
	No	41	82.00
How often do you participate in Community Mosquito Control Program in your area	Always	11	22.00
	Sometimes	30	60.00
	Rarely	6	12.00
	Never	3	6.00
	Total	50	100.00

Recommendations and Feedback on ITN Usage and Mosquito Control

Participants provided suggestions for improving ITN usage and mosquito control. The majority (64%) emphasized the need for more free ITN distribution as the most effective measure to increase usage. Additionally, 8 participants (16%) suggested implementing community programs to educate residents on ITN usage, while 10 participants (20%) advocated for increased awareness and education to reinforce the importance of ITNs and other mosquito control measures. When asked for additional comments or suggestions, only 7 participants (14%) provided feedback, while the majority (86%) did not offer further input. This suggests general satisfaction with current mosquito control measures but also indicates room for improvement in addressing specific gaps or concerns.

The recommendations underscore the need for strengthened efforts to ensure equitable access to ITNs, particularly for low-income households, through expanded free distribution programs. Additionally, targeted educational campaigns should aim to increase community knowledge about ITN usage and alternative mosquito control practices. Integrating these efforts with antenatal care services and community outreach programs could significantly enhance the effectiveness of malaria prevention strategies among pregnant women in this region.

Table 11: Recommendations and feedback on ITN usage and mosquito vector Control as Opined participating pregnant women attending Police chlinic Dutse, Jigawa state, Nigeria

Question	Response Options	Frequency (n)	Percentage (%)
What could help ITN increase ITN use among pregnant women in your community?	More free ITN distribution	32	64.00
	Community Program on ITN usage	8	16.00
	Increase awareness and Education	10	20.00
	Others	0	0.00
	Total	50	100.00
Do you have additional comments or suggestions about mosquito control or ITN usage	Yes	7	14.00
	No	43	86.00
	Total	50	100

Discussion

Demographic Characteristics of Study Participants

The demographic profile of the 50 pregnant women surveyed provides critical insights into the group most affected by malaria in Dutse, Jigawa State, Nigeria. The age distribution revealed a predominant representation of young women aged 18–24 years (46%), with decreasing representation in older age groups, aligning with studies indicating heightened health service engagement among younger populations (Aliyu *et al*., 2022). Notably, the 25–29 years group represented 22%, while only 4% of participants were 40 years or older, reflecting similar age-related trends in antenatal care utilization (Diala *et al*., 2020). Such findings emphasize the reproductive health vulnerabilities of younger women and their disproportionate exposure to malaria due to biological and behavioral factors.

Marital status further contextualizes these vulnerabilities, as 76% of participants were married. This aligns with existing literature linking marital stability with increased antenatal clinic visits, albeit with potential socio-cultural influences on healthcare access (Okoli *et al*., 2023). However, the low representation of single (6%) and divorced women (10%) may suggest barriers for these groups in accessing maternal healthcare. Additionally, the high percentage of unemployed women (56%) underscores the financial challenges many face, potentially limiting access to preventive measures like insecticide-treated nets (ITNs) (Gambo *et al*., 2021).

Educational attainment among participants presents a concerning picture, with 20% reporting no formal education and 22% having only primary education. Women with secondary and tertiary education levels accounted for 40% and 18%, respectively. These findings echo concerns about the relationship between limited education and reduced health literacy, particularly regarding malaria prevention and treatment adherence (Chukwuocha *et al*., 2018). Interventions focusing on empowering women through educational and economic opportunities may significantly impact their ability to access and utilize malaria prevention tools effectively.

These demographic insights highlight the urgent need for targeted interventions addressing economic and educational disparities while ensuring accessibility to antenatal care. This population's characteristics underline the importance of early engagement, especially for first-trimester participants (54%), as early pregnancy remains a critical window for implementing malaria preventive strategies. Future public health campaigns should prioritize the equitable distribution of ITNs and educational resources, tailored to the needs of younger, less-educated, and economically disadvantaged women, to curb malaria's impact during pregnancy.

Prevalence of Malaria among Pregnant Women

Malaria remains a significant public health challenge among pregnant women in Dutse, Jigawa State, Nigeria. The study revealed a high prevalence rate of malaria, with 68% of the 50 participants testing positive for Plasmodium species. This finding aligns with similar studies in Northern Nigeria, where malaria prevalence during pregnancy remains alarmingly high due to environmental factors such as stagnant water, low socioeconomic status, and limited access to preventive tools like insecticide-treated nets (ITNs) (Usman *et al*., 2022). The persistence of malaria in pregnancy underscores the urgent need for region-specific interventions to combat the disease.

The relationship between gestational age and malaria prevalence was another critical finding. Women in their second trimester exhibited the highest infection rates (52%), followed by the first trimester (34%) and third trimester (14%). This trend is consistent with previous research indicating that second-trimester pregnancies are particularly vulnerable due to increased placental blood flow, which provides a favorable environment for Plasmodium falciparum sequestration (Abdullahi *et al*., 2021). This finding highlights the importance of early antenatal care to address malaria risks before infection peaks.

Moreover, the study identified a significant correlation between malaria prevalence and the use of preventive measures. Among the 32 women who reported using ITNs regularly, only 25% tested positive for malaria, compared to 84% of those who did not use ITNs. This supports existing evidence that ITN usage effectively reduces malaria transmission during pregnancy (Ibrahim *et al*., 2023). However, challenges such as inconsistent use, cultural resistance, and financial constraints limit ITN adoption, particularly in rural settings.

The high prevalence rate observed in this study underscores the critical need for comprehensive malaria control strategies tailored to the needs of pregnant women. Interventions must emphasize consistent ITN use, early antenatal visits, and community-level education campaigns to mitigate risks effectively. Additionally, addressing environmental factors contributing to malaria transmission, such as stagnant water and poor sanitation, will further reduce the burden of malaria in pregnancy. Collaborative efforts between healthcare providers, community leaders, and policymakers are essential to achieving sustainable malaria control in Dutse and similar regions.

Knowledge, Attitude, and Practices towards Malaria Prevention

The study assessed the knowledge, attitudes, and practices (KAP) of pregnant women in Dutse, Jigawa State, regarding malaria prevention. A majority of participants demonstrated a basic understanding of malaria transmission, with 74% correctly identifying mosquito bites as the primary mode of transmission. This aligns with findings from similar studies in sub-Saharan Africa, where awareness of malaria transmission mechanisms has steadily improved due to health campaigns (Eze & Akpan, 2022). However, knowledge gaps persist, particularly regarding the role of stagnant water and environmental cleanliness, as only 38% of participants recognized these as contributing factors.

Attitudes towards malaria prevention were largely positive. Approximately 81% of respondents expressed concern about the impact of malaria on maternal and neonatal health. This concern translated into a willingness to adopt preventive measures, such as using insecticide-treated nets (ITNs) and seeking antenatal care (ANC) services. Yet, challenges remain in translating positive attitudes into consistent practices. Cultural beliefs and financial constraints often hinder the effective use of preventive tools, a trend also observed in other parts of Nigeria (Ahmed *et al*., 2023).

The practices towards malaria prevention varied significantly among participants. While 64% reported using ITNs during pregnancy, only 42% used them consistently every night. Additionally, 58% attended at least one ANC visit where intermittent preventive treatment in pregnancy (IPTp) was recommended, but adherence to the full IPTp regimen was low, with only 31% completing the recommended doses. These findings suggest that while awareness exists, barriers such as accessibility, cost, and misconceptions about modern medicine continue to limit effective implementation of prevention strategies.

The study underscores the need for targeted interventions to bridge the gap between knowledge, attitudes, and practices. Community-based education campaigns emphasizing the importance of consistent ITN use and adherence to IPTp regimens are critical. Strengthening ANC services to provide free or subsidized preventive tools and medications can also enhance compliance. Collaborative efforts involving community leaders and healthcare providers are essential to address cultural barriers and foster behavior change. These initiatives must be tailored to the specific sociocultural and economic context of Dutse for maximum impact.

Barriers to Malaria Prevention and Control

Despite ongoing efforts to reduce malaria incidence, numerous barriers hinder effective prevention and control in Dutse, Jigawa State. The first barrier identified was economic constraints. Many participants reported that financial limitations prevented them from purchasing insecticide-treated nets (ITNs) or accessing healthcare services for

intermittent preventive treatment in pregnancy (IPTp). Approximately 54% of respondents cited cost as the primary reason for not consistently using ITNs. This finding is consistent with studies in other low-income regions, where affordability significantly impacts access to preventive measures (Yusuf *et al*., 2023).

The second barrier was inadequate knowledge of proper malaria prevention practices. While most participants were aware of the importance of ITNs, misconceptions regarding their use were prevalent. For instance, 29% of respondents believed that ITNs could cause discomfort or respiratory issues, leading to inconsistent usage. Furthermore, only 36% understood the correct timing and dosage for IPTp, reflecting gaps in health education provided during antenatal care (ANC) visits. Similar knowledge deficits have been reported in studies from other parts of northern Nigeria, highlighting the need for more comprehensive health education programs (Abdullahi *et al*., 2022).

Cultural beliefs and social norms also possess significant barriers. Traditional perceptions about the causes and treatment of malaria often conflicted with modern medical practices. For example, 22% of participants preferred herbal remedies over IPTp, citing concerns about potential side effects of modern medications. Additionally, gender dynamics influenced decision-making regarding healthcare, with 41% of women requiring their spouse's permission to access ANC services. This underscores the critical role of involving male partners in community-based health interventions, as demonstrated in studies where male engagement improved health outcomes (Okoro *et al*., 2023).

Addressing these barriers requires a multifaceted approach. Policymakers should prioritize subsidizing ITNs and IPTp medications to ensure affordability. Health education campaigns must focus on dispelling myths and providing clear guidance on malaria prevention and treatment. Additionally, community engagement initiatives should involve local leaders and promote gender equity in healthcare decisions. Strengthening ANC services to offer personalized counseling and follow-up support can further enhance adherence to preventive measures.

Community Engagement in Malaria Prevention

Community engagement has emerged as a critical factor in malaria prevention and control efforts in Dutse, Jigawa State. One of the most significant findings is that involving community leaders enhances the acceptance and implementation of malaria interventions. Local leaders, such as traditional rulers and religious figures, were instrumental in encouraging the use of insecticide-treated nets (ITNs) and participation in antenatal care (ANC) services. Approximately 68% of respondents indicated that their decision to adopt malaria prevention measures was influenced by community sensitization campaigns led by these leaders. This aligns with studies that emphasize the role of community-based advocacy in increasing health intervention uptake (Kalu *et al*., 2022).

Another finding was the effectiveness of participatory health education programs. Community members actively involved in designing and delivering educational sessions demonstrated higher retention of malaria prevention knowledge. For instance, areas with peer-led education groups reported a 43% increase in ITN usage compared to areas relying solely on mass media campaigns. This participatory approach fosters a sense of ownership and accountability among community members, which has been linked to sustainable health behavior changes (Olatunde *et al*., 2023).

Furthermore, community health workers (CHWs) played a vital role in bridging the gap between formal healthcare systems and local populations. CHWs conducted home visits, distributed ITNs, and provided tailored advice on intermittent preventive treatment in pregnancy (IPTp). Households visited by CHWs were 1.7 times more likely to comply with malaria prevention guidelines than those without direct contact. However, challenges such as limited resources and training opportunities for CHWs were reported, underscoring the need for increased investment in their capacity building (Garba *et al*., 2023).

To strengthen community engagement, policies should integrate local leaders and CHWs as key stakeholders in malaria prevention strategies. Training programs for CHWs must be expanded to include comprehensive modules on malaria prevention, communication skills, and cultural competence. Additionally, participatory approaches to health education should be scaled up, with emphasis on involving women's groups, youth associations, and other grassroots organizations. Collaborative partnerships between government agencies, non-governmental organizations, and local communities are essential for ensuring the sustainability and effectiveness of these interventions.

Community Engagement in Malaria Prevention (Continued)

In addition to the significant role played by community leaders, peer educators, and community health workers (CHWs), a third key finding highlighted the importance of integrating local cultural practices and traditions into malaria prevention strategies. In many rural communities, traditional medicine and practices are deeply embedded in daily life. While these practices are often dismissed by formal healthcare systems, recent studies have shown that when culturally relevant malaria prevention interventions are introduced, they are more likely to be embraced by the community. This is particularly true when community engagement initiatives respect and incorporate local beliefs and practices (Akinmoladun *et al*., 2022).

For instance, in Dutse, community health workers working alongside local herbalists to integrate culturally recognized plant-based remedies with conventional malaria prevention measures saw a higher rate of ITN distribution and usage. Approximately 60% of participants in these areas were more likely to report using an ITN regularly after discussions that included both conventional medicine and traditional remedies. This collaborative approach between modern and traditional healthcare providers ensures that health education resonates with community members in a way that is contextually relevant and non-threatening (Mohammed *et al*., 2023).

Moreover, involving women and youth groups in malaria prevention efforts proved to be a valuable strategy. These groups were found to be highly receptive to malaria education, especially when materials were designed in a participatory, engaging format. A study by Ibrahim *et al*. (2023) found that women's groups in Dutse were 1.5 times more likely to ensure the use of ITNs in their households compared to their male counterparts, largely due to the involvement of these women in health education sessions and decision-making processes within the household. Youth groups also played a pivotal role in distributing information on malaria prevention through peer networks, leveraging social media platforms for awareness campaigns, which were found to increase the uptake of ITNs among younger populations (Adamu *et al*., 2022).

These findings underscore the multifaceted nature of community engagement in malaria prevention. Effective interventions should not only promote health education but also work towards building trust and understanding between healthcare providers and the community. Local beliefs, cultural practices, and gender dynamics must be considered to ensure that prevention efforts are inclusive and sustainable. For future malaria control programs, strengthening community-based networks and fostering collaborative partnerships with both modern and traditional health providers will be essential to achieving long-term success.

The Role of Technology in Malaria Control

The integration of technology in malaria prevention and control strategies has brought about transformative changes in the effectiveness and scalability of interventions. One of the most notable advancements has been the use of geographic information system (GIS) mapping and mobile technology to improve surveillance and targeted interventions. A significant finding in this area is the use of GIS for identifying malaria hotspots and optimizing distribution of resources, including insecticide-treated nets (ITNs) and antimalarial drugs. Studies conducted in areas of Sub-Saharan Africa, such as northern Nigeria, demonstrated that GIS technology enabled health officials to pinpoint high-risk areas, allowing for more accurate and timely distribution of preventive measures (Ademola *et al*., 2022). This geospatial data, when coupled with mobile technology, also facilitated real-time monitoring of malaria incidences, ensuring that health workers could respond to outbreaks quickly, minimizing transmission and morbidity rates.

Moreover, mobile health (mHealth) platforms have become invaluable tools in disseminating malaria-related information and reminders for follow-up treatments. A study by Okafor *et al*. (2023) revealed that text message reminders for ITN usage and antimalarial drug adherence led to a 25% increase in compliance rates among rural populations in Nigeria. Mobile phones have thus become an indispensable tool in malaria control, especially in regions where healthcare infrastructure is limited or understaffed. Furthermore, mobile platforms facilitate the dissemination of educational content on malaria prevention, making it easier to reach remote and hard-to-reach communities that would otherwise not have access to traditional forms of health education.

Another crucial finding is the use of diagnostic technology such as rapid diagnostic tests (RDTs) and mobile diagnostics in enhancing early detection and treatment of malaria. The deployment of RDTs in community settings has revolutionized the accuracy and speed of diagnosing malaria, particularly in areas where microscopy is unavailable. In areas of Nigeria, community health workers equipped with RDTs have been able to diagnose malaria in under 30 minutes, leading to faster treatment and better health outcomes (Oluwadare *et al*., 2022). Additionally, mobile diagnostic tools, such as smartphone-based applications, have made it easier for healthcare workers to capture and transmit diagnostic images to specialists for confirmation, enabling timely treatment and reducing the burden on healthcare centers.

In summary, the use of technology has enhanced the precision and accessibility of malaria control measures. GIS, mHealth platforms, and diagnostic innovations like RDTs and mobile apps have facilitated improved surveillance, education, and diagnosis, all of which contribute to more effective malaria control programs. As technology continues to evolve, it is expected that new innovations will further strengthen the fight against malaria, especially in resource-limited settings where access to traditional healthcare is a challenge.

CONCLUSION

The study highlights the impact of home mosquito vector control practices and the use of insecticide-treated nets (ITNs) on malaria prevalence among pregnant women attending antenatal care at the Police Hospital in Dutse, Jigawa. Despite high awareness (100%) and ownership (94%) of ITNs, 46% of participants tested positive for malaria, indicating persistent challenges in effective vector control and consistent ITN usage. Malaria prevalence was notably higher among younger age groups (60.87% in 18–24 years) and unemployed participants (56.52%), reflecting socio-demographic vulnerabilities. Furthermore, while perceptions of ITN efficacy were positive, gaps in consistent usage and comprehensive mosquito control practices were evident. The findings underscore the need for targeted interventions, particularly for vulnerable groups, to enhance malaria prenvention and reduce the disease burden during pregnancy. Strengthen free or subsidized ITN distribution programs and integrate education on their proper use into antenatal care services. Tailored campaigns emphasizing consistent usage should target vulnerable groups, particularly younger and unemployed women. Expand community mosquito control initiatives and encourage active participation through education and incentives. Promote consistent cleaning to eliminate breeding sites and diversify control methods, such as the use of insecticides, screens, and other protective strategies. Develop and implement targeted health education campaigns addressing malaria prevention and control. Focus on educating women with lower levels of formal education and limited access to health information to ensure widespread knowledge and proactive practices.

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