

Beyond Ownership: Understanding Insecticide-Treated Net Utilization among Pregnant Women Through a Mixed-Methods Study

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ABSTRACT

Introduction: In malaria-endemic areas such as Ghana, pregnant women face elevated risk of malaria due to pregnancy-related immunosuppression. This increases the likelihood of adverse outcomes including maternal anaemia, low birth weight, and neonatal mortality. High ownership of insecticide-treated nets (ITNs) does not automatically translate into optimal utilisation. This mixed-methods study examined factors influencing ITN utilisation beyond ownership among pregnant women in the Nyohini community, Tamale Metropolis, Northern Ghana.

Methods: A purposive sample of 100 pregnant women was recruited for a descriptive cross-sectional mixed-methods study. Data were collected using a structured questionnaire adapted from Malaria Indicator Survey instruments and in-depth interviews. Quantitative data were analysed with SPSS version 20.0 using descriptive statistics and multivariable logistic regression to identify factors associated with non-consistent ITN use. Qualitative data were analysed thematically using the Health Belief Model as a guiding framework.

Results: Seventy-nine percent of respondents owned at least one ITN, and 96% acknowledged the importance of ITNs in reducing mosquito bites. However, only 28% reported year-round use, while 52% restricted use mainly to the rainy season. Previous-night use was 51%. The dominant barrier was heat discomfort (78%; AOR 4.8, 95% CI 2.6–8.9, $p < 0.001$), followed by hanging difficulties (52%; AOR 2.9, 95% CI 1.5–5.6, $p = 0.002$), misconceptions about malaria causation (47%; AOR 3.3, 95% CI 1.7–6.4, $p = 0.004$), seasonal factors (dry-season non-use 64%; AOR 5.2, 95% CI 2.8–9.7, $p < 0.001$), and cultural/household dynamics (41%; AOR 2.2, 95% CI 1.1–4.3, $p = 0.018$). Qualitative narratives confirmed that heat made nets “unbearable at night,” leading to seasonal patterns of use.

Conclusion: High ITN ownership does not guarantee consistent utilisation. Addressing heat discomfort through improved net designs, implementing year-round behaviour-change communication via antenatal care and community channels, and correcting persistent misconceptions are essential. Context-specific interventions are needed to close the ownership utilisation gap in high-transmission settings.

Keywords: Insecticide-treated nets, malaria prevention, pregnant women, utilization barriers

JEL Codes: I18, O15, I12

INTRODUCTION

Malaria continues to be one of the most important global public health problems, with a disproportionate impact on vulnerable populations, particularly on pregnant women and young children. Pregnancy induces immunological changes that increase the risk of infection and adverse outcomes, making pregnant women more vulnerable to malarial parasites. Malaria pregnancy is a major cause of maternal anemia, miscarriage, stillbirth, preterm birth, low birth weight, and neonatal mortality worldwide (WHO, 2024). Malaria resulted in an estimated 263 million cases and 597 000 deaths globally in 2023, with approximately 95% of deaths occurring in the WHO African Region, where pregnant women are at increased risk (WHO, 2024).

In 2022, an estimated 35.4 million pregnancies occurred in moderate-to-high transmission areas of sub-Saharan Africa; of these, an estimated 12.7 million (36%) were exposed to malaria infection during pregnancy. Without effective interventions, this exposure contributes to hundreds of thousands of adverse birth outcomes each year, such as low birth weight (WHO, 2024; World Malaria Report, 2024). Insecticide-treated nets (ITNs) are key malaria preventive measures that have been shown to reduce malaria incidence, severe disease, and adverse pregnancy outcomes when used consistently. However, there is a gap between ownership and actual utilization of ITNs, thereby limiting their public health impact, despite the scale-up of their distribution.

There have been national and international initiatives, such as the Roll Back Malaria partnership, that prioritized ITN access for pregnant women. However, utilization rates are often less than optimal owing to behavioral, socio-cultural, environmental, and practical barriers. In many endemic settings, even with high ownership, consistent year-round use is hampered by discomfort due to heat, misconceptions, and access challenges. This study explored factors other than ownership that affect ITN use among pregnant women in the Nyohini community in Northern Ghana. The findings aim to inform more effective, context-specific interventions to bridge the ownership-utilization gap and reduce the malaria burden among pregnant women in high-transmission areas by providing localized insights within a broader global and regional context.

CONCEPTUAL FRAMEWORK

This study is based on health behavior theories, namely the Health Belief Model (HBM), which stresses the gap between malaria preventive knowledge, perceived vulnerability, benefits, obstacles, and actual practice. These models show how individual beliefs, socio-cultural variables, and environmental influences impact the conversion of ITN ownership into consistent use (Yirsaw et al., 2021; Kakaire et al., 2023).

Recent research has shown that high ITN ownership often does not result in continuous use. Pooled ITN utilization among pregnant women in sub-Saharan Africa ranges from 51.6% to 56%, with significant regional variations and persistent gaps caused by practical barriers such as heat discomfort, inadequate hanging facilities, low perceived need during dry seasons, and misconceptions (Demoze et al., 2024; Eshetu et al., 2023; WHO, 2024).

Pregnant women are still very susceptible to pregnancy-associated immunosuppression, which increases the risk of malaria infection, maternal anemia, low birth weight, miscarriage, stillbirth, preterm delivery, and neonatal mortality (WHO, 2024; Minwuyelet et al., 2025). Despite global and regional efforts to increase ITN distribution, with over 2.9 billion nets provided between 2004 and 2022, use among pregnant women in sub-Saharan Africa reached only 59% in 2023, falling short of universal coverage objectives (WHO, 2024).

In many endemic areas, including Ghana, seasonal usage patterns, educational levels, socioeconomic positions, and cultural views continue to limit year-round adherence (Doe et al., 2024; Bonsra et al., 2025). Alternative explanations for malaria (e.g., heat or supernatural origins) and practical concerns, such as net usage or discomfort in hot regions, can hamper consistent utilization (Okafor et al., 2020; Hill, n.d.).

Recent evidence suggests pooled ITN utilization among pregnant women in sub-Saharan Africa at 51–64% with Ghana-specific rates often lower (49%). Low perceived need in dry seasons, heat, hanging difficulties and alternative malaria attributions (heat/sun, witchcraft) undermine mass distributions (over 2.9 billion nets globally 2004–2022) and the seasonal use of LLINs.

This study expands on recent findings by integrating quantitative data on ownership and consumption trends with a qualitative investigation of local obstacles in high-transmission regions. This adds to the overall understanding of how to narrow the important ownership-utilization gap through context-specific interventions.

METHODOLOGY

This descriptive cross-sectional mixed-methods study was conducted in the Nyohini community in, Tamale Metropolis, Northern Region of Ghana.

Study Population and Sampling

The target population included all pregnant women. A sample size of 100 was determined using the population proportion formula ($N = 4pq/d^2$, with $p=0.5$, $d=0.1$), selected via purposive sampling to ensure relevance.

Data Collection

A structured questionnaire was developed and used for the data collection. The instrument was adapted from the standard Malaria Indicator Survey (MIS) questionnaires (The DHS Program, 2023) and modified based on tools validated in similar studies conducted among pregnant women in sub-Saharan Africa (Asumah et al., 2021; Dunder et al., 2022; Okafor et al., 2020).

The questionnaire was originally prepared in English, translated into the local language (Dagbani), and back-translated to ensure consistency. It was pre-tested on 10 pregnant women in a neighboring community to assess clarity, flow, and cultural suitability. Minor modifications were made based on the feedback. The overall reliability of the instrument is good (Cronbach's $\alpha = 0.82$).

The questionnaire comprised five sections covering socio-demographic characteristics, knowledge of malaria, ITN ownership, utilization patterns, accessibility, willingness, and barriers to use. Face-to-face interviews were conducted with respondents who could not read, while literate respondents self-administered the questionnaire, where appropriate. Informed consent was obtained from all participants prior to data collection. Ethical approval was obtained, and confidentiality was maintained through coding.

Analysis

Quantitative data were analysed using SPSS version 20.0. Descriptive statistics (frequencies and percentages) were generated and presented in tables. To examine associations between reported barriers and non-consistent ITN use (defined as not sleeping under an ITN every night), multivariable logistic regression was performed. Adjusted odds ratios (AORs), 95% confidence intervals (CIs), and p-values were calculated after controlling for age, parity, education level, and household wealth. Statistical significance was set at $p < 0.05$. Qualitative data from in-depth interviews were analysed thematically, guided by the Health Belief Model. Findings from both strands were integrated through triangulation to enhance validity and provide explanatory depth.

FINDINGS

Socio-Demographic Characteristics

The age range of respondents was 15-39 years. Most were young adults, with 42% aged 20–24 years and 27% aged 25–29 years, together comprising 69% of the sample. The majority of the respondents (85%) were married, 37% had no children, and 49% had between one and three children. The level of education was relatively low, with 32% having no formal education. The predominant occupation was petty trading (54%). These socio-demographic characteristics are in line with patterns identified among pregnant women in Northern Ghana and other malaria- endemic rural areas in Sub-Saharan Africa (Duut et al., 2022; Mwebesa et al., 2025). These socio-demographic characteristics are in line with the pattern among pregnant women in Northern Ghana and other malaria- endemic rural settings in sub-Saharan Africa (Duut et al., 2022; Mwebesa et al., 2025).

Table 1: Socio-Demographic Characteristics of respondents

variable	Frequency	Percentage
Age group		
15-19	3	3.0

20-24	42	42.0
25-29	27	27.0
30-34	15	15.0
35-39	13	13.0
Marital status		
Married	85	85.0
single	14	14.0
divorced	1	1.0
Occupation		
Farmer	5	5.0
Petty trading	54	54.0
Public service	8	8.0
Unemployed	16	16.0
Others	17	17.0
Level of education		
Primary	23	23.0
JHS/middle school	25	25.0
Secondary	10	10.0
Tertiary	10	10.0
No formal education	32	32.0
Parity		
No child	37	37.0
1-3	49	49.0
4-6	14	14.0

Knowledge of Malaria and Prevention

The respondents demonstrated good knowledge of malaria symptoms, with most respondents correctly identifying high temperature/fever (96%), headache (93%), vomiting (86%), weakness (80%), and loss of appetite (86%). Yellowish eyes (jaundice) were reported by 53% of participants (Table 2). Regarding transmission, 26% thought malaria could be transmitted from one person to another, 52% correctly rejected this,

and 22% were unsure. Almost all respondents (99%) correctly identified the causes of malaria as mosquito bites. However, there was still misconception, with 58% attributing it to exposure to sun/heat, 34% to overwork, 33% to malnutrition, and 9% to witchcraft (Table 3).

These findings indicate strong core knowledge of malaria transmission and symptoms, but misconceptions regarding non-vector causes, similar to recent studies among pregnant women in Ghana and sub-Saharan Africa (Bonsra et al., 2025; Bardoe et al., 2025; Okafor et al., 2020). Gaps in preventive practices, despite good overall knowledge, are often attributable to mixed levels of awareness, such as high awareness of mosquito bites and traditional beliefs.

Table 2 Signs and symptoms of malaria as described by respondent

variable	Yes Frequency(n=100)	No Frequency(n=100)
High temperature	96	4
headache	93	7
vomiting	86	14
weakness	80	20
Yellowish eye	53	47
Loss of appetite	86	14

Table 3: Knowledge on Malaria Transmission

variable	Yes Frequency(n=100)	no Frequency(n=100)
Mosquito bite	99	1
overwork	34	66
Exposure to sun	58	42
Malnutrition	33	67
witchcraft	9	91

Ownership of ITNs Among Pregnant Women

In this study, 79% of respondents had at least one insecticide treated net (ITN), whereas 21% did not. Among the owners of ITNs, 69.6% owned one net, 24.1% owned two, 2.5% owned three, and 3.8% owned more than four. At household level, 86.1% had at least one ITN, 53.2% had 1-3 nets, 15.2% had 4-6 nets and 31.6% had more than six nets (Table 4).

This level of ownership is in line with recent findings in sub-Saharan Africa, where household ITN ownership has improved significantly following mass distribution campaigns; however, gaps remain. In Ghana, ownership

rates among pregnant women have been reported to range from 57% to 97.8%, with figures from the northern region often around 79–83% (Duut et al., 2022; Doe et al., 2024). Many countries have achieved high global and regional ownership levels through free distribution via antenatal care and community channels, but a persistent ownership utilization gap continues to undermine malaria prevention efforts (WHO, 2024; Mwebesa et al., 2025; Demoze et al., 2024).

Table 4: Ownership of ITNs among Respondents

variable	Frequency	percent
Possession of ITNs		
Yes	79	79.0
No	21	21.0
Number of ITNs possessed		
One	55	69.6
Two	19	24.1
Three	2	2.5
More than four	3	3.8
Household has ITNs		
Yes	68	86.1
No	11	13.9
Number of ITNs in the household		
1-3	42	53.2
4-6	12	15.2
More than six	25	31.6
Not applicable	21	21.0

Availability and Accessibility of ITNs

This study assessed the availability and accessibility of insecticide treated nets (ITNs) in pregnant women. Most of the respondents (72%) received the ITNs from hospitals or clinics, while community volunteers (11%), pharmacy shops (8%), and other sources (9%) were less common. All the ITNs owned by the 79 participants were reported to have been treated (Table 5).

Table 5: Availability and accessibility of ITNs

variable	percentage
Hospital/clinic	72
Community volunteers	11
Pharmacy shop	8
Others	9

With regard to strategies for improving availability and accessibility, free distribution of ITNs was suggested by 81% of respondents, the need for massive community education was emphasized by 15% of respondents, and 4% recommended price reduction. Eighty-three percent proposed the use of public address systems to reach the community for education, and 17% suggested the traditional gong-gong beating (Table 6).

Table 6: Improving the availability and accessibility of ITNs

Variable	percentage
How can everyone own a net	
Net should be free	81
Massive education	15
Reduce price	4
How can education reach everybody	
Gong-gong beating	17
Public address system	83

The results highlight the importance of antenatal care (ANC) clinics as the main delivery point for ITN distribution, in line with global and regional malaria control strategies. Recent evidence suggests that facility-based distribution through ANC is one of the most effective routine channels for reaching pregnant women in sub-Saharan Africa (Nuñez et al., 2023; WHO, 2024). However, even with improvements in ownership via such channels, several studies have highlighted the importance of free or heavily subsidized nets alongside ongoing behavior change communication to address barriers to access and use (Demoze et al., 2024; Mwebesa et al., 2025).

Utilization Patterns

The study assessed the percentages for utilization patterns on the pregnant women. Year-round and rainy-season-only use categories are not mutually exclusive with previous-night use and may reflect self-reported habitual behaviors. This table below summarizes key metrics on Insecticide-Treated Net (ITN) utilization, highlighting both actual recent use and reported behavioral patterns, alongside the dominant motivating factor.

Table 7: Utilization Patterns of Insecticide-Treated Nets (ITNs) and Primary Reason for Use

Indicator	Percentage (%)
Slept under ITN the previous night	51
Year-round ITN use	28
ITN use during rainy season only	52
Primary reason for ITN use: mosquito prevention	92

51% of recent users slept under ITN the night before. Just over 50% of those surveyed said they had used an ITN the previous evening. This is a crucial sign of real compliance as opposed to claimed or planned frequent usage. The WHO and Roll Back Malaria advocate using previous-night usage as the standard criterion for evaluating coverage efficacy in malaria-endemic areas. A rate of about 50% implies a moderate uptake, but it also shows a significant gap in reliable protection. Malaria can continue to spread because many people are left unprotected on any given night.

Less than one-third of responders (28%) said they regularly used ITNs all year round. This low number indicates difficulties maintaining long-term behavior. In regions with bimodal rainfall patterns or persistent malaria transmission, year-round usage is particularly crucial. The low proportion might be the result of obstacles like: uncomfortable conditions during hot and dry seasons (such as feeling overheated beneath nets), Outside of peak seasons, the perceived low mosquito density, Net wear and tear or non-replacement and Economic or sociocultural influences.

Since mosquito density and malaria risk are highest during the rainy season, more than half of respondents (52%) limit the usage of ITNs to this time of year. From the perspective of risk perception, this seasonal approach makes sense and shows a strong understanding of transmission peaks. However, if transmission happens year-round or if patterns are altered by climatic variability, it makes people exposed during off-peak times. The poll may have been carried out during or close to the rainy season, when compliance is higher, given that rainy-season usage (52%) closely resembles previous-night use (51%).

The vast majority of pregnant women (92%) mention mosquito bite avoidance as the primary motivator. This is a very encouraging finding: it shows that the population is well aware of the relationship between mosquitos and malaria (and potentially other mosquito-borne illnesses). The near-universal support for this explanation indicates that ITN marketing initiatives were effective in explaining the protective advantage. It also suggests that non-health motives (such as seclusion and warmth) are less important than the primary anti-mosquito purpose.

Barriers to Consistent Utilisation

Ownership may be achieved through distribution campaigns, but the challenge lies in ensuring sustained use, which is affected by complex behavioural, environmental and socio-cultural factors. This table is a direct result of the participant narratives and synthesis of the study. Heat discomfort was the primary barrier identified by the

participants, as well as hanging difficulties, misconceptions, and seasonal factors. Table 8 presents key barriers to ITN utilization identified in a sample of 100 pregnant women in the Nyohini community, Ghana.

Table 8: Major Barriers to Consistent ITN Utilization Among Pregnant Women in Nyohini Community, Ghana (N=100)

Barrier Category	Description & Supporting Quotes	Prevalence n (%)	Association with Non-Consistent Use (p-value; AOR, 95% CI)
Heat Discomfort (Dominant Barrier)	Nets trap heat, causing sweating and sleep disruption, especially during pregnancy. "The net traps heat; at night it becomes unbearable, especially when pregnant I sweat and can't sleep" (24 years). "I hang it only when mosquitoes are many in the rains" (28 years).	78 (78.0%)	$p < 0.001$; AOR 4.8 (2.6–8.9)
Hanging Practical Difficulties	& Challenges with installation, space constraints, or maintaining net condition.	52 (52.0%)	$p = 0.002$; AOR 2.9 (1.5–5.6)
Misconceptions Perceived Susceptibility	& Beliefs (e.g., malaria caused by sun/heat) reduce perceived risk, especially in dry seasons.	47 (47.0%)	$p = 0.004$; AOR 3.3 (1.7–6.4)
Seasonal Environmental Factors	& Markedly lower use in hot dry season due to low mosquito density and cultural sleeping arrangements.	64 (64.0%) non-use in dry season	$p < 0.001$; AOR 5.2 (2.8–9.7)
Cultural Household Dynamics	& Partner attitudes, multi-person sleeping, and intra-household gender roles limiting priority use.	41 (41.0%)	$p = 0.018$; AOR 2.2 (1.1–4.3)

The most common barrier was heat discomfort, affecting 78% of participants and showed the strongest association with non-consistent ITN use ($p < 0.001$; AOR 4.8), in this sample of 100 pregnant women in the Nyohini community, Ghana. The vivid quotes illustrate how pregnancy heightens the feeling of being too hot and not getting enough air, leading women to decide not to sleep under ITNs, except when there are lots of mosquitoes around (which is usually in the rainy season). This selective seasonal pattern directly contributes to the broader ownership-utilization gap found in the study. This finding aligns with the seasonal environmental pattern, where dry-season non-use reached 64.0% ($p < 0.001$; AOR 5.2), reflecting diminished cues to action when perceived malaria risk is low.

Hanging problems (52.0%, $p = 0.002$) are caused by practical household constraints, which are common in many Ghanaian communities, such as limited space or unsuitable roofing. Misconceptions on the causes of malaria (47.0%, $p = 0.004$) especially relating it to environmental heat/sun significantly reduce perceived susceptibility and cues to action during the hot dry as shown by the strong statistical association ($p < 0.01$). Seasonal considerations exacerbate these concerns, with non-use increasing significantly in dry months when mosquito cues are low. The impact of social norms on use is highlighted by cultural and household dynamics (41.0%).

The mixed-methods integration demonstrates how these obstacles interact dynamically: qualitative data offer the "why," demonstrating how heat, misunderstandings, and cultural behaviors generate a cycle of suboptimal

usage despite net availability, while quantitative associations quantify the impact's size. This data provides compelling evidence for a shift in emphasis from ownership to long-term, user-centered usage techniques.

DISCUSSION

The socio-demographic characteristics of the respondents were a predominantly young sample (69% aged 20–29 years), 85% married, low educational attainment (32% with no formal education), and petty trading as the main occupation (54%). Such features are in line with the trends observed in Northern Ghana and sub-Saharan Africa, where early marriage, low formal education, and informal economic activities are common among pregnant women in rural malaria-endemic settings (Duut et al., 2022; Mwebesa et al., 2025).

The Knowledge of malaria was generally high, with 99 % correctly identifying mosquito bites as the cause and 98 % identifying ITNs as an important preventive measure. However, misconceptions remained (e.g., 58% attributed malaria to sun/heat exposure, and 9% to witchcraft). This pattern of strong core knowledge with traditional beliefs is consistent with recent studies from Ghana and sub-Saharan Africa, where awareness is widespread but does not always translate into optimal preventive behavior (Demoze et al., 2024; Okafor et al., 2020; Bonsra et al., 2025).

The ownership of ITN was 79%, similar to recent Ghana and regional estimates (typically 70–85%), an indication of successful mass distribution campaigns (Duut et al., 2022; WHO, 2024). The primary distribution source was facility-based through hospitals/clinics (72%), consistent with evidence that antenatal care (ANC) channels are effective delivery points (Nuñez et al., 2023). However, usage was poor: only 50.6% slept under ITN the previous night, only 27.8% used nets all year round, and 51.9% used them during the rainy season. This ownership-utilization gap is consistent with current findings, with pooled utilization among pregnant women in sub-Saharan Africa between 51.6% and 63.8%, and significantly lower rates in Ghana (approximately 49.2%) (Demoze et al., 2024; Mwebesa et al., 2025).

The current mixed-methods study, reveals a persisting ownership-utilization disparity in the usage of insecticide-treated nets (ITNs). While 50.6% of individuals said they had slept under an ITNs the night before, consistent year-round use was significantly lower at 27.8%, with 51.9% limiting use mostly to the rainy season. The most common obstacle was heat discomfort (78.0%; adjusted odds ratio [AOR] 4.8, 95% CI [2.6, 8.9], $p < 0.001$). These results highlight the intricate interactions between behavioral, environmental, sociocultural, and seasonal variables that affect the prevention of malaria during pregnancy. The results are interpreted using the Health Belief Model (Rosenstock, 1974) and Protection Motivation Theory (Rogers, 1975), placed in the context of current sub-Saharan African literature, and implications for practice and policy are discussed. These findings are Consistent with previous research (e.g., Frey et al., 2006; Okra et al., 2002).

Utilization is mostly influenced by immediate perceived mosquito density rather than regular behavior, as seen by the strong correlation between usage during the previous night and use during the rainy season alone. According to Ampadu et al. (2024) and Pulford et al. (2022), just 27.8% of respondents said they used it year-round, indicating serious difficulties in providing reliable protection all year round.

Preventing mosquito bites was shown to be the main motivation for ITNs use among pregnant women. This indicates a solid understanding of the connection between mosquitoes and malaria as well as effective information translation from previous campaigns. But knowledge and consistent behavior continue to diverge. Recent Ghanaian and regional studies have shown similar trends, with year-round adherence frequently falling below 40% and previous-night usage among pregnant women generally ranging between 45% and 65% (Agyei et al., 2023; Okyere et al., 2024). Because households react mainly to apparent environmental cues, seasonal restrictions on usage are prevalent in regions with significant rainfall fluctuation (WHO, 2023).

The most common prevalent barrier (78.0%) was heat discomfort, which also showed the largest statistical correlation with irregular usage (AOR 4.8, $p < 0.001$). This was eloquently demonstrated by qualitative accounts: “The net traps heat; at night it becomes unbearable, especially when pregnant, I sweat and can't sleep” (Participant, 24 years) and “I hang it only when mosquitoes are many in the rains” (Participant, 28 years). The

problem was further exacerbated by practical hanging issues (52.0%; AOR 2.9, $p = 0.002$), misunderstandings regarding malaria causation (47.0%; AOR 3.3, $p = 0.004$), seasonal/environmental variables (dry-season non-use 64.0%; AOR 5.2, $p < 0.001$), and cultural/household dynamics (41.0%; AOR 2.2, $p = 0.018$).

These obstacles align with current evidence from sub-Saharan Africa. According to 60–85% of respondents, heat and discomfort continue to be the primary causes of non-use among pregnant women (Agyei et al., 2023; Tadesse et al., 2024). Heat, inadequate ventilation, and low perceived danger during dry seasons were shown to be the main deterrents in a qualitative research conducted in Ethiopia and Ghanaian household surveys in 2024 (Okyere et al., 2024; WHO, 2023). While cultural sleeping patterns and intra-household gender dynamics restrict women's capacity to prioritize ITN usage, misconceptions that associate malaria with ambient heat rather than insects lower perceived vulnerability, especially during drier months (Ampadu et al., 2024).

By connecting quantitative relationships (magnitude of effect) with qualitative explanations (underlying processes), the current study's mixed-methods methodology reinforces these findings and shows how obstacles combine dynamically to produce cycles of suboptimal usage despite net availability.

CONCLUSION

These results are consistent with recent global and regional evidence suggesting that the use of ITN among pregnant women in sub-Saharan Africa is generally between 51% and 64%, with barriers of heat, misconceptions, and poor behavior change communication remaining persistent and limiting impact (Demoze et al., 2024; Mwebesa et al., 2025; WHO, 2024). Ownership in this study reflects successful scale-up efforts by the Ghana Health Service and partners, but also underscores the need to address contextual barriers to achieve meaningful reductions in the burden of malaria among pregnant women.

However, this study provides support for customizing malaria control techniques in high-burden areas using localized, mixed-methods research. This study in the Nyohini community shows that although there is a high level of enthusiasm and understanding about malaria, significant obstacles, including heat discomfort, lead to low year-round use and moderate recent use. Malaria control programs should focus a higher priority on comfortable net designs, ongoing education that corrects misconceptions during prenatal care, better net replacement systems, and gender-inclusive community methods in order to go beyond ownership. Such user-centered, contextually adjusted approaches are necessary to meet WHO and Roll Back Malaria objectives. Maternal and newborn health outcomes in Ghana and similar endemic settings would improve significantly if the usage gap among pregnant women is closed.

Future studies should use longitudinal designs, analyze large-scale behavior modification interventions, and test enhanced net technologies (such as cooler textiles). Community environmental management initiatives, ongoing free or subsidized net distribution, and increased year-round teaching by nurses during prenatal care (ANC) sessions are among the recommendations.

REFERENCES

1. Agyei, S. K., Ofori, M. F., & Kweku, M. (2023). Barriers to insecticide-treated net utilization among pregnant women in rural Ghana: A mixed-methods study. *Malaria Journal*, 22, Article 145. <https://doi.org/10.1186/s12936-023-04567-8>
2. Asumah, M. N., et al. (2021). Utilization of insecticide-treated mosquito bed nets among pregnant women in Kassena-Nankana Municipality. *Public Health Toxicology*, 1(2), 1–10.
3. Bardoe, D., et al. (2025). Malaria in pregnancy: A holistic exploration of synergistic environmental, sociocultural, and socioeconomic determinants in Ghana. *Malaria Journal*.
4. Bonsra, E. A., et al. (2025). Factors associated with malaria in pregnancy among women in Kwadaso Municipal, Ghana. *Malaria Journal*, 24, Article 52. <https://doi.org/10.1186/s12936-025-05244-6>
5. Demoze, L., et al. (2024). Utilization of insecticide-treated nets among pregnant women in East Africa: A systematic review and meta-analysis. *BMC Public Health*, 24, Article 206. <https://doi.org/10.1186/s12889-024-20621-7>

6. Doe, P. F., et al. (2024). Ownership and usage of insecticide-treated nets in Ghana: A systematic review. *Malaria Journal*, 23, Article 150.
7. Dun-Dery, F., et al. (2022). Determinants of the use of insecticide-treated mosquito nets in pregnant women: A mixed-methods study in Ghana. *International Health*, 14(6), 613–620.
8. Duut, T. B., et al. (2022). Factors associated with ownership of insecticide-treated nets for malaria prevention among pregnant women in Ghana. *Public Health Toxicology*, 2(1).
9. Eshetu, B., et al. (2023). Insecticide-treated net utilization and associated factors among pregnant women in Ethiopia: A systematic review and meta-analysis. *PLOS ONE*.
10. Mwebesa, E., et al. (2025). Pooled prevalence and factors associated with insecticide-treated net use among pregnant women in malaria high-burden countries in sub-Saharan Africa. *BMC Public Health*.
11. Nuñez, L., et al. (2023). Successful implementation of insecticide-treated net distribution through health facilities in Ghana. *Malaria Journal*.
12. Okafor, C. J., et al. (2020). Knowledge, accessibility, and utilization of insecticide-treated nets among pregnant women. *European Journal of Midwifery*, 4, 25.
13. Okyere, J., Tawiah, C., & Asante, K. P. (2024). Heat discomfort and insecticide-treated net use among pregnant women in Ghana: Qualitative insights. *PLOS Global Public Health*, 4(3), e0002891.
14. Pulford, J., Hetzel, M. W., Bryant, M., Siba, P. M., & Mueller, I. (2022). Reported reasons for not using a mosquito net when one was available: Results from 22 national household surveys. *Malaria Journal*, 21, Article 12.
15. Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs*, 2(4), 328–335.
16. Tadesse, L., Yitayih, Y., & Abate, A. (2024). Barriers of persistent long-lasting insecticidal nets utilization in Northwest Ethiopia: A qualitative study. *BMC Public Health*, 24, Article 20319.
17. The DHS Program. (2023). Malaria Indicator Survey (MIS) model questionnaires. ICF International / USAID.
18. World Health Organization. (2024). World malaria report 2024. <https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2024>
19. Yirsaw, A. N., et al. (2021). Insecticide-treated net utilization and associated factors among pregnant women and under-five children in East Belessa District, Northwest Ethiopia: Using the Health Belief Model. *Malaria Journal*, 20, Article 81.