Factors Associated With Insecticide-Treated Net Utilisation among Pregnant Women Attending Antenatal Care in Kibiya Local Government Area, Kano State, Nigeria

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ABSTRACT

Household ownership of insecticide-treated nets (ITNs) does not ensure that pregnant women sleep under them, and the factors that determine use in rural north-western Nigeria are poorly documented. This study examined the factors associated with ITN utilisation among pregnant women attending antenatal care (ANC) in Kibiya Local Government Area (LGA), Kano State. A facility-based cross-sectional survey of 340 pregnant women, selected by multistage sampling from five primary health centres, used an interviewer-administered questionnaire. The outcome was self-reported ITN use on the previous night (332 valid responses), analysed with chi-square tests and binary logistic regression. Household ownership was 85.6%, but 62.7% of women slept under an ITN the previous night and only 28.2% used one every night over the past 30 days. After adjustment, good knowledge (AOR 2.24; 95% CI 1.28–3.90), favourable attitude (AOR 2.00; 1.19–3.36), four or more ANC visits compared with none (AOR 2.43; 1.12–5.24) and primary education compared with no formal education (AOR 3.33; 1.29–8.59) remained independently associated with use, whereas residence, prior malaria-prevention information and health-worker advice did not. Heat or weather was reported as an influence on use by 75.3% of respondents. These findings are associations from one facility-based sample and do not show cause. Access to nets is not the only constraint on use, and repeated, practical antenatal counselling that addresses barriers such as heat should be strengthened and evaluated.

KEYWORDS

Insecticide-treated nets, malaria in pregnancy, antenatal care, associated factors, Kano State

I. INTRODUCTION

Malaria in pregnancy remains a major threat to maternal and new-born health in sub-Saharan Africa. The World Health Organization (2025) estimated that 13 million of the 36 million pregnancies in 33 moderate- to high-transmission countries of the African Region were exposed to malaria infection in 2024, and Nigeria is one of five countries that together account for more than half of global cases. Pregnancy alters immune responses and increases susceptibility to infection and severe disease, and infection is linked to maternal

anaemia, miscarriage, stillbirth, preterm birth and low birth weight. Insecticide-treated nets (ITNs) are one of the principal tools for protecting pregnant women, yet only 53% of young children and pregnant women and girls in Africa slept under one in 2024.

Nigerian survey data illustrate the gap between access and use. The 2021 Nigeria Malaria Indicator Survey found that 49.6% of pregnant women slept under an ITN the previous night nationally and 59.5% in the North West zone, which includes Kano State (National Malaria Elimination Programme [NMEP], National Population Commission [NPC], & ICF, 2022). In the North West, use rose to 78.3% among pregnant women in households that owned a net, which indicates that access is necessary but not sufficient for use (NMEP et al., 2022). Facility-based work in South-South Nigeria likewise reported that awareness of nets coexisted with inadequate utilisation. Ownership figures alone therefore cannot show whether pregnant women are protected.

Education, wealth, residence, age and media exposure have been linked to ITN use in national analyses, and socio-economic inequity in use during pregnancy has been documented across high-burden countries. Knowing that nets prevent malaria and recognising the harm of malaria in pregnancy were associated with use in Nigeria, as were household circumstances such as the number of nets and sleeping rooms. Antenatal care has been described as a platform through which nets and counselling reach women, while heat, discomfort and difficulty in hanging nets are reported repeatedly as barriers. The strength of these associations differs between settings, so local evidence is needed to guide programmes.

Evidence from Kano State is limited. A post-campaign survey compared net use between women and men but did not examine pregnant women attending ANC. Kibiya LGA is a predominantly rural, farming-based area whose antenatal services are delivered through five apex primary health centres and 18 health posts, and, to our knowledge, no study has described the factors associated with ITN use among pregnant women there.

This paper reports findings from a larger dissertation study on knowledge, attitude and practice regarding ITN utilisation among pregnant women in Kibiya LGA, focusing on one of its objectives: to examine the factors associated with ITN utilisation among pregnant women attending ANC in the LGA, with attention to knowledge, attitude, socio-demographic characteristics and antenatal care contact.

II. MATERIALS AND METHODS

A. Study Design and Area

A descriptive cross-sectional design was used in Kibiya LGA, a predominantly rural and agrarian area of north-western Nigeria divided into ten wards. Health services are provided by 23 public facilities under the Kano State Primary Health Care Management Board, comprising five apex primary health centres (PHCs) (Kibiya, Durba, Sayasaya, Tarai and Kure) and 18 health posts. The study population comprised pregnant women attending ANC at these facilities during the period of data collection.

B. Sample Size and Sampling

The minimum sample size was calculated with Cochran's formula for a single proportion ($Z = 1.96$; $d = 0.05$) using $p = 0.718$, the most recent estimate of ITN use among childbearing women in Northern Nigeria. This gave 312, which was inflated to 347 to allow for 10% non-response. A total of 340 women were enrolled (seven short of the adjusted target), and no design effect was applied for the multistage design.

Multistage sampling was used because no list of pregnant women in the LGA existed. Five of the ten wards (Kibiya I, Durba, Fassi, Tarai and Fammar) were selected by balloting; one facility was selected per ward (Kibiya, Durba, Sayasaya, Tarai and Kure PHCs); and the 340 respondents were allocated equally (68 per facility) and selected on clinic days by systematic sampling from the attendance list, using a sampling interval $K = N/n$ and a random start. Women of any gestational age who usually resided in Kibiya LGA and consented were eligible. Women who were critically ill, who declined consent, or who were not pregnant were excluded.

C. Data Collection Instrument

A structured questionnaire with five sections was developed for the study: socio-demographic and obstetric characteristics (Section A), knowledge of ITNs (Section B, 15 items), and attitude towards ITN use (Section C, five-point Likert scale), practices (Section D) and perceived factors influencing use (Section E, 12 items). The questionnaire was administered face to face in English, with interpretation into Hausa when needed, by the researcher and trained research assistants who were community health workers, in a private part of each facility. Cronbach's alpha for the attitude items in the main sample was 0.807.

D. Variables and Measurement

The outcome was self-reported sleeping under an ITN on the night before the survey, coded yes or no; eight respondents who answered "don't know" were treated as missing, leaving 332 valid observations. Household ownership and frequency of use during the previous 30 days were recorded as separate indicators. Knowledge was scored from 0 to 15 (one point per correct answer), with 12 or more (80%) classified as good knowledge. Attitude scores ranged from 12 to 60 after reverse-coding negatively worded items, with 45 or more (75%) classified as favourable.

E. Data Analysis

Data were coded, cleaned and analysed with SPSS. Categorical variables were summarised as frequencies and percentages, and continuous variables as means and standard deviations. Associations between categorical explanatory variables and previous-night ITN use were tested with the chi-square test, applying the continuity correction to 2×2 tables. Binary logistic regression was used to estimate adjusted odds ratios (AORs) with 95% confidence intervals (CIs), with previous-night use as the outcome and the variables examined in the cross-tabulations entered in the model. Statistical significance was set at $p < 0.05$, and results are described as associations because the study was cross-sectional.

F. Ethical Considerations

Administrative permission was obtained from the Kibiya Primary Health Care Department of the Kano State Primary Health Care Management Board. Participation was voluntary, and respondents were informed of the purpose of the study, the confidentiality of their responses and their right to decline.

III. RESULTS

A. Characteristics of Respondents

Of the 340 respondents, the mean age was 27.7 years (SD 6.3), 91.2% were married and 73.8% lived in rural areas. Household ownership of an ITN was reported by 85.6% (291/340). Among the 332 women with valid responses, 62.7% (208/332) slept under an ITN the previous night. In the preceding 30 days, 28.2% used an ITN every night, 24.4% most nights, 17.6% some nights, 12.9% rarely and 16.8% never (Figure 1).

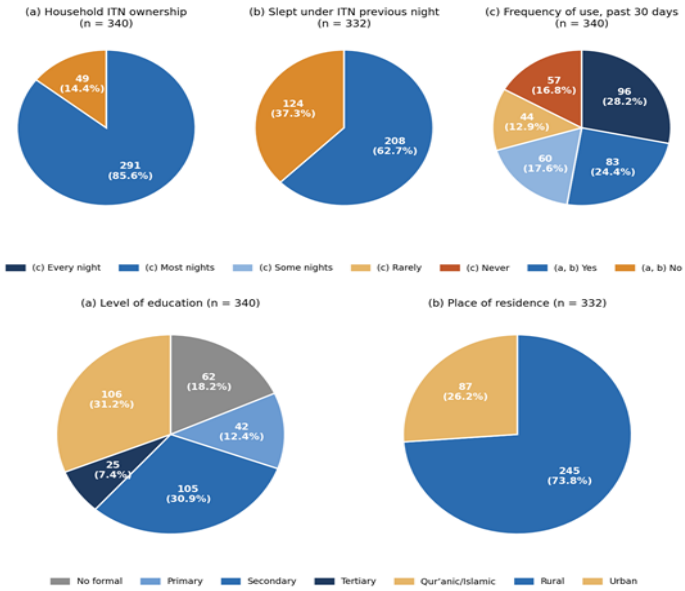


Figure 1: Household ITN ownership, previous-night ITN use and frequency of use in the past 30 days (upper row); respondents by level of education and place of residence (lower row)

B. Bivariate Associations with ITN Use

ITN use on the previous night by each explanatory variable is shown in Figures 2 and 4. Use was higher among women with good knowledge than poor knowledge (78.1% versus 50.5%; $\chi^2 = 25.357$, df = 1, $p < 0.001$) and among women with a favourable than an unfavourable attitude (74.4% versus 48.7%; $\chi^2 = 22.283$, df = 1, $p < 0.001$). Use ranged from 43.5% among women with no formal education to 87.5% among those with tertiary education ($\chi^2 = 24.930$, df = 4, $p < 0.001$), and was higher among urban (75.9%) than rural women (58.0%) ($\chi^2 = 8.046$, df = 1, $p = 0.005$). Use also rose with the number of ANC visits, from 45.0% with no visit to 77.4% with four or more. Age group ($\chi^2 = 5.102$, df = 4, $p = 0.277$) and occupation ($\chi^2 = 1.678$, df = 6, $p = 0.947$) were not associated with use.

C. Factors Independently Associated with ITN Use

Binary logistic regression identified the factors independently associated with ITN use (reference categories: poor knowledge, unfavourable attitude, no formal education, urban residence, no ANC visit, no prior information and no health-worker advice). Good knowledge (AOR 2.24; 95% CI 1.28–3.90; p = 0.005), favourable attitude (AOR 2.00; 95% CI 1.19–3.36; p = 0.008), four or more ANC visits compared with none (AOR 2.43; 95% CI 1.12–5.24; p = 0.024) and primary education compared with no formal education (AOR 3.33; 95% CI 1.29–8.59; p = 0.013) were independently associated with higher odds of use. The estimates for secondary education (AOR 1.74; 95% CI 0.84–3.59), tertiary education (AOR 3.17; 95% CI 0.76–13.20) and Qur'anic or Islamic education only (AOR 1.40; 95% CI 0.70–2.78) were not statistically significant. Rural residence was no longer significantly associated with use after adjustment (AOR 0.68; 95% CI 0.36–1.27; p = 0.225), and neither prior malaria-prevention information (AOR 1.14; 95% CI 0.66–1.99; p = 0.635) nor health-worker ITN advice (AOR 0.81; 95% CI 0.45–1.44; p = 0.465) was independently associated with use. [Insert number of observations in the model, model-fit statistics (e.g., Hosmer–Lemeshow test and Nagelkerke R^2) and collinearity checks from the SPSS output.]

D. Perceived Factors Influencing ITN Use

Figure 3 shows the factors that respondents said affected their own use of nets. Knowledge about malaria prevention (78.2%), availability of an ITN (75.9%) and heat or weather conditions (75.3%) were most frequently endorsed, followed by health-worker advice (67.1%), family support (64.7%) and frequency of ANC attendance (61.5%). Comfort while sleeping (60.6%), the condition of the net (58.5%) and previous experience with malaria (50.6%) were endorsed by more than half of respondents, whereas a suitable place to hang the net (47.9%), cost or access (42.4%) and cultural or family beliefs (28.5%) were endorsed least often. These perceptions were not entered in the regression model.

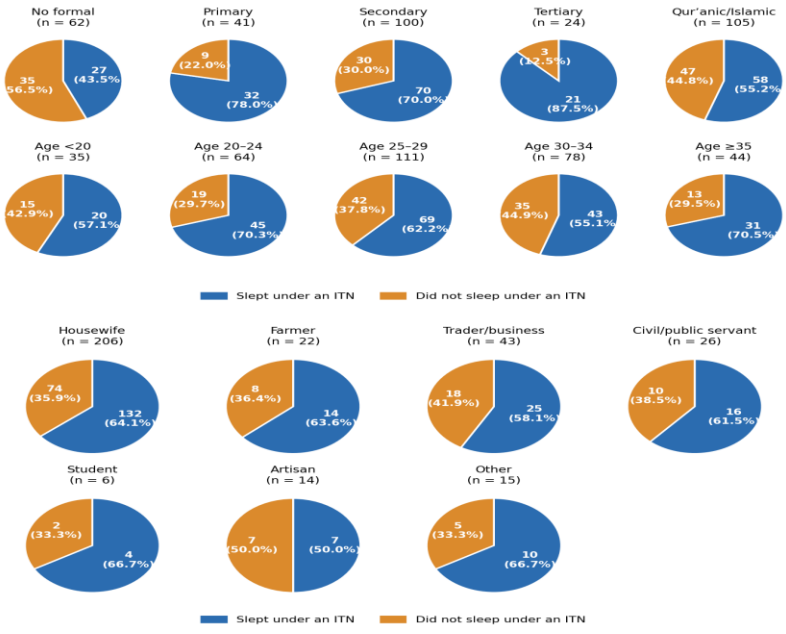


Figure 2: Previous-night ITN use by level of education and age group (upper block) and by occupation (lower block)

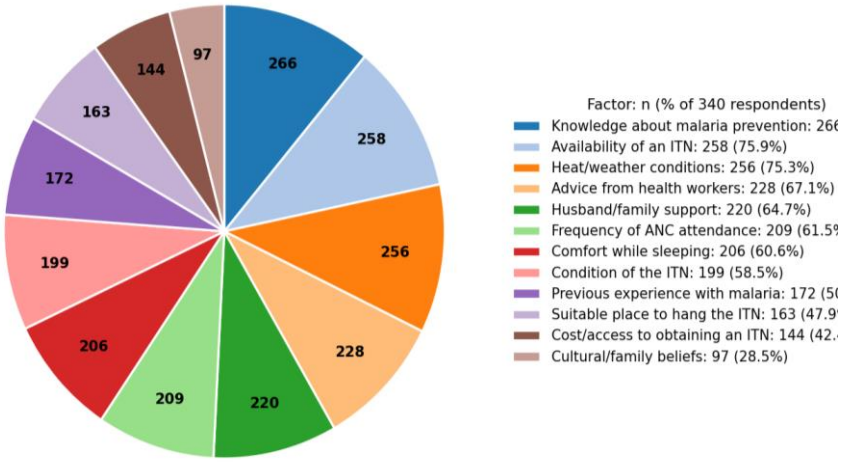


Figure 3: Respondents' perceived factors influencing ITN use (slice size = share of all 2,418 "yes" responses; respondents could endorse more than one factor)

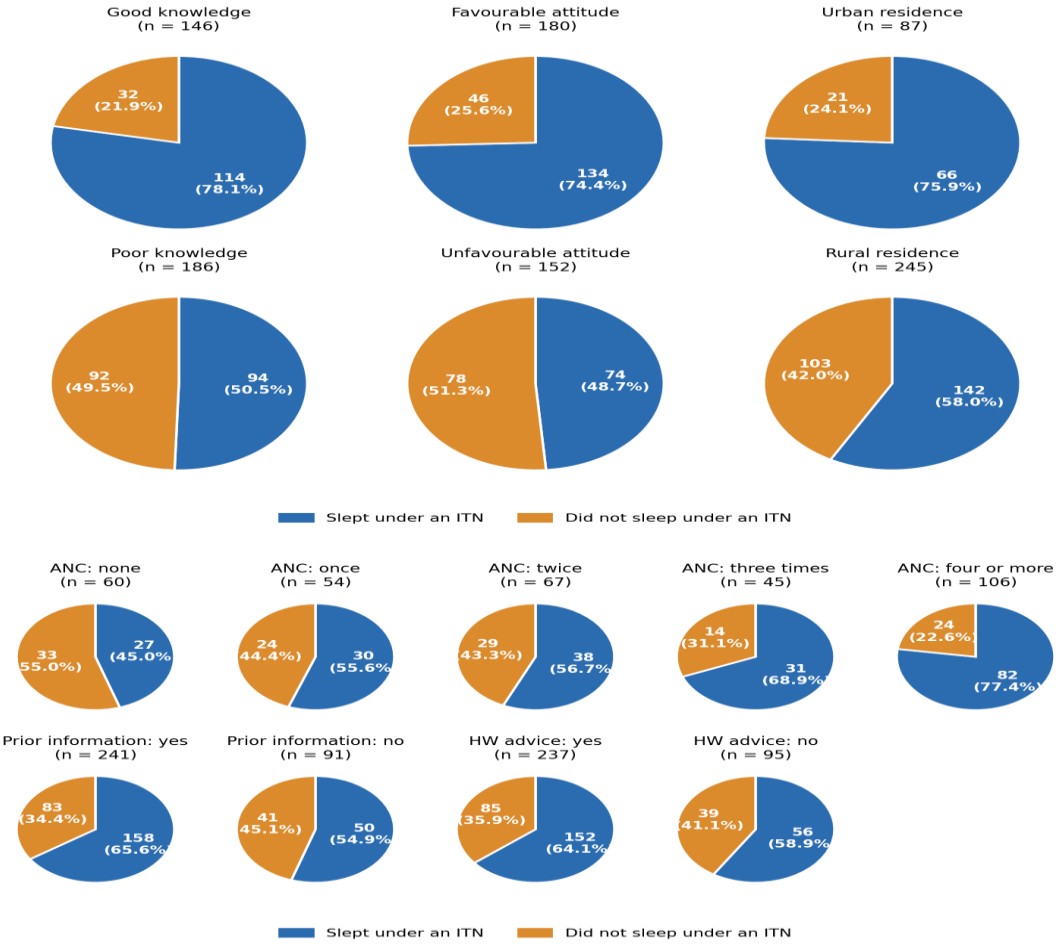


Figure 4: Previous-night ITN use by knowledge level, attitude and place of residence (upper block), and by number of ANC visits, prior malaria-prevention information and health-worker (HW) advice (lower block)

IV. DISCUSSION

This study examined the factors associated with ITN use among 340 pregnant women attending ANC in Kibiya LGA. Just under two-thirds of women (62.7%) had slept under a net the previous night, but only 28.2% reported using one every night over the past month, even though 85.6% of households owned a net. After adjustment, good knowledge, a favourable attitude, four or more ANC visits and primary education were independently associated with higher odds of use. The previous-night prevalence is slightly higher than the 59.5% reported for pregnant women in the North West zone and the national figure of 49.6% (NMEP et al., 2022); the present sample was drawn from ANC attendees, whereas the survey was population-based.

Knowledge was strongly associated with use. The association persisted after controlling for education and attitude. This agrees with the finding in a national Nigerian analysis that knowing nets prevent malaria and recognising the risks of malaria in pregnancy were linked to higher use. Item-level results suggest where the gaps lie, because only 48.5% knew that a net should be used every night and 49.1% knew that it is needed even when mosquitoes are not seen.

A favourable attitude independently doubled the odds of use. This finding supports the view that knowledge alone does not translate into behaviour unless women also regard nets as important, safe and acceptable. Misconceptions about the safety of the insecticide have been reported to reduce use even among women with sound factual knowledge, and barriers identified through the Health Belief Model in Ethiopia included perceived discomfort and doubts about benefit. In the present study, heat or weather was endorsed by 75.3% of respondents as an influence on use, consistent with heat being a leading reason for non-use in Enugu State. Cost or access was endorsed less often (42.4%), which may reflect free distribution.

Four or more ANC visits, compared with none, were associated with 2.43 times the adjusted odds of use, and use rose from 45.0% with no visit to 77.4% with four or more. This supports the role of ANC as a platform for malaria-prevention commodities and counselling. In contrast, neither prior receipt of malaria-prevention information (AOR 1.14) nor health-worker ITN advice (AOR 0.81) was independently associated with use. Repeated contact with the health system, and not a report of having received advice at some point, may support consistent use, although a yes/no question may also miss the content or quality of the advice, or overlap with ANC attendance.

The pattern for education was not simply graded. Use rose from 43.5% among women with no formal education to 87.5% among those with tertiary education, but only primary education remained significant after adjustment; the estimate for tertiary education (AOR 3.17) was of similar magnitude but imprecise (95% CI 0.76–13.20) because only 24 women had tertiary education. The non-significant results for secondary and Qur'anic education should likewise be read as imprecise and not as evidence of no effect. Education has been associated with ITN use in several national and multi-country analyses, so our results are consistent with an education gradient, although they cannot define its shape.

Residence was associated with use in the unadjusted analysis (rural 58.0% versus urban 75.9%), but the association weakened after adjustment (AOR 0.68; 95% CI 0.36–1.27). Rural–urban differences in ITN use among Nigerian pregnant women have been documented

nationally, so the loss of significance may reflect the small urban group and the overlap between residence, education and knowledge, and the wide interval does not exclude a meaningful rural disadvantage. Age group and occupation were not associated with use.

Strengths of the study are the probability-based selection at each stage, the separate reporting of ownership, previous-night use and every-night use, and the adjusted analysis of knowledge, attitude and ANC contact. Limitations are as follows. The cross-sectional design cannot establish causal direction, for example between attitude and use. Use was self-reported and may be affected by recall error and social desirability, particularly because interviews took place at health facilities, and previous-night use reflects a single night. Only women attending ANC at five facilities were included, so the results may not apply to women who do not attend ANC or to other LGAs. The response rate could not be established. Household-level determinants and self-efficacy were not measured, and the knowledge, attitude and practice approach may not capture the beliefs that shape women's decisions.

V. CONCLUSION AND RECOMMENDATIONS

Among pregnant women attending ANC in Kibiya LGA, good knowledge of ITNs, a favorable attitude, four or more ANC visits and primary education were independently associated with sleeping under an ITN the previous night, whereas residence, age, occupation, prior malaria-prevention information and health-worker advice were not. High household ownership (85.6%) coexisted with low every-night use (28.2%), which indicates that access to nets is not the only constraint. These are associations and do not show that any factor caused use.

Based on these findings, it is recommended that: (i) health workers and facility managers in Kibiya LGA strengthen repeated antenatal counselling that stresses nightly use, use even when mosquitoes are not noticed, and practical advice on heat and net placement; (ii) the Kibiya Primary Health Care Department and malaria programmer managers monitor ITN use, and not only ownership, with attention to women with no formal education and those who attend few ANC visits; and (iii) any intervention based on these findings be evaluated for its effect on consistent use. Future studies should include women who do not attend ANC, measure household factors, and use longitudinal and qualitative designs to clarify how heat, sleeping arrangements, family influence and net condition shape use.

A. Declarations

Ethics approval and consent to participate:

[Complete as in Section 2.6.]

Data availability, competing interests, and funding and author contributions: [To be completed by the authors.]

B. Acknowledgements:

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