

Research Article

Prevalence of Malaria Prevention Practices and Their Associated Factors Among Caregivers of Children Under Five Years in Kpando Municipality, Ghana

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Abstract

Background: Malaria poses a significant threat to children under five in Ghana. Despite the availability of effective preventive measures, caregiver compliance remains inconsistent. This study investigated the prevalence of malaria prevention practices and their associated factors among caregivers of children under five years in Kpando Municipality, Ghana. **Method:** A community-based cross-sectional study was conducted among 293 mothers and caregivers with children under five years in Kpando Municipal of Ghana. A multi-stage sampling technique was used to collect data from respondents through one-on-one interviewer-led enumeration using a semi-structured questionnaire. Descriptive statistics, Fisher's Exact Test, and binary logistic regression were used to analyze the data. Adjusted odds ratios (aOR), p-values, 95% confidence intervals (CI), frequencies and proportions were reported with statistical significance set at $p < 0.05$. The analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 26. **Results:** Approximately a 99% participation rate (293 out of the expected 295) was recorded in this study. The prevalence of adequate malaria preventive practices among caregivers was 49%. Long-lasting Insecticide Nets (LLINs) ownership was 93.2%. Most caregivers (65.2%) consistently used LLINs and ensured their household members used them as well (49%) for malaria prevention. Malaria preventive measures such as clearing stagnant water (66.6%), clearing bushes in the house compound (56%) and visiting health facilities when they fell sick (67.9%), were not consistently practiced by the caregivers. About 64% ensured their water storage containers were always closed. Caregivers with SHS education (aOR = 0.23, 95%CI [0.07-0.78], $p = 0.018$), and income below Gh ₵500 (aOR = 5.81, 95%CI [2.45-13.79], $P < .001$) had increased odds of practising adequate malaria prevention. Unmarried caregivers (aOR = 0.20, 95% CI [0.09-0.42], $p < .001$) and caregivers not owning an LLIN (aOR = 0.09, 95% CI [0.02-0.43], $p = 0.003$) had decreased odds of practising adequate malaria prevention. **Conclusion:** Though caregivers in the Kpando Municipality had good possession of LLINs, repeated use and practice of other preventive practices against malaria were poor. Targeted community interventions and health education will be required to improve preventive practices against malaria among them. Caregivers' knowledge, attitudes, and perceptions towards the prevention of malaria need to be explored in future studies to plan more effective behaviour change interventions.

Keywords

Malaria Prevention, Caregivers, Children Under Five, Long-lasting Insecticide Nets (LLINs), Kpando Municipality

1. Background

Malaria is one of the most important worldwide public health issues, with the greatest burden in sub-Saharan Africa [1]. As reported by the World Health Organization (WHO), there were an estimated 249 million cases and 608,000 deaths caused by malaria in 2022 worldwide, whereas Africa had around 94% of all cases and deaths due to malaria. Malaria is hyper-endemic in Ghana and remains a primary cause of morbidity and mortality, especially in groups like pregnant women and children aged less than five years [2]. There has been substantial success realized in malaria control through the expansion of national efforts like mass LLIN distribution campaigns, seasonal malaria chemoprevention, and enhanced access to diagnostics and treatment, but malaria still poses a severe public health threat and a primary child killer [3].

It has a disproportionate impact on children under the age of five as a result of their underdeveloped immune systems, and hence, both become more prevalent and virulent in this age group. Control efforts are thus paramount in reducing the disease and resultant mortality. Among these, the application of Long-Lasting Insecticidal Nets (LLINs) has been observed to have a very significant impact of malaria reduction and mortality among children if put into effective and sustained

use [4]. Despite this, various studies have documented an ownership-usage gap, triggered by discomfort, heat, risk perception, and ignorance [2, 5, 6]. Environmental management, such as clearing of cover and elimination of standing water, which are breeding sites for mosquitoes, is another vital, though often neglected, aspect of malaria prevention in addition to self-protection interventions [7].

Socio-demographic and socio-economic characteristics of caregivers, especially mothers, contribute significantly to shaping health-seeking behaviour and preventive practice uptake [8]. Level of education, marital status, family income, religious and cultural beliefs are more likely to impact whether and to what extent preventive practices are embraced [2, 7]. Though national surveys such as the Ghana Malaria Indicator Survey (GMIS) are valuable for population-level data, they often cannot adequately capture local patterns of behaviour and context-specific barriers, particularly in semi-urban or rural areas where infrastructure and resources for health can be inadequate [9].

Kpando Municipality, Volta Region of Ghana, is an area with endemic malaria and heterogeneous social and economic conditions. This context has few empirical studies on the

adoption of malaria prevention practices by caregivers and conditions that promote or impede their adoption [8, 10]. Understanding these patterns is important in developing conceptualizations of interventions that are suitable to the local community and capable of penetrating behavioural and structural barriers to prevention.

This study aimed to determine the prevalence of preventive practice for malaria and sociodemographic predictors of preventive practice among caregivers of children aged less than five years in the Kpando Municipality. Results of this research will serve as evidence to inform targeted health education, maximize program planning, and achieve maximum impact of malaria control programs in similar settings in Ghana and beyond.

2. Method

2.1. Study Area and Design

This was a community-based cross-sectional study to assess the prevalence of malaria prevention practices and its associated factors among caregivers of children under five years in selected communities within the Kpando Municipality. The study area is situated in Ghana, a tropical region in the sub-Saharan African region known for its environmental conduciveness for breeding female *Anopheles* mosquitoes. Socio-economic factors like poverty in Kpando increase children's vulnerability to malaria. The Kpando Municipal lies within latitudes 6° 55' N 7° 05' N and 0° 23' E. It shares a boundary with Biakoye District in the North, Afadzato South to the East and the North Dayi District in the South. The Municipality covers approximately a total land area of 314.07 km². The municipality has a projected population of 62,722 (in 2023) with an annual growth rate of 3.5%. Kpando has 17 health facilities. [11].

2.2. Study Population and Sample Size Estimation

The study population was made up of caregivers of children aged under five years in the Kpando Municipality. The selection of these target groups was due to their role in managing the health and malaria prevention practices for their young children. The required sample size for this study was calculated using Cochran's formula [12]:

$$n = \frac{z^2 * p * q}{e^2}$$

Where $z = 1.96$ at a 95% confidence level, $p = 24\%$ (assumed prevalence of malaria prevention practice), $q = 1-p$, and $e = 0.05$ (margin of error). The calculated sample size was approximately 280. To account for a 5% non-response rate, we adjusted the sample size to yield a final sample of 295.

2.3. Sampling Method and Data Collection Procedure

This study used a multi-stage sampling method to gather data from 9 October 2023 to 3 November 2023. The first stage involved randomly sampling communities from a list stratified by location (rural and urban) within the Kpando Municipality. The second stage involved selecting households within these communities using systematic sampling from a complete household list obtained from community leaders. In the third stage, all caregivers with children under five years old within the selected households were included in the study. Participation was based solely on consent. Caregivers who declined to participate or were too ill to respond were excluded. A semi-structured questionnaire, covering socio-demographics and malaria prevention practices, was used to collect information from respondents. The questionnaire was adapted from a previous study [7]. Before the main data collection, the questionnaire was pretested with approximately 15 caregivers of children under five years in Ho Municipal, a nearby district with similar characteristics to Kpando, representing about 5% of the estimated sample size. These respondents were not part of the final data collection. Adjustments to the questionnaire included changing question sequences to improve ease of administration. Trained Research Assistants conducted face-to-face interviews in the community, using the predominantly spoken dialect (Ewe). Research Assistants also translated questions into the appropriate dialect for respondents who did not understand Ewe.

2.4. Variables Studied

In this study, the dependent variable examined was the practice level of malaria preventive measures, categorized as inadequate, coded as "0", and adequate, coded as "1". The explanatory variables included age group, educational level, religious affiliation, marital status, income level, ethnicity and ownership of LLINs.

2.5. Data Management and Data Analysis

The data collected were exported into Excel and were checked for missing and incorrect data entries by two different researchers. The certified data were then imported into SPSS version 26 for further management, such as recoding, before analysis.

We employed a series of statistical tests to examine the prevalence of malaria preventive practices among respondents and their relationship with socio-demographic factors using SPSS version 26. Descriptive statistics were first used to summarize the socio-demographic characteristics of respondents. Questions on malaria prevention practices were measured on three response levels, that is "Always" (coded as 3), "Sometimes" (coded as 2) and "Never" (coded as 1). Descriptive statistics, such as means and standard deviations,

were computed for individual responses from caregivers on their malaria preventive practices. A weighted mean (2.04 ± 0.23) for all the malaria practice variables was further calculated. Respondents' mean scores below the weighted mean were classified as having inadequate malaria preventive practices. In contrast, respondents whose mean score was equal to or higher than the weighted mean were classified as having adequate malaria preventive practices [7]. The final practice level was presented using a pie chart. A Fisher's Exact Test was then employed to assess the association between socio-demographic variables and malaria prevention practices. Finally, binary logistic regression was performed to evaluate the impact of the socio-demographic factors that showed statistical significance during Fisher's Exact Test. Predictor variables such as educational level, marital status, income level, and ownership of LLINs remained statistically significant predictors of malaria prevention measures after controlling for possible confounders in the multivariate logistic regression analysis. Adjusted odds ratios (aOR), p-value, and 95% confidence intervals (CI) were reported for the logistic regression analysis. Adjusted odds ratios and

significant p-values from the multivariate logistic regression analysis were used for the discussion in this study. The significance level for all inferential analyses in this study was set at a p-value less than 0.05.

3. Results

3.1. Socio-Demographic Characteristics

Table 1 illustrates the social-demographic characteristics of respondents. A total of 293 out of the expected 295 caregivers participated in this study, resulting in a participation rate of approximately 99%. Most respondents (51.2%) were between 20 and 29 years old. Most caregivers were Christian (94.2%) and had attained JHS education. Over half (53.9%) are married. The largest ethnic group was Ewe (85.7%). Most respondents had an income of less than Gh ₵500. Most (93.2%) caregivers own LLIN.

Table 1. Socio-Demographic Characteristics of Respondents.

Age Group	Frequency	Percent
<20 yrs	34	11.6
20-29 yrs	150	51.2
30-39 yrs	92	31.4
40-49 yrs	13	4.4
50 yrs and above	4	1.4
Religion		
Christian	276	94.2
Islam	12	4.1
Traditional	5	1.7
Education Level		
None	27	9.2
Primary	75	25.6
JHS	107	36.5
SHS	61	20.8
Tertiary	23	7.8
Marital Status		
Single	73	24.9
Co-habiting	62	21.2
Married	158	53.9
Ethnicity		
other	28	9.6

Age Group	Frequency	Percent
Akan	12	4.1
Guan	2	0.7
Ewe	251	85.7
Occupation		
Unemployed	60	20.5
Informal	213	72.7
Formal	20	6.8
Income Level		
<500 Ghc	130	44.4
500 Ghc to 1000 Ghc	87	29.7
>1000 Ghc	76	25.9
Possession of LLINs		
No	20	6.8
Yes	273	93.2

3.2. Malaria Preventive Measures Among Respondents

Table 2 shows the prevalence of various malaria preventive measures among respondents. Most (65.2%) respondents consistently use LLINs and ensure their household members

use them as well (48.8%) for malaria prevention. About 34% regularly check and repair LLINs. Malaria Preventive measures, such as cleaning stagnant water (66.6%), cleaning bushes around houses (56.0%), and visiting health facilities when ill (67.9%), were not regularly practiced among respondents. Most respondents always ensured their water reservoirs were closed (63.8%).

Table 2. Frequency of Malaria Preventive Measures Among Respondents.

Malaria Preventive Measures	Never	Sometimes	Always
Sleep in a (LLIN)	22 (7.5)	80 (27.3)	191 (65.2)
Other members of the household sleep in (LLIN)	71 (24.2)	79 (27.0)	143 (48.8)
Check for holes/repair of (LLIN)	33 (11.3)	161 (54.9)	99 (33.8)
Clean/cut bushes around your house	5 (1.7)	164 (56.0)	124 (42.3)
Clean stagnant water near your house	3 (1.0)	195 (66.6)	95 (32.4)
Close the windows before 6 pm	5 (1.7)	171 (58.4)	117 (39.9)
Visit the health centre when you fall sick	3 (1.0)	199 (67.9)	91 (31.1)
Use mosquito coils	163 (55.6)	84 (28.7)	46 (15.7)
Use mosquito repellent (spray)	169 (57.7)	114 (38.9)	10 (3.4)
Use mosquito repellent (body cream)	276 (94.2)	7 (2.4)	10 (3.4)
Inner walls sprayed to prevent mosquitoes (IRS)	231 (78.8)	33 (11.3)	29 (9.9)
Sleep under a fan to prevent mosquitoes	65 (22.2)	132 (45.1)	96 (32.8)
Water tanks closed	57 (19.5)	49 (16.7)	187 (63.8)

3.3. Prevalence of Malaria Preventive Practices

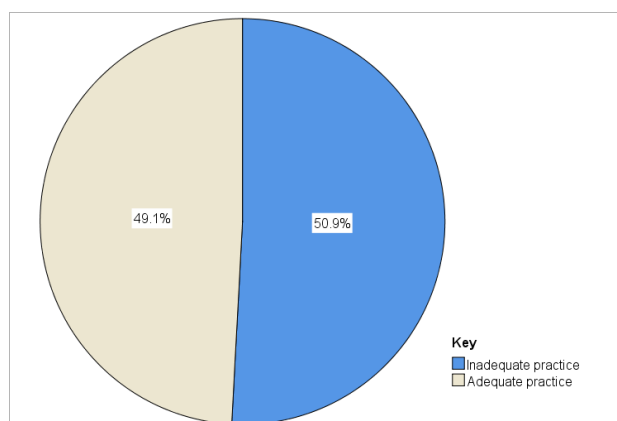


Figure 1. Overall Prevalence of Malaria Preventive Practices Among Respondents.

Figure 1 shows the overall prevalence of malaria preventive measures among respondents. About 51% of respondents engaged in inadequate practice, while 49% followed adequate practices.

3.4. Association Between Socio-Demographic Variables and Malaria Preventive Practices

Table 3 presents the results of a Fisher's Exact Test to examine the association between the various socio-demographic factors and the level of malaria prevention practices among respondents. The analysis revealed that religious affiliation ($p = 0.015$), Level of education ($p < 0.001$), marital status ($p < 0.001$), income level ($p < 0.001$), and LLIN ownership ($p < 0.001$) were significantly associated with malaria prevention practices among caregivers of children under 5 years. Respondents' age, occupation and ethnicity were not significantly associated with malaria prevention practices.

Table 3. Association Between Socio-Demographic Variables and Malaria Preventive Practices.

Variables/Categories	Inadequate practice	Adequate practice	Fisher's Exact Test P-value
Age Group			
<20 yrs	20 (58.8)	14 (41.2)	0.526
20-29 yrs	78 (52.0)	72 (48.0)	
30-39 yrs	43 (46.7)	49 (53.3)	
40-49 yrs	5 (38.5)	8 (61.5)	
50 yrs and above	3 (75.0)	1 (25.0)	
Religious affiliation			
Others	9 (52.9)	8(47.1)	0.015
Christian	140 (50.7)	136 (49.3)	
Level of education			
None	14 (51.9)	13 (48.1)	P< .001
Primary	21 (28.0)	54 (72.0)	
JHS	49 (45.8)	58 (54.2)	
SHS	50 (82.0)	11 (18.0)	
Tertiary	15 (65.2)	8 (34.8)	
Marital status			
Single	55 (75.3)	18 (24.7)	P< .001
Co-habiting	20 (32.3)	42 (67.7)	
Married	74 (46.8)	84 (53.2)	
Occupation			
Unemployed	32(53.3)	28(46.7)	0.359

Variables/Categories	Inadequate practice	Adequate practice	Fisher's Exact Test P-value
Informal	104(48.8)	109(51.2)	P< .001
Formal	13(65.0)	7(35.0)	
Income Level			
<500 Ghc	38 (29.2)	92 (70.8)	
500 Ghc to 1000 Ghc	56 (64.4)	31 (35.6)	P< .001
>1000 Ghc	55 (72.4)	21 (27.6)	
Owns LLIN			
No	18 (90.0)	2 (10.0)	
Yes	131 (48.0)	142 (52.0)	0.136
Ethnicity			
Others	26 (61.9)	16 (38.1)	
Ewe	123 (49.0)	128 (51.0)	

Table 4 shows the results of binary logistic regression analysis to assess the impact of the association between the various socio-demographic factors and malaria prevention practices. After controlling for possible confounders, educational level, marital status, income level, and ownership of LLINs remained significant predictors of malaria preventive measures among respondents. Caregivers with SHS education were 77% less likely to engage in adequate practices compared to caregivers with tertiary education (aOR = 0.23, 95%CI [0.07-0.78], $p = 0.018$). Single caregivers were 80%

less likely to engage in adequate malaria preventive practices compared to their married counterparts (aOR = 0.20, 95%CI [0.09-0.42], $p < .001$). Caregivers with income levels less than Gh ₵ 500 had significantly higher odds of practising adequate malaria preventive measures compared to caregivers who earn more than Gh ₵1,000 (aOR = 5.81, 95%CI [2.45-13.79], $P < .001$). Caregivers not owning an LLIN were 91% less likely to practice adequate malaria preventive measures compared to their counterparts (aOR = 0.09, 95%CI [0.02-0.43], $p = 0.003$).

Table 4. Logistic Regression Analysis of Socio-Demographic Factors Associated with Malaria Preventive Practices.

Variables/Categories	Inadequate practice	Adequate practice	cOR (95%CI)	P-value	aOR (95%CI)	P-value
Religious affiliation						
Others	9 (52.9)	8(47.1)	0.92(0.34-2.44)	0.859		
Christian	140 (50.7)	136 (49.3)	Ref			
Level of education						
None	14 (51.9)	13 (48.1)	1.74(0.56-5.46)	0.342	0.39(0.10-1.55)	0.183
Primary	21 (28.0)	54 (72.0)	4.82(1.78-13.04)	0.002*	1.52(0.45-5.13)	0.497
JHS	49 (45.8)	58 (54.2)	2.522(0.87-0.57)	0.096	1.17(0.38-3.61)	0.782
SHS	50 (82.0)	11 (18.0)	0.41(0.14-1.21)	0.107	0.23(0.07-0.78)	0.018*
Tertiary	15 (65.2)	8 (34.8)	Ref		Ref	
Marital status						
Single	55 (75.3)	18 (24.7)	0.29(0.16-0.53)	$P < .001^*$	0.20(0.09-0.42)	$P < .001^*$
Co-habiting	20 (32.3)	42 (67.7)	1.85(1.00-3.43)	0.051	0.74(0.34-1.58)	0.431

Variables/Categories	Inadequate practice	Adequate practice	cOR (95%CI)	P-value	aOR (95%CI)	P-value
Married	74 (46.8)	84 (53.2)	Ref		Ref	
Income Level						
<500 Ghc	38 (29.2)	92 (70.8)	6.34(3.38-11.89)	P<.001*	5.81(2.45-13.79)	P<.001*
500 Ghc to 1000 Ghc	56 (64.4)	31 (35.6)	1.45(0.74-2.83)	0.275	1.56(0.67-3.62)	0.299
>1000 Ghc	55 (72.4)	21 (27.6)	Ref		Ref	
Owens LLIN						
No	18 (90.0)	2 (10.0)	0.10(0.02-0.45)	0.003*	0.09(0.02-0.43)	0.003*
Yes	131 (48.0)	142 (52.0)	Ref		Ref	
Ethnicity						
Others	26 (61.9)	16 (38.1)	0.59(0.30-1.16)	0.124		
Ewe	123 (49.0)	128 (51.0)	Ref			

Ref= Reference Category; *Statistically significant at $p < .05$

4. Discussion

This study evaluated the prevalence of malaria preventive practices and their socio-demographic determinants among caregivers of children under five years old in Kpando Municipality, Ghana. The results reflect varied adherence to several malaria preventive measures, with only 49% of caregivers practising them sufficiently. Such adherence, although higher than reported prevalence in some areas of rural Sub-Saharan Africa, is still not encouraging considering the susceptibility of children to malaria, especially in the current study setting.

In Ghana, the promotion of the use of LLINs serves as a backbone of the national strategy for controlling malaria. In this study, the ownership and use of long-lasting insecticide-treated nets (LLINs) routinely by caregivers concurs with documented results in previous studies among comparable target populations [4, 6]. Nonetheless, higher compared to about 67% ownership and 49% utilization documented in the 2022 Ghana Demographic and Health Survey report [3]. Again, the rate of LLIN use in our study is higher compared to the approximately 42% reported by Konlan et al. and Lopez & Brown [8, 13].

Furthermore, in this current study, the comparatively low percentage of people who confirmed that all members in their homes always slept under LLINs is indicative of intra-household gaps, which is a known limitation to universal coverage [14]. In addition, less than a third of respondents checked or mended their nets regularly, compromising their long-term strength. A study in Côte d'Ivoire similarly found low net maintenance rates, and in this instance were often linked to a lack of knowledge or misunderstanding about the

durability of nets [15].

The current study found that other environmental practices, like emptying stagnant water, trimming bushes, and closing windows before sunset, were not carried out regularly. These results concur with previous studies that indicate community-level environmental management practices tend to be poorly followed, which results from inadequate mobilization of communities or mechanisms for shared responsibility [10]. Moreover, in this study, fewer people used indoor residual spraying (IRS) or mosquito repellents. This concurs with a similar study elsewhere [16], but contradicts the 90% documented in Nigeria among caregivers by Haifete & Shevanyengal [17].

Interestingly, a high proportion of respondents always screened water reservoirs, a key action in the reduction of breeding sites for mosquitoes. This is in line with experience on urban malaria control studies in sub-Saharan Africa, which calls attention to enhanced water management as a critical behavioural change in controlling malaria in urban areas [18].

Overall, the prevalence of malaria prevention measures in this study was low but corroborates findings from urban or peri-urban Ghanaian and West African populations, which also estimated prevalence rates of malaria preventive practice measures between 40% to 60% [7, 19]. This indicates a moderate level of awareness and practice of malaria preventive measures, but also highlights the existence of ongoing behavioural barriers to achieving the level of complete compliance with correct malaria prevention standards. Nonetheless, the overall prevalence of malaria preventive measures in this study is lower compared to the 51% reported in Ethiopia [7]. This could be attributed to the hospital-based cross-sectional approach adopted by the researchers compared to the community-based approach adopted by this current study. As perceived, caregivers turn to give positive

answers to most questions concerning the use of LLIN for themselves and their children under five years to avoid reprimand from healthcare professionals, especially at healthcare centres and in the presence of healthcare professionals.

In this present study, a variety of socio-demographic determinants, such as the level of education, marital status, income level, and ownership of LLINs, were strongly associated with malaria prevention behaviour even after adjusting for potential confounding variables. In this study, caregivers with SHS education were less likely to practice good preventive measures compared to their tertiary-educated counterparts, a finding which is in line with a previous study in Ethiopia [7]. However, this contradicts a previous study, where individuals with at least a secondary education were more likely to demonstrate a positive attitude towards malaria preventive measures [20]. This contradiction may indicate context-specific factors, such as the quality of health education information or misinformation given to beneficiaries from variable levels of the education ladder.

Marital status was also a strong determinant, and unmarried caregivers were less likely to practice malaria preventive measures compared with their married counterparts. This concurs with earlier studies in sub-Saharan Africa that have established marital status to influence household decision-making and health-seeking behaviour [21].

Surprisingly, caregivers with lower incomes (<GH¢500) had greater chances of undertaking effective preventive activities compared to those who were higher incomes. While unexpected, the same pattern has been seen in other studies where low-income communities were targeted more by public health efforts that provided free LLINs or transmitted directed education [22]. This might also reflect differential coverage of government or NGO prevention programs for malaria based on perceived risk.

Lastly, LLIN ownership was strongly associated with malaria prevention practices. Caregivers with no LLIN were 91% less likely to adopt good malaria preventive measures, reaffirming evidence from multicountry studies that LLIN access is a key driver of use [2, 4, 8, 23]. This shows that although behaviour change communication is important, physical access to LLIN is key to malaria preventive practices among caregivers.

Limitations

The current study is not without limitations. The cross-sectional approach restricts causality inference. Moreover, the use of self-reported outcomes likely introduced social desirability or recall bias and thus may have overestimated the reported use of preventive measures. Despite this, the study presents valuable contextual insight into policymakers and health educators in Kpando and other comparable settings.

5. Conclusion

Even with fairly good use of LLINs, malaria preventive practices among Kpando Municipality's caregivers remain

inadequate for nearly half of the population studied. Education, marital status, income, and ownership of LLINs significantly influence malaria preventive behaviours. Targeted health education and promotion, enhanced LLIN accessibility, and environmental control intervention at the community level are needed to improve malaria prevention, particularly among the vulnerable caregiver population. Future studies should investigate the knowledge, attitudes, and perceptions of caregivers on malaria preventive measures.

6. Recommendations

- 1) The Municipal Health Directorate of the Ghana Health Service should intensify health education on environmental cleanliness and LLINs maintenance among caregivers with low education levels.
- 2) The Ministry of Education and the Ghana Education Service should include education on malaria prevention in school curricula and adult literacy programs to facilitate long-term behaviour change.
- 3) The Municipal Health Directorate and community health workers should provide focused outreach interventions among caregivers at high risk, including single parents and those with only a secondary level of education.
- 4) The District Assembly and Environmental Health Officers must provide daily cleaning activities to communities and guide people's actions in an attempt to eliminate mosquito breeding sites.

Abbreviations

cOR	Crude Odds Ratio
aOR	Adjusted Odds Ratio
IRS	Indoor Residual Spraying

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Author Contributions

Conceptualization: O.A.-O., D.A.A., R.B.N., J.H.A.; Methodology: R.B.N., K.A.Y., J.M.G., F.P., D.N.; Validation: O.A.-O., S.A. (Samuel Antwi), M.N., K.A.Y., R.G.A.B., F.P.; Formal analysis: R.B.N., S.A. (Samuel Antwi), M.D.A., I.M.; Resources: D.N., M.N., E.K., E.K.A.; Data curation: R.G.A.B., K.A.Y., R.B.N., P.K.O., A.L., E.K.; Writing - original draft: R.B.N., O.A.-O., D.A.A., S.A. (Samuel Abudey); Writing - review & editing: J.M.G., J.H.A., D.N., I.M.,

M.D.A., E.K.A.; Visualization: E.K., A.L., P.K.O.; Supervision: O.A.-O., J.H.A., D.N.; Project administration: F.P., O.A.-O., D.A.A.

Ethics Approval and Consent to Participate

This cross-sectional survey of tuberculosis (TB) patients was reviewed and approved by the Kpando Municipal Health Research Committee. The study was conducted following the ethical principles of the Declaration of Helsinki (1964) and its subsequent amendments.

Informed consent was obtained from all participants before data collection. Participants were informed about the voluntary nature of their participation, their right to withdraw at any time without penalty, and the assurance that all information provided would remain confidential and be used solely for research purposes.

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Conflicts of Interest

The authors declare no conflicts of interest.

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