Factors associated with ownership of insecticide-treated nets for malaria prevention among pregnant women in Ghana

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ABSTRACT

INTRODUCTION In Saharan Africa, an estimated 25 million pregnancies are at risk from malaria every year, with substantial morbidity and death effects for both mother and fetus. The aim was to identify socioeconomic and demographic factors associated with ownership of insecticide-treated nets for preventing malaria among pregnant women reporting at the Tamale Teaching Hospital, Ghana.

METHODS This study was conducted in the antenatal clinic of Tamale Teaching Hospital (TTH) in 2021 with 250 pregnant women using a descriptive cross-sectional survey design. Data analysis was done with SPSS version 20. Graphs and tables were used to present the study data. Bivariate analysis was done using chi-squared tests to determine the relationships.

RESULTS The mean age of the study participants was 30.0 ± 4.5 years and most (73.0%) were aged 25–35 years. The prevalence of ITN ownership among the studied pregnant women was 83.2%. Most (62.4%) of those who owned an ITN obtained it free of charge from public campaign programs. Factors associated with ITN ownership were: age (χ^2=7.659, p=0.022), marital status (χ^2=9.047, p<0.029), education level (χ^2=19.027, p<0.001), employment status (χ^2=13.279, p=0.001), and monthly income (χ^2=6.686, p=0.035).

CONCLUSIONS Though not of the national target, this study recorded very good ITN ownership coverage among pregnant women. Educational level and economic status were the major factors associated with ITN ownership.

INTRODUCTION

Malaria is the leading cause of death and other socioeconomic effects in Ghana, attributable to morbidity and its social, economic, and health implications[1-3]. Malaria has a significant impact on health and livelihood around the world, even though it is preventable and treatable[4]. Every year, around 216 million individuals worldwide are infected with malaria[5]. Malaria killed around 445000 people in 2016, with Sub-Saharan Africa accounting for 91.0% of all deaths[5].

Pregnant women in malaria-endemic areas are more likely to contract the sickness[6], with more severe problems than their counterparts who are not pregnant[7]. Due to impaired and immature immunity, pregnant women and children are at risk[8]. Malaria in pregnancy is associated with negative health effects such as maternal anemia, IUGR, and low birth weight babies[9].

Malaria-related maternal fatalities are predicted to occur 10000 times per year in Sub-Saharan Africa, with adverse pregnancy anemia being the leading cause[10]. The pooled prevalence of malaria in pregnant women in Africa is higher than in the overall population, according to the findings of a current systematic review and meta-analysis[10]. Annually, an estimated 25 million pregnancies in Sub-Saharan Africa are at risk of malaria, with significant morbidity and mortality

repercussions for both the mother and the baby[8,11,12].

Plasmodium falciparum causes 80–90% of malaria-related illnesses in Ghana, mainly among pregnant women and children aged <5 years[13]. *P. falciparum* infection was discovered in one in every five pregnant women who attended their first ANC clinic visit in a malaria-endemic zone in Ghana's middle belt. The majority of the infections were linked with anemia and had a parasite level of fewer than 1000 parasites per liter[14]. In Northern Ghana, a study comprising Tamale Teaching Hospital, Tamale Central Hospital, Tamale West Hospital, and Bilpella Health Centre revealed the prevalence of malaria infection among pregnant women to be 14.1% and 13.4% based on RDTs tests and 13.4% on PCR test, respectively[15].

Malaria control programs such as the use of ITNs, indoor residual spraying (IRS), and rapid diagnostic tests (RDTs), are all part of Ghana's core malaria control strategies[16]. Lack of access to ITNs, as well as a lack of information and perception about ITNs and malaria, has previously been identified as significant hurdles to ITN use in Africa[17]. However, due to social and logistical factors, access does not always result in utilization[18]. Evidence from portions of Ghana indicates that more than 40% of ITNs offered to households are underutilized[19]. This has the potential to jeopardize the advances made in ITN utilization over the years.

Even though Ghana has made tremendous progress in recent years, much more work is needed to expand individual and family ownership coverage and ITN use. Still, 48.9% of homes lack ITN coverage, and 57.0% of pregnant women do not utilize ITNs[20]. Given that a significant portion of pregnant women in Ghana does not utilize an ITN, as stated by the Ghana Statistical Service, Ghana Health Service, and ICF[20], there is cause for concern for public health. Therefore, this current study aimed at identifying socioeconomic and demographic factors associated with ownership of insecticide-treated nets for preventing malaria among pregnant women reporting at Tamale Teaching Hospital, Ghana.

METHODS

Study design and site

This study employed a descriptive cross-sectional survey, with quantitative data analyzed. The research was conducted at Tamale Teaching Hospital's prenatal clinic. Tamale Teaching Hospital, later Tamale Regional Hospital, was established in 1974. Under Act 525 of the Ghana Health Service and Teaching Hospitals Act of 1996, the hospital was elevated to the status of Teaching Hospital in 2005. The Tamale Teaching Hospital is Ghana's third teaching hospital. It acts as a referral hub for Ghana's northern regions.

Study participants

This study included all pregnant women who visited Tamale Teaching Hospital's prenatal clinic. According to a poll conducted at TTH's antenatal clinic, 50 pregnant women attend the clinic daily. Depending on the gestational weeks of the pregnancy, pregnant women must wait at least one week between appointments. As a result, the population was computed for five days (one week minus Saturday and Sunday) to avoid topic duplication in the overall population. This study included a total population of 50×50 = 250 people. This survey engaged the participation of the entire estimated population of 250 people.

Data collection tool and procedure

The data collection period lasted one week (Monday to Friday), based on the clinic days of TTH's prenatal clinic. Pregnant women with a gestational age of ≥16 weeks were chosen for this study to assess SP use, which begins after 16 weeks of gestation. Respondents who were unable to read were interviewed using the self-administrable questionnaire.

Ethical considerations

The data gathering process began immediately after the research department of Tamale Teaching Hospital issued a certificate of authorization to research the hospital. Participants gave their consent to answer the questionnaire, the information they provided was kept anonymous, and the study's findings were made available to them. Participants were not subjected to any physical or psychological stress.

Data analysis

For data entry and analysis, the Statistical Package for the Social Sciences (SPSS) version 20 was utilized. Responses to categorical factors were coded to allow for quantitative analysis. The age was shown as a continuous variable with mean plus standard deviation. Gender, for example, was expressed as a proportion of all categorical factors. Tables are used to present the study data. The relationship between dependent and independent variable was assessed using chi-squared analysis.

RESULTS

Demographic characteristics of respondents

The average age of study participants was 30.0±4.5 years, with the majority (73.0%) aged 25–35 years. For slightly more than half of the individuals, the gestational age of pregnancy was 28–38 weeks (52.8%). Islam was the most frequent religious affiliation among research participants (69.4%), and 95.6% were married. In terms of employment, 44.2% were self-employed, with the majority (77.2%) earning less than 1000 GHS (10 Ghanaian Cedis about 1 US$) each month (Table 1).

Ownership of an ITN among pregnant women

The prevalence of ITN ownership among the studied pregnant women was 83.2%. The majority (62.4%) of those who own an ITN obtained it free of charge from public campaign programs. Out of the 208 respondents with

Table 1. Socioeconomic characteristics of respondent pregnant women, Tamale Teaching Hospital, Ghana, 2021 (N=250)

Characteristics		n (%)
Age (years)		
18–25		41 (16.5)
25–35		181 (73.0)
36–55		26 (10.5)
Religion		
Islam		172 (69.4)
Christianity		74 (29.8)
Traditional		2 (0.8)
Marital status		
Married		238 (95.6)
Single		7 (2.8)
Widowed		3 (1.2)
Divorced		1 (0.4)
Education level		
None		28 (11.2)
Primary		72 (28.8)
Secondary		68 (27.2)
Tertiary		82 (32.8)
Employment status		
Unemployed		61 (24.5)
Self-employed		110 (44.2)
Government employee		78 (31.3)
Monthly income (GHS)		
≤1000		176 (77.2)
2000–3000		40 (17.5)
>3000		12 (5.3)
Gestation weeks group		
16–27		117 (47.2)
28–38		131 (52.8)
Ownership and usage of ITN among respondents		
Do you own insecticide-treated nets (ITNs) at home?	No	42 (16.8)
	Yes	208 (83.2)
Source of ITN	Buying at shops	24 (10.9)
	Free of charge from campaigns	138 (62.4)
	Subsidized price from health facility	59 (26.7)
Sleeping under bed nets can prevent malaria	No	12 (4.8)
	Yes	236 (95.2)
I believe sleeping under a mosquito net during the night can be avoided because of heat	Agree	149 (59.8)
	Disagree	78 (31.3)
	Neutral	22 (8.8)
Do you sleep under bed nets to prevent malaria?	No	44 (17.7)
	Yes	205 (82.3)

GHS: 10 Ghanaian Cedis about 1 US$. Source: Field Survey 2021.

ownership, 205 were using an ITN representing 82.3% of the total respondents. Most (95.2%) of respondents knew that sleeping under a bed net can prevent malaria. However, attitude towards ITN usage was poor as more than average (59.8%) of the respondents agreed that sleeping under an ITN can be avoided in hot weather (Table 1).

Most (96.8%) of the respondents were using spray or mosquito coil to prevent malaria. About 76.8% of the respondents trimmed bushes around their houses to prevent malaria. Also, the majority (69.2%) of the respondents do clean the dark corners in their houses to prevent malaria. Most (72.6%) of pregnant women eliminated stagnant waters around their houses to prevent the breeding of mosquitos that cause malaria. Netting of doors and windows to prevent malaria was done by 78.3% of the respondents. The least malaria prevention practice done by the respondents was wearing long-sleeve clothing in the evening (Table 2).

Factors associated with ITN ownership

From chi-squared analysis, the demographic factors associated with ITN ownership were: age, marital status, and education level. Proportionally, more of those aged ≥25 years owned an ITN, (χ^2=7.659, p=0.022). Marital status made a difference in terms of ITN ownership among study respondents (χ^2=9.047, p<0.029). Higher education level was associated with higher ITN ownership (χ^2=19.027, p<0.001). The two economic characteristics that made a significant difference in terms of ITN ownership were employment status and monthly income level. Proportionally, those employed were more for ITN ownership compared to those

Table 2. Other mosquito vector control practices among respondent pregnant women, Tamale Teaching Hospital, Ghana, 2021 (N=250)

Control practices		n (%)
Do you wear long-sleeve clothing in the evening to prevent malaria?	No	118 (47.2)
	Yes	132 (52.8)
Do you use insecticide spray or mosquito coil to prevent malaria?	No	8 (3.2)
	Yes	241 (96.8)
Do you trim bushes around the house to prevent malaria?	No	58 (23.2)
	Yes	192 (76.8)
Do you clean dark corners in your house to prevent malaria?	No	77 (30.8)
	Yes	173 (69.2)
Do you eliminate stagnant water around the house to prevent the breeding of mosquitos?	No	68 (27.4)
	Yes	180 (72.6)
Do you put a net on your doors and windows to prevent malaria attacks?	No	54 (21.7)
	Yes	195 (78.3)

Source: Field Survey 2021.

unemployed (χ^2=13.279, p=0.001). With regard to monthly income, those with monthly income ≥2000 GHS were more for ITN ownership compared to those with monthly income ≤1000 GHS (χ^2=6.686, p=0.035) (Table 3).

Relationship between other mosquito vectors control practices and ITN ownership

From the cross-tabulation analysis, proportionally ownership of an ITN was more among those with other malaria prevention practices (mosquito vector control). Ownership of an ITN was more among those who trimmed bushes around their houses for malaria prevention (χ^2=37.382, p<0.001). Ownership of an ITN was identified to be higher among those who clean dark corners in their houses for malaria prevention (χ^2=13.599, p<0.001). Finally, more of those with the practice of eliminating stagnant waters around their houses for malaria prevention had higher ownership of an ITN (χ^2=15.831, p=0.001) (Table 4).

Table 3. Socioeconomic factors associated with ITN ownership among respondent pregnant women, Tamale Teaching Hospital, Ghana, 2021

Factors	Do you own insecticide-treated nets at home?		Test statistics	
	No n (%)	Yes n (%)	χ^2	p
Age (years)	7.659	0.022		
18–25	13 (31.7)	28 (68.3)	7.659	0.022
25–35	25 (13.8)	156 (86.2)		
36–55	4 (15.4)	22 (84.6)		
Religion	2.226	0.329		
Islam	33 (19.2)	139 (80.8)	2.226	0.329
Christianity	9 (12.2)	65 (87.8)		
Traditional	0 (0.0)	2 (100)		
Marital status	9.047	0.029		
Married	38 (16.0)	200 (84.0)	9.047	0.029
Single	4 (57.1)	3 (42.9)		
Widowed	0 (0.0)	3 (100)		
Divorced	0 (0.0)	1 (100)		
Education level				
None	11 (39.3)	17 (60.7)	19.027	<0.001
Primary	17 (23.6)	55 (76.4)		
Secondary	8 (11.8)	60 (88.2)		
Tertiary	6 (7.3)	76 (92.7)		
Employment status	13.279	0.001		
Unemployed	18 (29.5)	43 (70.5)	13.279	0.001
Self-employed	18 (16.4)	92 (83.6)		
Government employee	5 (6.4)	73 (93.6)		
Monthly income (GHS)	6.683	0.035		
≤1000	32 (18.2)	144 (81.8)	6.683	0.035
2000–3000	2 (5.0)	38 (95)		
>3000	0 (0.0)	12 (100)		
Gestation weeks group	0.076	0.782		
16–27	19 (16.2)	98 (83.8)	0.076	0.782
28–38	23 (17.6)	108 (82.4)		

GHS: 10 Ghanaian Cedis about 1 US$. Source: Field Survey 2021.

Table 4. Relationship between other mosquito vectors control practices and ITN ownership among respondent pregnant women, Tamale Teaching Hospital, Ghana, 2021

Control practices		Do you own insecticide-treated nets at home?		Test statistics	
		No n (%)	Yes n (%)	χ^2	p
Do you wear long-sleeve clothing in the evening to prevent malaria?	No	24 (20.3)	94 (79.7)	2.002	0.157
	Yes	18 (13.6)	114 (86.4)		
Do you use insecticide spray or mosquito coil to prevent malaria?	No	2 (25.0)	6 (75.0)	0.390	0.532
	Yes	40 (16.6)	201 (83.4)		
Do you trim bushes around the house to prevent malaria?	No	25 (43.1)	33 (56.9)	37.382	<0.001
	Yes	17 (8.9)	175 (91.1)		
Do you clean dark corners in your house to prevent malaria?	No	23 (29.9)	54 (70.1)	13.599	<0.001
	Yes	19 (11.0)	154 (89.0)		
Do you eliminate stagnant water around the house to prevent the breeding of mosquitos?	No	22 (32.4)	46 (67.6)	15.831	<0.001
	Yes	20 (11.1)	160 (88.9)		
Do you put a net on your doors and windows to prevent malaria attacks?	No	13 (24.1)	41 (75.9)	2.902	0.088
	Yes	28 (14.4)	167 (85.6)		

Source: Field Survey 2021.

Relationship between other mosquito vectors control practices and monthly income

Chi-squared analysis was conducted to identify if economic status made a significant difference with other malaria preventive practices as in ITN ownership. Proportionally, those with higher monthly income practice bush trimming around their houses for malaria prevention (χ^2=14.338, p=0.001). Cleaning of dark corners of houses was by proportion practiced more in those with higher monthly income (χ^2=25.258, p<0.001). And finally, elimination of stagnant water around houses was by proportion practiced more among those with a higher income status (χ^2=17.091, p<0.001) (Table 5).

Table 5. Relationship between other mosquito vectors control practices and monthly income, Tamale Teaching Hospital, Ghana, 2021

Control practices		Monthly income (GHS)			Test statistics	
		≤1000 n (%)	2000–3000 n (%)	>3000 n (%)	χ^2	p
Do you wear long-sleeve clothing in the evening to prevent malaria?	No	78 (44.3)	16 (40.0)	8 (66.7)	2.710	0.258
	Yes	98 (55.7)	24 (60.0)	4 (33.3)		
Do you use insecticide spray or mosquito coil to prevent malaria?	No	5 (2.9)	1 (2.5)	0 (0.0)	0.360	0.835
	Yes	170 (97.1)	39 (97.5)	12 (100)		
Do you trim bushes around the house to prevent malaria?	No	51 (29.0)	2 (5.0)	0 (0.0)	14.338	0.001
	Yes	125 (71.0)	38 (95.0)	12 (100)		
Do you clean dark corners in your house to prevent malaria?	No	72 (40.9)	2 (5.0)	0 (0.0)	25.258	<0.001
	Yes	104 (59.1)	38 (95.0)	12 (100)		
Do you eliminate stagnant water around the house to prevent the breeding of mosquitos?	No	62 (35.4)	3 (7.7)	0 (0.0)	17.091	<0.001
	Yes	113 (64.6)	36 (92.3)	12 (100)		
Do you put net on your doors and windows to prevent malaria attack?	No	44 (25.1	6 (15.0)	0 (0.0)	5.529	0.063
	Yes	131 (74.9)	34 (85.0)	12 (100)		

GHS: 10 Ghanaian Cedis about 1 US$. Source: Field survey 2021.

DISCUSSION

In Saharan Africa, an estimated 25 million pregnancies are at risk from malaria every year, with substantial morbidity and death effects for both mother and fetus. Therefore, this study aimed to identify socioeconomic and demographic factors associated with ownership of insecticide-treated nets for preventing malaria among pregnant women reporting at Tamale Teaching Hospital, Ghana. The prevalence of ITN ownership among the studied pregnant women was 83.2%. This study's prevalence of ownership is similar to a similar study in the northern part of Ghana[21]. Although the national aim of the National Malaria Control Program (NMCP) for ITN ownership (100%) was not met, the results remained reassuring. The high ownership of an ITN among pregnant women at Tamale Teaching Hospital could be attributed to Ghana's free distribution of ITNs, as most ITNs are obtained for free[20]; this is confirmed in the present study as only 10.9% ownership was acquired by buying from shops with the remaining from the free campaign or subsidized price from a health facility. Furthermore, this could be attributable to the provision of an ITN to pregnant women during prenatal checkups. Also, in a study by Darko et al.[21], utilization of mosquito nets was 69.3%, which is low compared to this study's result (82.3%)[21].

Lack of access to ITNs, as well as a lack of information and perception about ITNs and malaria, have previously been identified as significant barriers to ITN use in Africa[17]. In the present study, most (95.2%) of the respondents knew that sleeping under a bed net can prevent malaria. However, attitude or perception towards ITN usage was poor, as 59.8% of the respondents agreed that sleeping under an ITN can be avoided when there is hot weather.

It is possible that ownership of an ITN can be influenced by demographic characteristics of pregnant women and in this study, proportionally, more of those aged ≥25 years owned an ITN. Also, in the Darko et al.[21] study, pregnant women aged 30–34 years showed the highest level of association with regard to ITN ownership[21]. This was similarly reported in an earlier study in Ethiopia[22].

Marital status made a difference in terms of ITN ownership among study respondents. However, earlier studies did not show a significant difference in terms of ITN ownership and marital status[21,23,24]. A prior study in Southwest Ethiopia did identify a relationship between household marital status and ITN ownership[25]. In this study, higher education level was associated with more ITN ownership. Other earlier studies have confirmed that higher educational level made a significant difference in ownership of an ITN[21,23,24]. This might be characterized as follows: education develops empowerment and ensures growth benefit through a continual learning process, which enables pregnant women to discover more about ITNs. This study also identified that economic characteristics made a significant difference in ITN ownership. Proportionally, those employed were more for ITN ownership compared to those unemployed. With regard to monthly income, those with monthly income ≥2000 GHS were more with ITN ownership compared to those with monthly income ≤1000 GHS. This finding is in accordance with an earlier study in the same part of the country (northern Ghana)[21,24]. Unfortunately, due to the wear and tear of campaign nets, new births between campaigns, and specific groups overlooked by various channels, more efforts to enhance or sustain ITN ownership are needed.

The ITN alone is sufficient in the malaria control program; hence we further tried to assess other mosquito vector control measures that respondents employed. In this study, most of the respondents were using spray or mosquito coil, trimming bushes around their houses, cleaning dark corners in their houses, eliminating stagnant waters around their houses to prevent the breeding of mosquitos, and netting doors and windows to prevent malaria. The least malaria prevention practice done by the respondents was wearing of long-sleeve clothing in the evening. Those with an ITN continued with other preventive practices. Ownership of an ITN was higher among those who trimmed bushes around their houses for malaria prevention. Ownership of an ITN was identified to be higher among those who clean dark corners in their houses for malaria prevention. Finally, more of those with the practice of eliminating stagnant waters around their houses for malaria prevention had higher ownership of an ITN.

This study identified economic factors that made a difference in the ownership of mosquito nets. Proportionally, those with a higher monthly income practice bush trimming around their houses from malaria prevention. Cleaning of dark corners of houses was by proportion practiced more by those with a higher monthly income. Finally, the elimination of stagnant water around houses was by proportion practiced more among those with a higher income. Previous research has indicated that the lack of education, low income, low wealth, and living in poorly constructed housing may raise the risk of *P. falciparum* infection among people in SSA[26].

Limitations

This study's understanding of some of the contextual elements influencing ITN ownership and use is limited because it is a cross-sectional quantitative study, in which only bivariate analyses were performed. Furthermore, the study's findings should be read with caution to avoid generalization. Regardless, the study provides valuable information to guide malaria control intervention actions in Ghana and other similar situations.

CONCLUSIONS

Though not of the national target, this study recorded very good ITN ownership coverage among pregnant women. Educational level and economic status were the major factors associated with ITN ownership. Public policy interventions

that eliminate inequalities in health coverage while also improving economic and educational possibilities for the poor may increase malaria prevention practices and hence aid in reducing the malaria burden in Ghana.

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CONFLICTS OF INTEREST
The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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DATA AVAILABILITY
The data supporting this research are available from the authors on reasonable request.

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