Logistic Regression Modeling to Isolate Factors that Correlate with Usage of ITN as a Prophylactic to Malaria in Ghana

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Abstract: The study was conducted to isolate factors that correlate with ownership and usage of insecticide treated nets (ITNs) as a prophylactic to malaria in Asamankese, Ghana and explore the policy implications of the findings for ITN programmes. A cross-sectional design was deployed. A structured close-ended interviewer-administered questionnaire was designed and administered. Snowball technique was adopted to sample views from 500 mothers and care-givers of children under five years from 23 communities of Asamankese, Ghana. A chi- square test was employed to ascertain the significance of certain variables; a logistic regression model was utilized to isolate factors that had possible influence on ITN usage at 95% confidence interval. In determining one's motivation for usage of ITN, sleeping area allowing for use of ITN was the most important (Wald Chi-square = 45.184), followed by expected monthly income (Wald Chi-square =7.114), then second cycle level of education (Wald Chi-square = 6.512) and finally, number of children under five years (Wald Chi-square = 5.029). There was an association between ITN use and monthly income of respondents ($p < 0.05$). Furthermore, there was a significant relationship ($p < 0.05$) between environmental factors and ITN usage. Finally, there was a relationship ($p < 0.05$) between one's knowledge and use of ITN. Behavior change education should be intensified in the municipality so that more people could accept and adopt lifestyles that will protect them from the deadly disease. Proper housing structures that promote the use of ITNs should also be encouraged.
Keywords: cross- sectional design, hang–up campaign, insecticide treated nets, logistic regression, malaria

INTRODUCTION

Malaria is a major cause of death and illness in both children and adults in sub-saharan Africa and Ghana is no exception[1]. In most countries of sub-saharan Africa, malaria is highly endemic and due to repeated exposure to malaria infection, people develop a certain degree of immunity to it during the first decade of life.The disease is caused by a plasmodium parasite. Five species of these plasmodium malaria parasites are known to infect humans, with varying degrees of severity. These parasites are transmitted from human to human via *Anopheles* mosquitoes, most commonly *Anopheles Gambia* in Africa. Plasmodium falciparum, is found worldwide in tropical and subtropical areas. It is estimated that every year approximately one million people are killed by P. falciparum, especially in Africa where this species predominates [2]. Initial symptoms of malaria include fever, headache, and vomiting. In more severe cases of malaria, such as those caused by *Plasmodium falciparum*, coma and death are common if untreated. Even when treatment is administered, impaired development in children is common after severe malaria. In 2012, an estimated 627,000 people died of malaria**;** most of them were young children in sub-Saharan Africa. Within the last decade, increasing numbers of partners and resources have rapidly increased malaria control efforts. This scale-up of interventions has saved 3.3 million lives globally and cut malaria mortality by 45%, leading to hopes and plans for elimination and ultimately eradication[3].

In a study done in Ghana, malaria topped the list of predominant diseases in Ghana[4]. It has been established that the malaria incidence rate in the Anyigba state in Nigeria is 467/1000 [5]. The disease can be diagnosed by a microscopic examination or use of Rapid Diagnostic Test kits (RDTs) of the patient's blood and can normally be cured by taking anti-malarial drugs. However, there are some regions where parasites have developed resistance to these drugs. Key interventions to control malaria include: prompt and effective treatment with artemisinin-based combination therapies; use of insecticidal nets by people at risk; and indoor residual spraying with insecticide to control the vector mosquitoes[6].

The Long Lasting Insecticide Treated Net (ITN)

All mosquito nets act as a physical barrier, preventing access to humans from mosquito bites and thus protection against malaria to the individual using the net. Pyrethroid insecticides, which are used to treat nets, have an excito-repellent effect that adds a chemical barrier to the physical one, reducing human-vector contact and increasing the protective efficacy of the mosquito nets. Most commonly, the insecticide kills the malaria vectors that come into contact with the Insecticide Treated Nets (ITNs). By reducing the vector population in this way, ITNs provide protection for all people in the community, including those who do not sleep under nets, this means that, the vector is either killed or rendered inactive to transmit parasite from one protected person to a non- protected person. A number of studies have found that Insecticide Treated Nets (ITNs) provide varying degrees of protection against malaria morbidity, anemia and low birth weight. In a trial of untreated bed nets in the Gambia, the nets were found to reduce the number of infective bites but not enough to reduce morbidity from malaria. Eisele et al [7] noted that there had been a robust evidence of the efficacy of insecticide-treated mosquito nets (ITNs) in reducing malaria parasite prevalence, incidence, and all-cause child mortality. A study conducted in Ethiopia with the aim of examining the factors associated with the use and non-use of ITNs revealed that out of the 857 households surveyed, 91percent of them owned at least one ITN[8].

ITN distribution has a strong track record of significantly reducing mortality in both repeated, randomized controlled trials and in larger-scale, country-level distribution efforts[9].

Kariuki et al [10] investigated the effect of ITNs on two genes in a large community-based ITN trial site in western Kenya. They noted that the high diversity in these two genes had been maintained overtime despite marked reductions in malaria transmission due to ITNs use.

In a national cross-sectional survey, it came to light that there was some degree of association between ITNs-usage and malaria prevention. There was a 23 per cent reduction in all-cause child mortality[11]. In response to the increased global prioritization of malaria prevention and treatment, attention has now been shifted from prevention campaigns to monitoring and evaluation (M&E) of the interventions, in this direction, many countries are currently using large multistage cluster sample surveys to monitor malaria outcome indicators on a regional and national level[12].

Knowledge on ITNs Vis a Vis its Use

Several studies have shown that poor perception and knowledge on malaria or its control is common among people living in areas where malaria is endemic. While misconception about the cause and prevention of malaria was significantly associated with non-use of ITNs, no association between knowledge of symptoms and risk of malaria and the use of ITNs were observed. A study conducted by Tomass et al [13] with the view of evaluating the knowledge, attitude and practice (KAP) about ITNs at household level in rural sub-distracts of Kolla Tembien and its usage revealed that the overall knowledge, attitude and practice of ITN usage was found to be satisfactory in the study district. Atieli et al [14] reported that the insecticide-treated mosquito nets (ITNs) used to protect people against mosquito bites had proved to be highly and cost-effective intervention scheme. In supporting their assertion, they noted that there were evidences from the public health that the prevalence of *Plasmodium falciparum* infection in community-based randomized controlled trials (RCT) in endemic regions had shown average reductions of 20% in all causes of mortality in children under 5 years in the space of two years of increasing ITN usage from zero to 50-70%.

Environmental Factors on ITNs Usage

A study aimed at ascertaining the linkages between exposure to the environment and health hazards revealed that the hazard ratio of the exposed group was higher than the less exposed group. The study also revealed that dwellers who subscribed to insecticide treated nets (ITNs) as means of reducing exposure to the malaria parasite had better and longer survival prognosis than non-subscribers[15]. Takang et al [16] observed that after a decade of investment in malaria control across sub Saharan Africa, there was the need to evaluate the impact of the investment on reducing the malaria burden on households. WHO[17] admonished travelers to note the ABCD of malaria protection:

- Be Aware of the risk, the incubation period, the possibility of delayed onset, and the main symptoms.
- Avoid being bitten by mosquitoes, especially between dusk and dawn.
- Take antimalarial drugs (Chemoprophylaxis) when appropriate, to prevent infection from developing into clinical disease.

- Immediately seek Diagnosis and treatment if a fever develops 1 week or more after entering an area where there is a malaria risk and up to 3 months (or, rarely, later) after departure from a risk area.

Socio Economic Factors on ITN Usage

Ayele et al [18] noted that the prevalence of malaria for households with clean water was lower than households without clean water, it was also noted that diagnosis of malaria was higher for people living in thatch and mud houses and earth dung plaster floor than people living in the other types of houses. Owusu Adjah *et al*[19] reported that efforts by health workers, volunteers and the media in relating ITN messages to the public was very useful in increasing use of bed nets**.** Singh and Singh[20] also noted that the effective control of malaria could enhance the attainment of international malaria targets by 2015. Kilian et al [21] intimated that even though long-lasting insecticidal nets were effective materials for malaria prevention, nevertheless, national level campaigns in several countries had often run out of nets in the course of the distribution, they noted that this situation reveals a problem in assessing the actual quantity needed for distribution.

The Present Study

Today ITNs are used in several communities in Asamankese in the Eastern region of Ghana. Although the efficacy and cost effectiveness of treated bed nets have been widely reported, little is known about the range, strength, or interaction between different factors that influence their appropriate use at the household level. This study seeks to investigate the interactive effects of one's knowledge on ITN vis a vis its usage, effects of environmental factors on the use of ITN and the effect of socio-economic factors on ITN ownership and usage in children under five years in the Eastern region of Ghana after the free door-to-door mass distribution and hang-up campaign in 2011. The specific objectives of the study were to:

- Determine the influence of one's knowledge on ITN and use of it;
- Examine the influence of environmental factors on ITN use; and
- Determine the effect of socio-economic factors on ownership and usage of ITN

Three hypothesis were tested as follows:
H_0: There is no association between knowledge on and use of ITN among children under five years
H_0: Use of ITN in children under five years is not a function of the environmental set up of mothers or caregivers.
H_0: Use of ITN in children under five years is not a function of socio-economic standing of mothers or caregivers.

This study is innovative in the following direction. Firstly, from the literature reviewed, most of the researchers focused their attention on either a typically rural or urban setting, but this study shifted attention to a peri-urban area. In addition, studies done on ITN laid little emphasis on determinants of ITN use after a nationwide free door-to-door distribution and hang-up campaign had been done which this study extensively addressed. The empirical analysis also isolated factors that promoted the ownership and usage of ITN.

The study will broaden previous studies conducted on different aspects of ITN implementation, stimulate further research as well as provide recommendations for improving the efforts of malaria control in Ghana and lives of communities in Asamankese.The study was delimited to Asamankese sub-metropolis because of the free door-to-door and hang- up campaign that was done there. It was also delimited to a sample size of 500 mothers and caregivers instead of the entire population. Finally, the study was delimited to the use of the simple random sampling and snow ball technique due to their significance when it comes to surveys of this nature.

MATERIAL AND METHODS

Cross-sectional design was adopted for this study. This was used to investigate the factors affecting use of ITN in malaria control in children under five in the Asamankese sub-municipal. This design was used because it is relatively quicker and easier to use since data on all variables were collected only once. It is also good for studies of this nature where a section of the population is to be investigated. Finally, it provides data on health related characteristics in a defined population at a given point in time. The study population consisted of mothers and caregivers of children under five in Asamankese which is one of the eight sub-municipal areas in West Akim Municipal. It is the largest sub municipal area with a total population of 58,044. This figure represents 30.1% of the total population in the municipal. Children under five years constituted 20% of the total population of the sub-municipal.

The area is made up of a combination of urban and rural dwellers whose dominant business is trading and subsistence farming. Apart from the members of the community who are involved in 'white collar jobs', the income of the indigenes tend to be unstable due to the seasonality of their occupation. The climate in the area is typically wet equatorial with the major rainy season running from late February to early July and minor from mid-September to early November. The dry season lasts for four months; December to April with its peak in February. The prevalence of appropriate ITN use in the study area was not known, thus a prevalence figure of 50% was assumed and used to calculate the sample size. With 95% confidence level, the sample size was 384.16 and was approximated to 500 (adjusting for 96% response rate). This was also done to cater for errors and sample variability in the study population. The sample size was estimated using the formula:

$$n \geq \frac{Z^2 p \left(1-p\right)}{d^2}$$

Where:

Z = 1.96

p = Proportion of the sample that is assumed to be using ITN

d = Error margin.(The margin of error one is prepared to make determines the size of sample he will take and vice versa, it is statistically pegged at 5%)

$$n = \frac{1.96 \times 0.5 \times 0.5}{0.05^2} = 384.2 \quad [22]$$

The questionnaire was developed based on the sub-municipal profile and the set of study objectives. The questionnaire sought information on socio-demographic variables, knowledge level on the importance of ITN vis a vis its usage and the influence of environmental factors on ITN use. The questionnaire was reviewed by fellow researchers from the public health sector and pretested on a small sample to ensure content validity. The participants were selected using the snowball technique, where respondent mothers and caregivers of children under five gave referrals to the research team; this then led to other mothers and caregivers.

The data was analyzed using the Statistical Package for Social Sciences (SPSS) version 17. It was coded and keyed into the software. Frequencies, percentages, mean, standard deviation, graphs and tables were used to explore the data. Chi-square and logistic regression analysis were used to further analyze the data. The significance of the result was pegged at probability value ($p<0.05$). Logistic regression analysis was performed to predict which of the sets of factors; background characteristics (age, marital status, educational level, etc); environmental factors (structure of rooms, refuse disposal, water storage, climatic conditions etc), socio-economic factors (income of mothers and nature of occupation) and knowledge on ITN (acquisition of ITNs, hanging and importance) could predict use of ITN among respondents.

RESULTS AND DISCUSSIONS

A total of 500 households were investigated during the study. The demographic data is presented in Table 1. Of these, 67.8% were women while the remaining 32.2% were men, indicating that women were typically the custodians of children under 5years. The ages of the respondents ranged from 15 to 65 years with a median age of 30 years and standard deviation 8.417years. The age group with the largest number of participants was the 15-29 year group which constituted 47%; this was followed by the age group 30-44 years which constitutes (45.8%). About 92% of the respondents were gainfully employed. These respondents were either artisans or engaged in farming, trading and other activities. The table further shows that only 8.8% of the respondents had no formal education. Over 50% of respondents had junior high education, while the remaining 39% was distributed among those who had primary (19.4%), senior high (11.8%) and tertiary (7.4%) education.

From Table 2, we could see that 368 married couples (73.6%), eighty eight singles (17.6%) and forty four (8.8%) either divorced or separated were included in the study. About 63.4% of respondents had a child under five years, 35% had two children under five years while 1.6% had three or four children under five years. The result also shows that the highest number of children a family could have was seven, which was just 0.2% of the respondents. The majority of them had between one to three children. The average number of child per household was two. With an average of two ITNs per household, 431 (86.2%) out of the 500 respondents owned ITNs. From Table 3, about 83% of those who owned ITNs acquired it from the free ITNs door-to-door hang-up campaign. Those who acquired ITNs from health facilities and other sources, formed 16% and 1% respectively. About 82% of ITNs were observed hanging during the study. More than 92%

of children under five years slept in ITNs the night before the interview. Figure 1 represents a multi-response variable, from it, we could see that 79.4% of respondents believed that the use of ITNs would reduce the burden of malaria on their under five children, 44% were of the view that children slept better in ITNs. Over 33% of respondents thought that it would help save money for other purposes. Finally, 36.6% believed that the use of ITNs saved the time one would spend visiting health facilities or hospitals.

From Table 4, 465/500 respondents (93%) knew where to acquire ITNs. A little above 64% of respondents mentioned the health facilities as the source of acquiring ITNs, while 26% acquired it from the chemical or pharmacy shops, only 8.4% mentioned that they got the nets from other sources like gifts and donations. 10.8% of the mothers and care givers of children under five did not know how to hang the net. More than 71% indicated that the hanging process was easy. Finally, 97.6% of respondents affirmed that they knew how to use the ITN.

Table 5 shows the relationship between background characteristics and ITN ownership and usage. From the table, we could see that there was a significant relation between ITN ownership and educational level $p < 0.05$. The results further revealed that ownership was more among those with lower levels of education (primary and JHS) than those with higher levels. In addition, there was a significant relation between ITNs usage and the educational level of mothers and caregivers of children under 5years. There was a slight decreasing trend in the level of education and use of ITNs, starting from SHS to the primary level as shown in Table 6.

Table 1. Socio-demographic profile of respondents

Explanatory variables	Frequency	Percentage
Gender		
Male	161	32.2
Female		
Age	339	67.8
15-29	235	47.0
30-44	229	45.8
45-59	30	6.0
60 and above	6	1.2
Employment status		
Employed	462	92.4
Unemployed		
Occupation	38	7.60
Artisan	149	32.25
Farming	70	15.15
Trader	201	43.51
Other		
Level of Education	42	9.09
Primary	97	19.40
Junior high or MSLC	263	52.60
Senior high	59	11.80
Tertiary	37	7.40
No formal education	44	8.80

Source: Field work 2013

Table 2. Background characteristics of mothers and care givers

Household variables	Frequency	Percentage
Marital status		
Single	88	17.6
Married	368	73.6
Divorced	27	5.4
Separated	17	3.4
Number of children		
1	145	29.0
2	151	30.2
3	135	27.0
4	59	11.8
5	5	1.0
6	4	0.8
7	1	0.2
Number of children aged between 0 and 5 years		
1	317	63.4
2	175	35.0
3	7	1.4
4	1	0.2

Source: Field work 2013

Table-3: Baseline characteristics of households

Explanatory variables	Frequency	Percentage
Do you own ITNs?		
Yes	431	86.2
No	69	13.8
Number of ITNs in households		
1	149	34.57
2	179	41.53
3	83	19.26
4	20	4.64
Mean: 1.67, standard deviation: 1.037		
Where did you acquire ITNs from?		
ITNs hang-up campaign	358	83.06
Health facility	69	16.01
Other (friends, church)	4	0.93
Number of children under 5 who slept in ITN last night		
0(years)	31	7.19
1	258	59.86
2	137	31.79
3	5	1.16
Were ITN observed hanging?		
Yes	355	82.37
No	76	17.63

Source: Field work 2013. N = 500

Table-4: Respondents knowledge on use of ITN and where to acquire them

Question	Frequency	Percentage
Do you know where to acquire ITN?		
Yes	465	93.0
No	35	7.0
Where to acquire ITN		
Health facility	324	64.8
Chemical Shop/pharmacy	134	26.8
Other	42	8.4
Do you know how to hang ITN?		
Yes	446	89.2
No	54	10.8
Process of hanging ITN		
Easy	359	71.8
Difficult	141	28.2
Do you know how to use ITN?		
Yes	488	97.6
No	12	2.4

Source: Field work, 2013 N = 500

Table-5: Relationship between background characteristics and ITN ownership and use

Ownership of ITN	Yes	No	Total	Chi-square	P-value
Level of education					
Primary	82	15	97		
Junior high or MSLC	218	45	263		
Senior high	58	1	59	12.109	0.017
Tertiary	35	2	37		
No formal education	38	6	44		
ITN use among caregivers of children under 5years					
Level of education					
Primary	82	15	97		
Junior high or MSLC	212	51	263		
Senior high	58	1	59	32.791	0.000
Tertiary	35	2	37		
No formal education	32	12	44		
ITN usage among children under 5 years					
Level of education					
Primary	80	17	97		
Junior high or MSLC	105	63	168	15.162	0.004
Senior high	47	4	51		
Tertiary	36	3	39		
No formal education	39	13	52		

Source: Field study, 2013

Table-6: Relationship between knowledge, environmental factors and ownership of ITN on usage

	Yes	No	Total	Chi-square	P-value
ITN usage among children under 5 years					
Knowledge on ITN Use					
Yes	410	71	481	19.31	0.000
No	9	10	19		
Does the environment permit use of ITN?					
Yes	350	74	424	11.311	0.001
No	50	26	76		
ITN ownership					
Yes	419	12	431	414.067	0.000
No	0	69	69		

Source: Field study, 2013
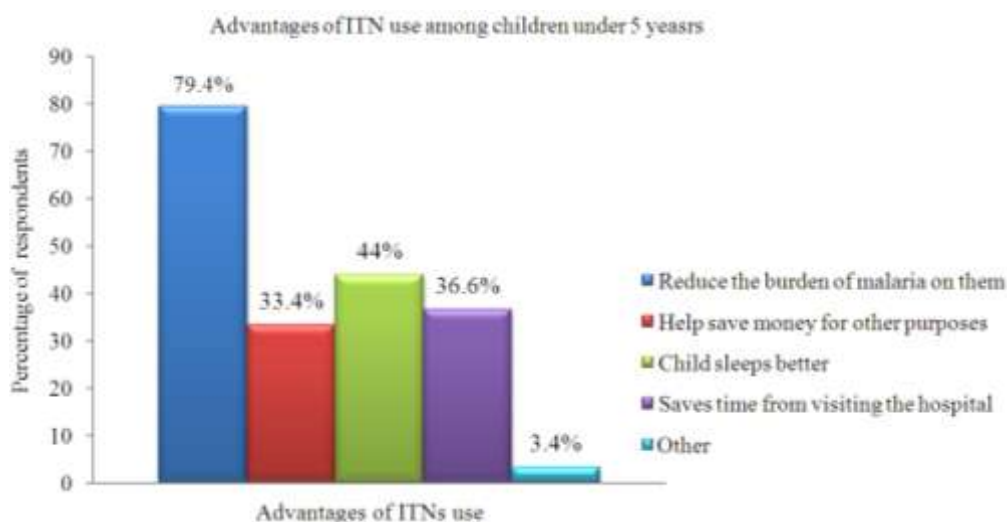
Fig. 1. Histogram displaying the Knowledge of the advantages of ITNs usage among children under 5 years old as revealed in the study

Table 7. Tests of association between predetermined factors and Use of ITN

| Use of ITN	Yes	No	Chi-Square	P-value
Knowledge of how to use ITN				
Yes	388	58	31.620	<0.001
No	31	23		
Effect of ITN use on visit to source health care services				
Same	58	37	144.984	<0.001
Reduced	355	23		
Increased	5	8		
Other	1	13		
Environmental factors affecting use of ITN				
No	55	21	8.627	0.003
Yes	364	60		
Knowledge (heard, seen or read anything) of ITN				
Yes	410	71	19.310	<0.001
No	9	10		

Source: Field study, 2013
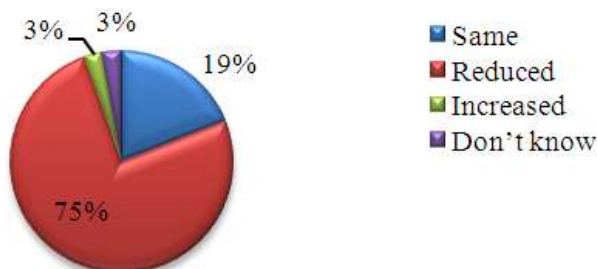
Fig. 2. Pie chart showing effect of ITN use and the frequency of visits to health facilities

Those who owned and used ITNs also believed that children were at risk of getting malaria if they did not sleep under ITNs. There was a significant relationship (p<0.05) between ITNs ownership and usage. There was also a significant relationship between employment status and the use of ITNs among children under five (p = 0.007 < 0.05). There was also an association between ITNs use and the monthly income of respondents (p < 0.05). Table 6 revealed that there was a significant relationship (p < 0.05) between environmental factors and ITNs usage. The significant test (Table 7) also revealed that there was a relationship (p < 0.01) between one's knowledge and use of ITNs, in addition there was a relationship between usage and the number of times per month they visited hospitals to source for health care. As to whether the environmental factors permitted the use of ITNs, it was found out that it did influence its use; it was revealed that 86% of the respondents who used ITNs did use it because the weather aided them. There was a significant relationship (p < 0.05) between the climatic condition (environmental factor) and use of ITNs. Finally, respondents' knowledge on ITNs had a significant influence (p < 0.05) on their usage (Table 7). From Fig. 2, we could see that 75% of respondents had a reduction in the frequency of visits to health facilities as a result of use of ITNs. 19% did not observe any change in their visit to the health facility.

Logistic Regression on Determinants of Appropriate use of ITNs
Model: *Positive = f (Sex, number of children under five, expected monthly income, marital status, highest educational level, whether children's sleeping space allows for the hanging of ITN, structure of the room, other protective measures against mosquitoes)*

The dependent variable in the model measures the view of respondents on the use of ITN. The response is either 'Yes' (=1) or 'No' (= 0) 'Yes' if the respondent uses ITN and No, otherwise.

The logistic regression model was used to isolate factors which influenced the use of ITN among respondents. This is shown in the regression analysis above. The covariates are enclosed in the brackets in the model above.

Table 8. Classification table for the logistic regression models

Observed			Predicted		
			Do you use ITN?		
			Yes	No	(%) Correct
Step 1	Do you use ITN?	Yes	365	16	95.8
		No	44	26	37.1
	Overall Percentage				86.7
Step 2	Do you use ITN?	Yes	367	14	96.3
		No	46	24	34.3
	Overall Percentage				86.7
Step 3	Do you use ITN?	Yes	367	14	96.3
		No	45	25	35.7
	Overall Percentage				86.9
Step 4	Do you use ITN?	Yes	368	13	96.6
		No	45	25	35.7
	Overall Percentage				87.1

Source: Field study, 2013

Table 9. Final logistic regression model on ITN use

	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I. for Exp (B)	
							Lower	Upper
Step 1b Sleep area allows use of net vrs not	-2.601	0.356	53.519	1	0.000	0.074	0.037	0.149
Constant	0.486	0.318	2.335	1	0.127	1.625		
Step 2b Expected Monthly Income (EMI)	-0.543	0.182	8.911	1	0.003	0.581	0.407	0.830
Sleep area allows for use of net vrs not	-2.511	0.361	48.476	1	0.000	0.081	0.040	0.165
Constant	1.480	0.466	10.086	1	0.001	4.394		
Step 3b Number of children under 5	-0.588	0.288	4.161	1	0.041	0.555	0.315	0.977
EMI	-0.569	0.181	9.912	1	0.002	0.566	0.397	0.807
Sleep area allows for use of net vrs not.	-2.639	0.374	49.740	1	0.000	0.071	0.034	0.149
Constant	2.456	0.677	13.178	1	0.000	11.657		
Step 4b Number of children under 5	-0.680	0.303	5.029	1	0.025	0.507	0.280	0.918
Level of education			7.488	4	0.112			
None vrs Primary	-0.442	0.524	0.711	1	0.399	0.643	0.230	1.796
None vrs JHS/MSLC	-0.344	0.443	0.602	1	0.438	0.709	0.297	1.690
None vrs SHS	-2.858	1.120	6.512	1	0.011	0.057	0.006	0.515
None vrs Tertiary	-1.371	1.138	1.452	1	0.228	0.254	0.027	2.361
Expected mthly income	-0.533	0.200	7.114	1	0.008	0.587	0.397	0.868
Sleep area allows for use of net vrs not	-2.591	0.385	45.184	1	0.000	0.075	0.035	0.160
Constant	2.971	0.767	15.014	1	0.000	19.503		

Note: JHS = Junior High School; SHS = Senior High School; MSLC= Middle School Leaving Cert

Table 8 depicts the steps involved in the logistic regression analysis; the first variable used at step 1 was 'children's sleeping space allows for the hanging of ITN', this variable helped us to identify its significance on use or non-use of ITN. From Table 9 it was revealed that children's sleeping space allows for the hanging of ITN was highly significant at 99% level of significance. Furthermore, with an odds ratio of 0.074 and a 95% confidence interval of [0.037, 0.149], there was less likelihood for one to use an ITN with a smaller room space.

At the second stage, the variable 'Expected Monthly Income (EMI)' was added to the model. The result shows that expected monthly income was significant p = 0.003 <0.05. This shows that, with a rise in one's expected monthly income, there was the likelihood that ITN would be used. However, Wald's Chi-square statistics of 48.476 indicates that among the two predictors considered so far 'children's sleep space allows for the hanging of ITN' and 'expected monthly income', the former was the most important determinant of whether one uses ITN or not.

At the third stage, the variable 'number of children under five' was added to the model, this was also significant (p = 0.041<0.05). This implies that as the number of children under five increases, the likelihood of using ITN increases. At this stage, the important determinant of the use of ITN in reducing order of importance was as follows: 'Children's sleeping space allows for hanging of ITN' (Wald Chi-square = 49.7), 'expected monthly income' (Wald Chi-square = 9.912), then 'number of children under five' (Wald Chi-square = 4.161).

At the final stage, 'level of education' was added to the model. It could be seen that only none versus SHS level of education was significant (p = 0.011<0.05). This shows that a person with an SHS level of education is less likely to use ITN, compared to one with no education (odds ratio = 0.057). At the final stage, the following could be extracted; the most important determinant was 'Sleeping area allowing for the use of ITN' (Wald Chi-squared = 45.184), followed by 'Expected monthly income' (Wald Chi-squared = 7.114), then SHS level of education compared to none (Wald Chi-squared = 6.512) while the least important determinant

CONCLUSION
In this study, Logistic regression model was used to isolate factors that correlate with the ownership and usage of long lasting Insecticide Treated Nets (ITN) as a prophylactic to malaria at the West Akim sub-municipal in Ghana. The researchers used a forward stepwise logistic regression to isolate the important factors that correlate with the ownership and usage of ITN. ITN use in the study area was influenced by a group of factors which included the following: Background characteristics of household, socio-economic status, environmental factors and knowledge on importance of ITN. In reducing order of importance in determining one's use of ITN, the size of sleeping area, expected monthly income, SHS level of education and number of children under five years were the most influential. There was a significant relationship between ITNs ownership and usage. There was also a significant relationship between

employment status and the use of ITNs among children under five. Moreover, there was an association between ITNs use and the monthly income of respondents. There was again a significant relationship between environmental factors and ITNs usage. One's knowledge on and use of ITNs were also associated.

It is recommended that behavior change education should be intensified in the municipality so that more people can accept and adopt a lifestyle that will protect them from the deadly malaria diseases. It is further recommended to the following institutions to take the indicated actions;

The Ministry of Health
The Ministry Of Health (MOH) should collaborate with MDA responsible for housing to enforce policy on proper house structure that encourages use of ITN such as presence of adequate ventilation and standard room size

Health Facilities
Intensify education on ITN use during antenatal, post natal clinic and child welfare clinic sessions

The Community
Organize durbars and invite persons with requisite knowledge to educate community on the use of ITNs and malaria control in general

The School
Teach children from the early stages about ITN use and its benefits

The Household
Practice environmental management to prevent breeding of mosquitoes by weeding all bushes that hold semi clean water

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