

Determinants of Insecticide Treated Nets (ITNs) Ownership and Use in Ghana

by

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Thesis submitted in partial fulfillment of
the requirements for the Masters of Science in the Department of
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Malaria is hyper-endemic in Ghana, and remains one of the leading causes of morbidity and mortality, especially in pregnant women and children under the age of five. The use of insecticide-treated nets is an effective intervention for malaria control; however, despite known evidence of its efficacy, there is still a low rate of implementation and usage. Considering the significant public health benefit from proper use of ITNs, it is worthwhile to study factors that determine ownership of ITNs in Ghana. Cross-sectional data from the Demographic and Health Surveys (DHS) for Ghana in 2008 were analyzed to determine which variables were predictors of ITN ownership. Additional semi-structured interviews were also conducted to explore these variables in greater detail. Approximately one third of Ghanaian households own at least one ITN. The strongest positive predictors of ITN ownership were number of children less than 5 years of age (OR = 1.67) and residence in a rural area (OR = 1.61). Marital status was also a positive predictor (OR = 1.55) in a subset of female samples. Electricity in the household was found to be a negative predictor (OR = 0.80)), while wealth was not a significant predictor. Consequently, there is the need for increased targeted government interventions towards groups that are less likely to own bed nets – those in urban areas and with low levels of education. It is also paramount that already existing interventions that target risk groups – young children and pregnant women – are continued to ensure continued reduction in the burden of malaria in Ghana.

TABLE OF CONTENTS

Abstract.....	iv
List of Tables.....	vii
List of Figures.....	viii
Acknowledgements.....	ix
Introduction.....	1
Methods.....	6
Country Site.....	6
DHS Data.....	8
DHS Data Analysis.....	9
Field Work.....	11
Sample Population.....	11
Sample Sites.....	11
Data Collection and Analysis.....	13
Ethical Approval.....	13
Quantitative Results.....	14
Sample Characteristics.....	14
Household Models.....	16
Female Model.....	18
Qualitative Results.....	20
Sample Characteristics.....	20
Knowledge of Malaria.....	21
Malaria Prevention and Bed Net Use.....	23

Factors Influencing Ownership and Use of Malaria Bed Nets.....	23
Cost.....	24
Individual/Household Behaviors.....	26
Type of Bed Net.....	27
Cultural Norms.....	29
Discussion.....	31
Recommendations.....	37
Appendix A.....	40
References.....	41

LIST OF TABLES

Table 1. Geographic Distribution of Study Population.....	9
Table 2. Background Characteristics of DHS Study Population.....	14
Table 3. Logit Regression Models - Household Net Ownership and Usage with corresponding p-values.....	16
Table 4. Logit Regression Model of Net Ownership for Female Sample with corresponding p-values.....	19
Table 5. Background Characteristics of Field Study Population.....	20
Table 6: Summary Responses from Field Study.....	21

LIST OF FIGURES

Figure 1. Map of Ghana.....	7
Figure 2. Ownership of ITN as a percentage of Total Population in Different Regions.....	15

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INTRODUCTION

Malaria is a life-threatening disease caused by the *Plasmodium* parasite and transmitted by the mosquito vector, *Anopheles gambiae*. It remains one of the most important parasitic infections that plague humans, and a significant health problem in most parts of world. It is estimated that more than 3 billion people live in regions that are considered susceptible to malaria infection, which is approximately 50% of the world's population; the annual mortality recorded ranges from one million to three million [1]. Approximately 90% of the world's burden of malaria is in Africa, with areas of Asia and South America also recording high incidences of malaria infection.

In these regions where malaria transmission and infection remain high, groups that are especially vulnerable to the effects of malaria are pregnant women and young children under the age of five [2]. The adverse effects of malaria on the mother include severe anemia, cerebral malaria and maternal mortality [3]. Malaria also has devastating effects on infants, such as fetal anemia and low birth weight due to intra-uterine growth restriction or preterm delivery, all of which are associated with a marked increase in infant mortality [4]. Beyond the post-partum period, the long term consequences of malaria during pregnancy on the infant include poor developmental outcomes, behavioral problems, short stature and neurological deficits [5]. Because of the strong association between malaria in pregnancy and infant mortality, successful malaria control during pregnancy has the potential to prevent 75,000 – 200,000 infant deaths every year, in addition to reductions in maternal mortality [6].

One recommended intervention from the World Health Organization (WHO) that has been implemented to ensure successful malaria prevention and control is the use of

Insecticide-Treated Nets (ITNs) [7]. Evidence from the literature has shown that the use of ITNs reduces malaria incidence in endemic areas by 50% compared to areas where there is no net use, and it is also cost-effective [8]. However, despite known evidence that these interventions significantly reduce malaria incidence and associated morbidity and mortality, there is still a low rate of implementation and usage. In Africa, which bears the world's highest burden of malaria, ITN use remains relatively low with approximately 3% of children sleeping under ITNs and up to ten times as many children sleeping under any net, both treated and untreated [9].

One country in Africa that has seen a consistently low rate of uptake of malaria interventions is Ghana. As with most Sub-Saharan African countries, malaria is endemic throughout Ghana and it continues to be a major health concern. Ghana is located in West Africa, and 22% of its under five mortality is still attributable to malaria [7]. Similar to other African countries, the use of ITNs in Ghana is only about 3.5%, and 14.7% using any net [10]. In pregnant women, the rates of bed net use are slightly lower at 2.2% for ITNs and 10.1% for both treated and untreated net. There has been no difference noted in bed net use in pregnant women compared to non-pregnant women [9].

Ghana has been actively involved in the Roll Back Malaria (RBM) Initiative, which is a global partnership committed to reducing by halve the malaria burden by 2015 [7]. The objective of this initiative is to ensure that at least 60% of those at risk for malaria infection, particularly young children and pregnant women, have access to the most suitable and affordable interventions [9]. Furthermore, the Ghanaian government has waived taxes on the importation of nets into the country, making bed nets more

affordable. However, the rate of bed net use still remains low and is no where near the RBM Initiative goal of 60%.

There has been an array of studies performed to investigate possible reasons for the low adoption of bed nets in different countries with high malaria incidence. A study in the Farafenni region of The Gambia revealed that ITN ownership by household in this setting was approximately 16%; affordability was cited as the main reason for not owning a bed net. Other factors that decreased the likelihood of net ownership were increase in the number of household members and increased spending on other forms of malaria prevention. Factors that increased net ownership were education of the household head and increasing age. Of these findings, the number of household members was the strongest predictor of net ownership with a predictive coefficient of 0.54 [11].

Another study in the Kinshasa area of the Democratic Republic of Congo (DRC) evaluated the continued usage of bed nets that were freely distributed to pregnant women [12]. Prior to the start of the study, net usage was approximately 25%, but this increased to about 80% after free net distribution Findings from this study also showed that women who reported this was their first pregnancy were less likely to have slept under a bed net the night before their delivery, after the nets were freely provided. The researchers observed that education of the women, and mothers living with their partners were positive predictors of ITN ownership. Negative predictors were first time pregnant women, and marriage. Conversely, other studies have shown that a marriage is a positive predictor of net ownership [13,14].

Additional factors that have been identified to be correlated with net ownership include sleeping arrangements, and education of the household head [15,16]. Effect of the

family size on net ownership has been ambiguous, with some studies showing a positive predictive effect [10,17], while other studies have shown a negative predictive effect [12,18]. Other variables that have been studied are ownership of durable goods and wealth index, both of which have a positive predictive value [16,19]. The type of place of residence, whether rural or urban, has also been studied, with urban locations having a positive relationship on net adoption [10,12].

These studies provided background information on the possible determinants of ITN ownership, thus providing a framework for our study in Ghana. Of note, these studies have been performed across a range of settings, all of which have different cultural and government contexts, in addition to a variety of public health programs. None of the studies reviewed specifically examined female characteristics. My study is unique in that it provides the opportunity to investigate both female and household variables within the same country setting. This eliminates the need to use information on these variables that are available from other countries. Such information can vary widely due to different government structures, malaria prevention programs, and development partners, all of which influence the use of malaria interventions. Furthermore, this study goes one step further by performing a qualitative analysis to explore some of these variables in a greater detail than is possible with quantitative analysis.

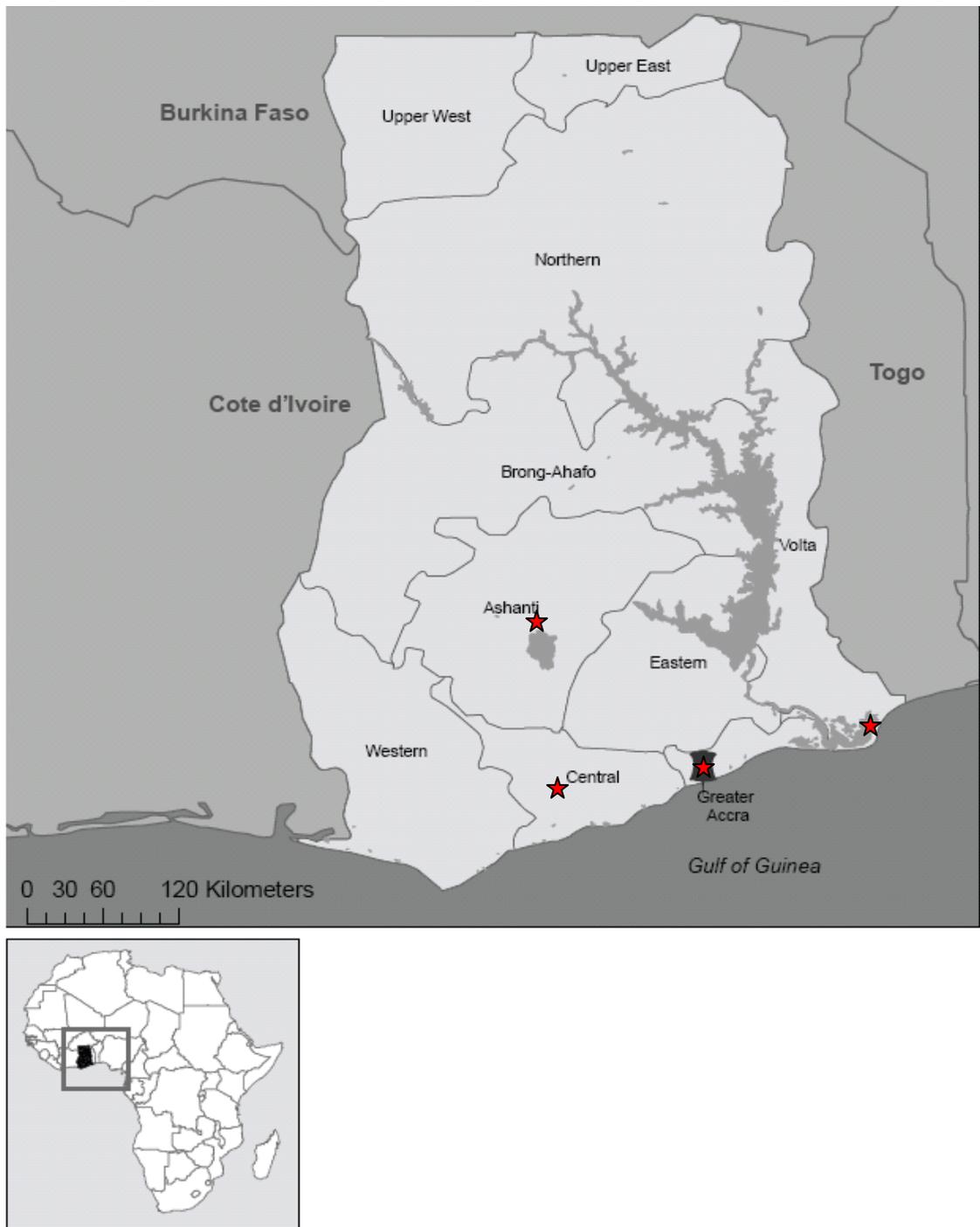
Considering the significant public health impact to be gained from proper use of ITNs, it is worthwhile to study factors that might be preventing wide-spread usage of ITNs in Ghana. Thus, the aim of this study will be to identify factors that predict ownership and usage of ITNs in Ghana, in both households and among females. Furthermore, these factors will be explored in detail, via interviews, to understand the

mechanisms by which they influence ownership and utilization of bed nets. This information can be used to further direct malaria health policy in Ghana, and provide targeted interventions in hopes of attaining the objectives of the RBM Initiative and decreasing the global burden of malaria.

METHODS

Country Site

Ghana is located in West Africa, along the coast which forms its southern border. It is also bordered on the east by Togo, the west by Cote d'Ivoire, and the north and northwest by Burkina Faso. A country map of Ghana is shown as Figure 1. Administratively, it is divided into 10 regions, which are further divided into 138 districts. Malaria is hyper-endemic in Ghana where it constitutes one of the major causes of morbidity and mortality, especially among pregnant women and young children under the age of five. Based on reports from the Ministry of Health, it is estimated that malaria represents 30-40 percent of outpatient attendance in public health facilities. Malaria also accounts for 22 percent of under-five mortality and 9 percent of maternal deaths.



★ Indicates field study site.

Figure 1: Map of Ghana [20]

Source: Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF Macro. (2009). *Ghana Demographic and Health Survey 2008*. Accra, Ghana: GSS, GHS, and ICF Macro

DHS Data

The quantitative portion of this study was a cross-sectional analysis using the most recent data available from the Demographic and Health Surveys (DHS) for Ghana in 2008. The fieldwork for this survey was carried out from September 8 to November 25, 2008. The DHS data are country-wide surveys sponsored by the United States Agency for International Development (USAID) and carried out in about 85 countries. The DHS collect nationally representative data on key demographic and health indicators such as fertility, contraceptive prevalence, and infant and child mortality. The DHS also includes information on health outcomes and behaviors such as malaria and the use of bed nets.

In Ghana, the DHS was implemented by the Ghana Statistical Service (GSS) in collaboration with the Ghana Health Service. Although a sample size of 12,323 households was initially chosen as the initial survey population, only 11,913 of these households were occupied at the time of the fieldwork. With a 99% household response rate, the final study population of successful interviews was 11,778 households. The female questionnaires used in the analysis were administered to half of this sample, with additional eligibility criteria for the interviews being age 15-49. The interviews were completed with 4,916 women. The distribution of the study population by region is shown in Table 1.

Table 1: Geographic Distribution of DHS Study Population

		Frequency	Percent
Region	Western	1,126	9.56
	Central	1,012	8.59
	Greater Accra	1,673	14.20
	Volta	1,019	8.65
	Eastern	1,248	10.60
	Ashanti	1,860	15.79
	Brong Ahafo	1,090	9.25
	Northern	1,064	9.03
	Upper West	822	6.98
	Upper East	864	7.34
Place of Residence	Urban	5,175	43.94
	Rural	6,603	56.06

Source: Demographic and Health Survey (2003). Retrieved 5 November, 2009 from <http://www.measuredhs.com>

DHS Data Analysis

Data obtained from the DHS surveys were analyzed to determine which factors were predictive for ownership of bed nets. The primary outcome variable of interest is the ownership of insecticide-treated nets (ITNs). This variable was classified into no ITN ownership and ownership of at least one ITN in the household. Secondary outcome variables in the analysis were ownership of any kind of net, either treated or untreated, and net usage the night prior to the interview. These outcome variables were selected as they reflect the status of each household, in terms of net ownership versus no net ownership. I also selected the outcomes of any net ownership as there are some households that have untreated bed nets. This allows for observation of any differences in

ownership patterns between ITN nets and all nets in general, both treated and untreated. Furthermore, the presence of a bed net within a household does not guarantee that it is being used, hence the need for an outcome variable of net usage the night prior to the interview.

The independent variables that represent possible determinants of ITN ownership were classified into two categories – household characteristics and female characteristics. Descriptive statistics of these variables, which include the mean, standard deviation, minimum and maximum values were also determined. Each of these categories was analyzed using multivariate regression models to determine their predictive odds of ITN net ownership and use. The outcome variables were classified as binary variables, as such, logit regressions were used instead of OLS regression models. Stata 11 from StataCorp (Austin, TX) was used for this analysis.

The household characteristics that were used as explanatory variables in the analysis were – number of household members, number of children under the age of 5 in the household, education of the household head (HH), gender of HH, wealth index of the household, type of household location (rural vs. urban), exposure to radio as a media outlet, electricity, and ownership of durable goods. The durable goods variable was an index composite measure using ownership of a television, radio and/or refrigerator. These variables were obtained from the household questionnaires

Female characteristics were also analyzed in a separate regression model, using variables obtained from the female questionnaire. The variables utilized were age of the woman in 5-year categories, place of residence type, highest education level attained by the woman, ownership of a radio, number of household members, number of children

under five in the household, wealth, number of living children, number of births in the last 5 yrs, current pregnancy, employment status and marital status.

Field Work

In addition to the analysis of DHS data, a field work study was performed to further explore the dynamics of bed net use in Ghana. Semi-structured interviews were performed in four different sites in Ghana. The interviews followed the interview guide in Appendix A. The focus of the qualitative portion of the study was to understand the choices individuals make with regards to the ownership of malaria bed nets. This portion of the study was performed between June and July 2010.

Sample Population

The main source of information was semi-structured interviews with 40 women. Ten subjects were recruited from each of the four regions. The target population was women aged 18 years and older. While the questions in the Appendix served as a guide, the informal nature of these interviews allowed me to address other issues that evolved during the course of the interviews.

Sample Sites

The study was fielded in four different regions in Ghana – Greater Accra, Ashanti, Volta and the Central region. These regions may be found on the map in Figure 1. These regions were purposefully selected to reflect a wide range of living conditions, location, whether rural or urban, infrastructure availability, and access to social services.

Dansoman (Greater Accra)

Dansoman is located in the south west of the city center in Accra, the capital city of the Greater Accra region. It is best described as an urban area with people of all income levels residing here. The houses in the area are mostly detached houses built with concrete, however, there are occasional patches of mud huts built out of bamboo and other materials.

Kumasi (Ashanti)

Kumasi is the capital city of the Ashanti region. It is another urban center providing a blend of the modern and historical aspects of Ghana, and it represents the second largest traffic hub in Ghana, surpassed only by Accra. The houses in this area are detached houses built with concrete.

Ada (Volta)

Ada is a small village along the coast, close to the Volta River. While there are tourist locations close by, this area is predominantly rural with all of the houses in the form of huts. There are often multiple huts within a compound with out-houses for the kitchen and rest rooms.

Kweikrom (Eastern)

Kweikrom is also a predominantly rural area with a mixture of huts and concrete houses as residences. The residents of this village are predominantly lower income individuals. Most of the women have farms that they tend to, while others work in neighboring regions.

Data Collection and Analysis

Selection of households for the study was primarily based on the willingness of the female in the household to participate. The choice of households to visit was arbitrarily selected, however, efforts were made to identify households within the same site that have different characteristics such as the size and type of the house. Each household that was visited had a unique identifier to prevent repeat visits. The interviews were conducted with the help of an interpreter who translated back and forth between the interviewer and the study participants. Each interview was transcribed and analyzed to identify common themes within the studies. Excerpts from individual transcripts were coded under these themes and classified into appropriate sub-headings that are reported in the findings.

Ethical Approval

The field work study was funded by the Duke Global Health Institute (DGHI). IRB approval was obtained from the Duke University Office of Research Support. No further approval was obtained from Ghana Health Services due to the lack of risk associated with the participating in the study. In Kweikrom, the consent of the village chief was required before interviews could be performed at that site. Individual verbal consent was also obtained from each individual before the interview commenced.

QUANTITATIVE RESULTS

Sample Characteristics

Table 2: Background Characteristics of DHS Study Population

	Mean	Standard Deviation	Min	Max
Household Size	3.95	2.63	1	22
Number of children <5	0.62	0.89	0	8
Electricity at home	0.55	0.50	0	1
Ownership of Radio	0.73	0.44	0	1
Wealth Index (1-poorest, 2-poorer, 3-middle, 4-richer, 5-richest.)	2.96	1.42	1	5
Education of HH head (1-no education, 2-primary, 3-secondary, 4-higher)	2.32	1.00	1	4
Ownership of durable goods	1.35	1.04	0	3
Age of HH head	44	16	14	96
Number of bed nets per HH	0.78	1.00	0	7
Number of HH with at least one ITN	0.34	0.47	0	1
Children under bed net previous night	0.23	0.55	0	4

Table 2 shows the general characteristics of the DHS study sample. The average household size is 3.95, and the average number of children under five in each household is 0.62. The middle wealth quintile is the approximate wealth index for this population, while the ownership of durable goods is approximately 1.4, ranging from a minimum of 0 to a maximum of 3. The mean age of the household head is 44 years old, and more than half of the population has attained at least a secondary level education. Fifty-five percent of the study population has electricity at home, and 73% of the households own a radio. Approximately 34% of the households in the sample has at least one insecticide-treated net; the average number of any bed nets per household is 0.78. The mean number of

children that slept under a bed net the night prior to the interview was 0.23, with a range of zero to four. Figure 2 shows that the Upper West region has the highest ITN ownership at 48% while Greater Accra has the lowest net ownership at 20%.

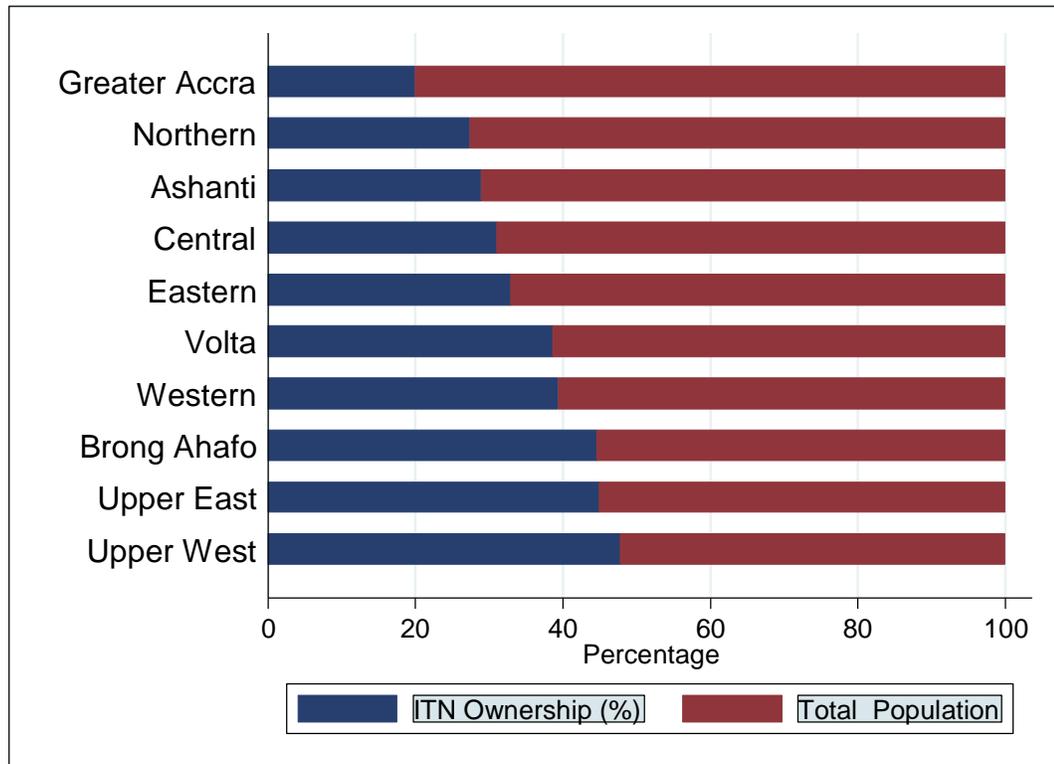


Figure 2: Ownership of ITN as a percentage of Total Population in Different Regions.

Household Regression Models

Table 3: Logit Regression Models - Household Net Ownership and Usage with corresponding p-values

	Model 1 (ITN Ownership)	Model 2 (Any net Ownership)	Model 3 (ITN net Usage)
Number of Children < 5	1.67 (0.00)	1.93 (0.00)	1.14 (0.00)
Number of HH members	1.04 (0.00)	1.05 (0.00)	1.01 (0.55)
Type of residence (urban vs. rural)	1.61 (0.00)	1.66 (0.00)	1.22 (0.05)
Electricity	0.80 (0.00)	0.77 (0.00)	1.07 (0.50)
Ownership of Radio	1.40 (0.00)	1.35 (0.00)	1.26 (0.06)
Sex of HH Head	1.21 (0.00)	1.08 (0.07)	0.63 (0.00)
Education of HH Head	1.21 (0.00)	1.15 (0.00)	1.09 (0.05)
Wealth Index	0.10 (0.91)	0.89 (0.00)	0.66 (0.00)
Ownership of Durable Goods	1.08 (0.06)	1.19 (0.00)	0.98 (0.82)
No. of Observations	11,719	11,719	3,967
Log likelihood	-7025.918	-7340.358	-2184.643
Pseudo R ²	0.064	0.095	0.075
Prob > chi ²	0.000	0.000	0.000

Table 3 shows the outputs from the logit regression models for ITN ownership, any net ownership, and ITN usage. The total number of observations used in these

models was 11,719 households. Model 1 shows that the number of children less than five, the size of the household, the type of residence, electricity, ownership of a radio, sex of the household head and education of the household head are all significant determinants of ITN ownership. Specifically, the presence of children under five had the strongest predictive odds of ITN ownership. For each additional child in the household, the odds of ITN ownership (versus no ITN ownership) increases by a factor of 1.67. The type of residence was the second strongest predictor, with an increase in odds by a factor of 1.61 in rural areas compared to urban areas. Electricity in the household was found to be a negative predictor of ITN ownership as it decreased the odds by a factor 0.80. Analysis of the other variables shows that the odds ratio of ITN ownership are increased when a female is the head of the household (1.21), with the ownership of a radio (1.40), with each additional household member (1.04), and with each additional level of education attainment (1.21). Wealth index and ownership of durable goods were not significant in this model.

Model 2 was used to determine the ownership of any net, either treated or untreated. A similar trend to the ownership of ITN nets (Model 1) was observed with a few exceptions. The sex of the household head, which was previously significant in Model 1, was not significant in Model 2. Furthermore, wealth index and ownership of durable goods, which were not significant in Model 1, became significant in Model 2. An increase in the wealth quintile results in a decrease in the odds of any net ownership by a factor of 0.89. Conversely, possession of an additional durable good resulted in an increase in the odds of any net ownership by a factor of 1.19. Model 3 represents data from 3,967 households which own ITNs. Among this subset, the variables that were

significant in predicting the use of ITNs are number of children less than five, sex of the household head, and wealth index.

Female Model

Table 4 shows the output for Model 4, which examines net ownership among the sample of females. The number of female observations used in this model was 4496. Residence in a rural area was the strongest predictor for net ownership, with an increase in odds by a factor of 1.91. Marital status and birth in the last five years were also positive predictors for net ownership, with an increase in odds by a factor of 1.55 and 1.35 respectively. Similar to Models 1& 2, the education of the female was also a positive predictor of net ownership. Variables that were not significant in this model were the age of the woman, number of living children, current pregnancy, number of household members, wealth index and employment status.

Table 4. Logit Regression Model of Net Ownership for Female Sample with corresponding p-values

	Model 4 (Net Ownership)
Birth in the last five years	1.35 (0.00)
Marital Status	1.55 (0.00)
Education of female	1.09 (0.04)
Number of HH members	1.03 (0.05)
Type of residence (urban vs. rural)	1.91 (0.00)
Number of living children	0.98 (0.267)
Wealth Index	0.96 (0.24)
Age (in 5 year categories)	0.98 (0.38)
Currently Pregnant	1.00 (0.845)
Employment Status	0.98 (0.614)
No. of Observations	4,496
Log likelihood	-2782.714
Pseudo R2	0.091
Prob > chi2	0.000

QUALITATIVE RESULTS

I will continue the discussion on determinants of bed net use in Ghana by reporting findings from the interviews performed during the field work analysis. The respondents were asked questions that delved into their understanding of malaria as an illness, including causative factors and methods of prevention. The study also explored their attitudes towards the use of malaria bed nets and the factors that limit or prevent the use of the bed nets within their households. Other variables such as the role of the public health system in delivery of bed nets, and the use of untreated bed nets versus insecticide treated bed nets were discussed over the course of the study. I will start the discussion by explaining local perceptions of malaria as an illness, and how it relates to their adoption of bed nets.

Sample Characteristics

Table 5: Background Characteristics of Field Study Population

	Mean	Standard Deviation	Min	Max
Age of Respondents	32.58	9.95	20	55
Household Size	5.67	1.83	3	12
Number of children <5	1.20	0.95	0	3
Number of bed nets per HH	1.18	1.30	0	5
Number of bed nets per individual per HH	0.21	0.21	0	0.75

The background characteristic of this study population is shown in Table 5. The age of the respondents ranged from 20 to 55, with an average age of 32 years, 6 months. The average household size of the women that participated in study was approximately 6

people. The number of bed nets in each household averaged 1.2, however, when the size of the households were considered, the average number of bed nets per person in each household is 0.21. Responses obtained during the course of the fieldwork study have been summarized under major themes in Table 6.

Table 6: Summary Responses from Field Study

Etiology of Malaria	
Mosquitoes	67.5%
Environment	47.5%
Food	12.5%
Malaria Prevention	
Knowledge of bed nets	82.5%
Use of bed nets	48.9%
Use of other methods	17.5%
Barriers to Net Use	
Cost	25%
Personal Choice	27.5%
Adult use of available nets	37.5%

Knowledge of Malaria

The study participants were asked to explain what they know about malaria. A variety of responses relating to the cause of malaria were obtained from the respondents. In many cases, participants attributed febrile illness of any cause to malaria. As such, the terms “fever” and “malaria” were often used interchangeably. In Kweikrom, which can be classified as being more rural, a 38-year old woman explained that:

“You get a fever when you eat oily foods”.

This idea was mentioned by five different women in different study sites:

“Eating oily foods such as stew, garri and corn dough gives you malaria”;

“If you have too much sugar in your body, it causes mosquitoes to bite you”.

Other causes of malaria that were identified by the study participants included “standing in the sun”, and “having worms in your stomach”. As expected, when these respondents went on to explain methods of preventing malaria, it often related to avoiding certain food items believed to cause malaria.

Despite these cases, about two-thirds of the participants were able to identify mosquitoes and the role they play in the transmission of malaria. While some of them were as straight forward as “mosquitoes cause malaria when they bite you”, some of these answers were quite informed as illustrated by this response obtained from one of the participants in Kumasi:

“You get malaria from mosquito bites...the parasites are in the mosquitoes and the mosquitoes bite you, allowing the parasites to enter your bloodstream.”

About half of the respondents made reference to environmental conditions with transmission of malaria. Examples include:

“Malaria is caused by a virus that is produced in the dustbin, and from unwanted materials around the house...you can also get malaria when there are mosquitoes around.”

“You can also get malaria when the weather changes and from unclean water.”

“Malaria comes when you have stagnant water and dirt around your house, or when the weeds around your high are allowed to grow high, so you have to keep them low.”

“...the gutters can serve as a breeding ground for mosquitoes”.

Among those that mentioned the role of the environment in the malaria transmission cycle, sanitation was often identified as a point of intervention in preventing transmission of malaria:

“You can prevent malaria by not throwing water around your house and sweeping around the house.....have gutters around houses to keep the water flowing, and burn your refuse far away from the house.”

“You can prevent malaria by draining stagnant water so it won’t breed mosquitoes...you should also throw your refuse out.”

“To prevent malaria, you have to wash your plates and not let them pile up; when you open cans, you should put them away...washing your hands and plates with soap and water are also important.”

Malaria Prevention and Bed Net Use

In addition to the diet choices and environmental approaches mentioned above, there are multiple other approaches that participants mentioned as ways to prevent malaria transmission. Examples of these include the use of mosquito coils that are burnt at night, insect repellants applied directly to the skin, indoor insecticide sprays, and fans to keep mosquitoes away. When asked specifically about the use of bed nets and its role in preventing malaria, it quickly became clear that regardless of the suspected cause of malaria, 82.5% of respondents recognized bed nets as a potential method of preventing malaria. Some answers when participants were asked how to avoid malaria was:

“You can prevent malaria by sleeping under a bed net”

“You can prevent malaria by using mosquito nets around windows all around the house.”

Some responses also recognized a multi-factorial approach that often involved the use of bed nets, towards reducing transmission of malaria:

“You can prevent malaria by using a mosquito net, by spraying around the house and clearing the bushes...this takes care of the mosquitoes.”

“If your environment is dirty, you should use the bed nets instead.”

“...you should use a bed net and washing your plates immediately.”

Factors Influencing Ownership and Use of Malaria Bed Nets

While the majority of the respondents acknowledged the role of bed nets in preventing malaria, approximately a third of them report not having at least one bed net

in their home. Amongst those that do own bed nets, there are not enough bed nets in the house to cater to the needs of every member of the household. However, with approximately twenty-eight percent of the respondents, I encountered reports of households who own bed nets that are not being used. Multiple social, cultural and economic factors were identified as feeding into this lack of ownership, and utilization, of malaria bed nets.

Cost

Among our study population, cost was commonly identified as a barrier towards purchasing bed nets for malaria prevention. Ten women reported a desire to own bed nets, or purchase additional bed nets for other individuals within their household, but were often limited by their financial resources. One 25 year old woman who lives in Kumasi explained her inability to provide enough bed nets for her family:

“I have only one bed net in my house...I received it from the hospital when I gave birth to my daughter three years ago. The net was treated with insecticide but I’ve washed it several times now so I’m sure the medicine is probably gone by now, in fact I have to wash it tomorrow because it is dirty. My mother sleeps under the net with my daughter...I have two other young children in the house, but they don’t sleep under the bed net. I would like all my children to sleep under a net, but it’s not that easy. If I have money to buy mosquito nets, I will save it and use it for their upkeep instead.”

This theme of limited resources to meet basic needs was recurring among multiple respondents and was more frequently observed in the rural areas. According to the women, most of them that have bed nets received it courtesy of the public health program in Ghana that provides malaria bed nets to pregnant women and lactating mothers following the delivery of their baby. However, this benefit is not always available at the hospitals, and even when available, the only way to access it is to deliver your baby at the hospital or take the baby in for a newborn visit. Consequently, women that deliver their

babies at home or those that do not receive for antenatal care visits are often not beneficiaries of this government program:

“The bed net we have right now, I received it when I went to the clinic for the weigh-in of my 4 year old when he was born.”

Other women stated:

“Although I went to the clinic for prenatal care, I did not go back after my pregnancy; so when I had my youngest child, I did not get a bed net”

“I received my antenatal care, but they did not give me a bed net even though they had in the hospital... well, when you deliver in the hospital, you get a bed net when you do your weigh-in for the baby, which is right after delivery. But if you do not deliver in the hospital, you are not able to get the nets.”

“Yes, I know that women receive free bed nets at the ANC visit, but I didn’t get one. I didn’t have my baby in the hospital.”

Another government intervention that was reported by the women were “promotions” organized by the government where bed nets are sold at discounted prices. At these lower prices, women are better able to afford the bed nets. This 40 year old woman from Kweikrom explains:

“I have two bed nets - I received one during my antenatal care visits, after I gave birth to my last child. I bought the other net after the net I had received with my first child spoilt...the one I had to buy cost me 2.5 GHc...they were doing a promotion when I bought it so that’s how much it cost, and I was able to afford that. If it was the full price, I probably would not have been able to purchase it...not everyone took advantage of the promotion, some people are still not able to afford it even at that price.”

When asked if she would consider buying another bed net if any of the ones she has currently becomes damaged, she replied:

“I don’t think so, unless the promotion comes back to town. Otherwise, we will sleep in the mosquitoes like that.”

Whereas the challenges associated with cost and affordability of the bed net was commonly commented on in the more rural areas, a different phenomenon was observed in the more urban areas. While cost remained an issue for some women in the areas, there appeared to be a bigger emphasis on choice when deciding not to purchase bed nets. That

is to say, women were more likely to choose not to buy nets even though they could afford it. A 23 year old woman from Kumasi who has a 2 year old daughter, but does not own a bed net told us:

“I don’t like to spend money...I have the money but I don’t want to use it to buy a bed net. It’s not that I can’t afford one, its that I want to use my money for other things. Maybe if someone gave me the bed net I would use it, or if they sold it for 5 cedis.”

Another 29 year old from Kumasi who is currently pregnant reported:

“I used to have two bed nets, one of which I bough four years ago....my children ripped the bed nets so we no longer use it... when I deliver my baby, I will start working again; then I can buy more bed nets.”

In Dansoman, Accra, a 48 year old woman told us:

“It’s not that I can’t afford the bed net, I can I can buy it, I just haven’t. I also don’t have the wooden t-stand to hang the net on....I do have plans to buy the net if the mosquitoes are becoming too much.”

Multiple other women admitted to having the means to buy the bed nets but have made the choice, either actively or passively to not purchase bed nets.

Individual/Household Behaviors

Several individual behaviors serve as barriers to increase adoption of bed nets. In about one-third of the households visited, study participants reported that although they have bed nets, they often opted not to use their nets. One of the commonly cited behaviors that limited the use of bed nets within this population is the physical discomfort associated with sleeping under a bed net. This complaint not only prevented some women from purchasing bed nets, but also prevented those that already own bed nets from using them. A 23 year old woman from Kumasi who owns a bed net reported:

“I have a net, I have never used it before and I don’t really have any plans of using it.... I don’t plan on using it because of the nature of the net. It is too hard and uncomfortable to sleep inside the net; plus I do not see a lot of mosquitoes come around. If the mosquitoes came around, I might consider using the net.”

When asked why she purchased the bed net initially, she said:

“I got the net from the nurses that give nets to pregnant women and lactating mothers.”

Several other women reported that “they feel hot” when they sleep under bed nets, as such, they opt to not sleep under their bed net. Another woman decides when to use her bed net based on the mosquitoes:

“We only sleep under the bed nets when the mosquitoes are biting; otherwise we don’t sleep under the nets.... When the mosquitoes are biting and the weather is hot, we bring the nets outside and sleep under them there. If the wind is blowing, we just don’t use the nets.”

Another individual behavior that often influenced the use of bed net was other preventive methods that were being employed within the household. One of the women in Kumasi reported:

“Sleeping under the ceiling fan also helps to prevent malaria...we do not have any bed nets in my household. I tried it once, but it was uncomfortable, plus it makes the fan ineffective because it doesn’t let it blow properly. I don’t think the bed nets worked to keep mosquitoes out. But the real reason I stopped was because it hindered the fan from working.”

Another woman in Accra reported:

“In our house, we spray the rooms with insecticide and close the windows. I think the bed nets work to prevent malaria, but I do not like them at all because they have too much heat in them.”

In urban areas such as Kumasi and Accra, the houses often have screen doors and windows covered with nets, thus precluding the need of using bed nets. One of the women interviewed in Accra does not own any bed nets for this reason:

“I do not own bed nets because I do not need them...I have net trapped doors in the hallway and the bedroom so there are no mosquitoes in my house. I also do not have small children who keep opening the door to let mosquitoes into the house....I’m satisfied with my current situation so I have no need for bed nets.”

Type of Bed Net

During the course of the interviews, several types of bed nets were mentioned by the different women. In general, they fall into the categories of untreated bed nets, bed nets that can be re-treated in 6-12 month intervals with insecticides, and pre-treated long

lasting insecticide treated bed nets. However, bed nets were characterized by most respondents as being treated or untreated (local) bed nets. When asked about the differences between the nets, sample responses include:

“When the mosquitoes come close to the treated nets, the medicine gets on them and it kills them.”

“Yes I have heard of bed nets that have medicine in them, but I haven’t used it. I think I might prefer it to the local bed net because it actually kills the mosquito, instead of the local net that just keeps the mosquitoes from biting you”.

“Well, if the mosquito touches the medicine net, it dies, which is good. Also the local ones, the insides can be very thick.”

Despite the general understanding that the insecticide treated nets add an additional level of protection by actually killing the mosquitoes, there were mixed feelings when the women were asked to express a preference between treated and untreated bed nets.

“...the blue net was a treated bed net. It was not comfortable because of the heat and also because of the medicine in it. I prefer the white one which is not treated. Its not like mosquito will bite me either way so I prefer the white one. At least it allows me to sleep.”

“I prefer the local one...because its bigger.”

“The local nets come in different sizes, so people have a few more options than the treated nets which often come in just one size.”

“I don’t think I will use the treated nets...our ancestors used the local nets in the old days and we learnt from them, so I will continue to use the local nets.”

“You have to wash the treated nets every 3 months...I prefer the local ones because they last longer.”

“I prefer the local bed net – the medicine in the treated bed net itches me.”

“I prefer the treated net to the local ones because it kills the mosquitoes.”

“...well the treated one is cheaper than the local one so we bought it instead.”

This variety of responses reflects the different factors people have to consider when deciding on what type of bed net to purchase. Some of these factors have been mentioned above as influencing the decision to even use bed nets at all. While most of the women acknowledged that some nets come pretreated with insecticides, almost none of them were familiar with the idea of long lasting insecticide nets that can last up to five

years. Popular responses on the life span of treated nets were often in the range of 6-12 months. However, a clear understanding on how long bed nets last or ways of maintaining a bed net was not as easily explained by the respondents. When one of the women from Kumasi was asked how she knew if her treated net was still effective, she replied:

“I knew the medicine was working in the beginning because the mosquitoes were not coming in. Also, I could feel the medicine in my face and on my body. All of these stopped so I knew the net was not working anymore.”

Other women reported:

“They don’t tell you anything like that about how long the net will last, they just give you the net...they told me that there is medicine in the net. I know that the net pains your eye when there is medicine in it. When the medicine goes away, it will stop paining my eye.”
“I’ve had the bed net for about 3 years; it is a treated net but I’ve washed it several times now so I’m sure the medicine is probably gone by now...this net I have now, I used to take good care of it, but now that’s its been a while, I treat it like the rest of my clothes, I wash it when its dirty and I even treat it with *blue*.”^a

Many of these women do not recall receiving any information on maintenance of their bed nets either when they purchased it or when they received it from the clinics.

Cultural Norms

Another challenge that was encountered was the decision on which individual in the household uses any bed net present. Within our study population, while there is an average of 1.25 bed nets per household, the average household size is approximately 5.7. This results in a ratio of 1:5, between bed nets and number of people in the household, thus creating a situation where this limited resource is even less readily available within individual households. In the household of this 27 year old woman in Ada, there reside

^a Blue is a coloring/dye used during washing to keep the color in clothes and keep them from fading. It is often used for dark clothes.

four adults and three children, and she has two bed nets. When asked who used the bed nets in the household, she replied:

“We adults use the nets and the children do not have bed nets, except the one that sleeps with me.”

In some instances, the adults in the household shared the bed nets with the children as was the case with this woman:

“I use one of the bed nets and my mother uses the other one...I have three children...two of the children sleep with me and the third one sleeps with my mother.”

One woman expressed her frustration over this situation:

“Every time the hospital or some organization tries to give you bed nets, they only give one bed net. We have a big household, how will one bed net be enough?”

Over the course of the interviews, it appeared that adults were sometimes given preference in using the bed nets over the children. The children that did sleep under bed nets often shared it with the adults in the household. While not discussed extensively, other factors that appeared to influence the presence of bed nets in the household were the presence of young children in the household, community sanitation programs, the design and location of houses, whether rural or urban, and skepticism as to the overall role of bed nets in malaria prevention.

DISCUSSION

The main research question in this paper was to determine which characteristics influence ITN ownership in Ghana. From the quantitative analysis, it appears that the strongest positive predictors for ITN ownership are children under five, rural residence and ownership of a radio; electricity in the household is a negative predictor. It is not surprising, and is actually quite reassuring, that the presence of children under five is a positive predictor for ITN ownership. As stated earlier, children under the age of five are one of the risk groups especially vulnerable to the adverse effects of malaria infection. Thus, it is expected that their presence in the household will result in protective measures against malaria infection, as is the case from our results.

In light of the fieldwork analysis, this observation of net ownership being associated with the presence of children under the age of five also makes sense. Multiple women reported that they obtained their bed nets from the public hospital during their antenatal care visits. Furthermore, some women indicated that their willingness to not purchase bed nets related to the absence of young children in their household. Two mechanisms were identified for this choice – the reduced need for protection against malaria in the absence of this vulnerable population, and the reduced access of mosquitoes into the house, as older adults are more cognizant of closing doors at night thus reducing the overall burden of the vector inside the house. This is in direct contrast to previous studies which either show that the presence of children in the household was negatively associated with bed net ownership [17], or only show a positive relationship at the 10% level [11]. This discrepancy might be due to the fact that these studies were

follow-up evaluations to evaluate the success of different distribution schemes, as opposed to an analysis of existing net ownership as in the current study.

However, the increased ownership of bed nets associated with the presence of young children in the house does not necessarily parallel increased protection for this vulnerable population. As mentioned earlier, the average number of bed nets, per person, per household is approximately 0.2. As such, even in households that own bed nets, there is always the question of who is using the bed nets. Based on the cultural norms in Ghana, the head of the household will make a major decision such as this. Consequently, in these cases of limited availability, the head of the household, or another adult in the household, is most likely to be assigned the use of the net. This inequity is often offset by adults and children sharing the same bed, and thus the bed net. However, with multiple children this becomes a bigger challenge. Even among the women that received a bed net following delivery of a child, there are cases where the baby in question is not sleeping under the bed net. This mismatch might result in increased net ownership in these households, but a misappropriation in the utilization of the net.

Our DHS data also showed that the odds of ITN ownership in households located in rural areas is greater by a factor of 1.61, compared to urban areas. Other studies performed in Tanzania, and Eritrea have reported that households in urban areas were more likely to own bed nets [13,14]. In the more urban sites of the field study, Kumasi and Accra, there were often other protective measures in place such as the use of screen doors, mosquito coils, indoor insecticide spraying and electric fans. Women that endorsed these other preventive methods were generally less likely to use bed nets as their primary method of malaria prevention. These women often recognized the protective effect of bed

nets but then make the choice to not purchase nets in lieu of these other methods. Also, those that employed other preventive methods often had personal oppositions to the use of bed nets. They were more likely to report increased heat or decreased air circulation underneath the net as challenges associated with using a bed net. These factors also affected utilization of bed nets within households that already own bed nets, either from direct purchase or obtained from the public health system.

Another aspect of decreased net ownership in urban areas might relate to improved access to health care facilities and public health structures. In addition to other protective measures, this might reduce the overall burden of malaria in urban areas, thus reducing the perceived need for ITNs. This might also explain the results of electricity being a negative predictor of bed net use. In certain settings, electric fans are often used to prevent malaria as it is believed that their constant motion keeps the mosquitoes from settling and biting individuals. As such, the presence of electricity in the household might reduce the need for a bed net.

Ownership of a radio was also observed to be a positive predictor for net ownership. In Ghana, malaria messages are broadcasted through various means of communication including radio, television, posters, newspapers, brochures, and health workers. Of all these media, radio was found to be the most effective communication tool as 80% of this study population reported having heard a malaria message on the radio in the past 10 months (results not shown). This can be compared to less effective methods such as brochures, which reached only 11% of the population or even television messages, which reaches just about half of the population. As such, it makes sense that with the ownership of a radio, the odds of owning a bed net increase.

The wealth index was expected to have a positive predictive value on net ownership, however, this was not the case. This observation is even more interesting considering that over 80% of people for whom the source of their bed net was indicated, stated that they bought it in a shop or market. Thus, one might expect households of higher wealth index to have a greater purchasing power of bed nets, and thus be more likely to own nets. A plausible explanation for this might again relate to the use of secondary prevention methods. Households with higher wealth index might be more likely to live in houses furnished with window nets and fans. Possession of these other methods to prevent malaria transmission might make these households less likely to purchase ITNs, even though their higher wealth index provides them with more purchasing power. These additional variables are not available in our dataset and thus cannot be accounted for.

Furthermore, when the results from the fieldwork study are considered, it provides more support for this wealth effect. Women in urban areas were more likely to attribute their lack of bed nets to a personal choice –either because they think they do not need a bed net due to an absence of mosquitoes, or because of the personal discomfort associated with using a bed net. This is in contrast to some of the responses obtained from women in the rural areas who often expressed a genuine desire to own bed nets but could not afford to purchase one due to limited financial resources. The bed nets provided by the public health system are distributed either following child birth or during the first visit the child makes to the hospital. However, women that have their babies outside of the hospital setting are often not privy to this benefit. During the field study, the women in the rural areas were more likely to report delivering their children outside the hospital,

when compared to women in the urban areas. The hospitals in these areas are often further away and so some of these women choose to have their babies at home. This choice further limits their access to bed nets, as the bed nets provided by the public health system is only accessible during a hospital visit. While these phenomena were not clearly dichotomized in all the interviews, in terms of rural versus urban, it was often a recurring theme over the course of the interviews. However, this method of net distribution inherently limits access of bed nets to groups that are already marginalized.

For the female sample in the DHS dataset, the unique predictors of net ownership are birth in the last five years and marital status, in addition to the type of residence. For the same reasoning that the presence of children under the age of five is predictive for net ownership, we would expect a birth in the last five years to also be predictive. Furthermore, the distribution of free bed nets by Ghana Health Service (GHS) through the antenatal clinic as discussed earlier, makes it more likely for women with recent births to own bed nets. A household head being married has been shown to have a positive association with net ownership, as is also the case with our results [13]. Again, this might be because the woman is more likely to acquire a bed net when she is pregnant, or after birth to protect her new born child.

An interesting discussion that was not addressed in the DHS dataset, but brought to light during the course of the interviews was the conflict between using local bed nets that are often untreated and insecticide treated bed nets. The perceived benefits of the local bed nets included its larger size, different size options and reduced irritation due to the absence of insecticides in these nets. Almost all of the women who recognized the differences between untreated and insecticide treated nets were able to highlight the

additional benefit that the insecticide treated nets provided. However, this knowledge did not translate to a behavioral change of using treated nets instead of untreated nets. While some of the reasons provided for preferring untreated nets can be attributed to a resistance to change due to personal discomfort or long standing habits, some of the factors discussed above again pose a barrier. In large household sizes, the bigger, untreated nets that can accommodate more people are more attractive than treated nets which are often smaller and come in only one size. Amongst those that do opt for a treated bed net, its efficacy is limited to the maintenance and life span of the net. No one reported using a long lasting insecticide net, and there remain mixed opinions on the proper way of taking care of a net, regardless of whether the net is treated or untreated.

During the field study, the role of the environment and sanitation in the malaria transmission cycle was recognized by majority of the women in both rural and urban areas. When asked to explain what they know about malaria, participants were able to identify stagnant water, gutters, and household refuse as potential contributors to malaria illness. Furthermore, the women were able to identify these environmental factors as intervention points in reducing the transmission of malaria. The women often answered with multiple options when asked how malaria can be prevented, thus emphasizing the multifactorial approach towards lowering malaria incidence.

RECOMMENDATIONS

The results of my DHS data analysis reveal some key predictors in ITN ownership, some of which are modifiable. The underlying issue remains the low rate of ITN use in Ghana and how this might be increased. Only about a third of the DHS sample owns at least one ITN in their household. While this does not approximate the RBM Initiative target, it is a marked improvement from previous years. Furthermore, utilization of the available ITNs is significantly higher at about 78%. Although this is reassuring, it also creates an intervention point to increase ITN usage. Currently, 28% of households with at least one ITN are not using it. Optimizing usage among current ITN owners might be a cost-effective way of reducing malaria transmission. These households already own the nets, they are just not using them.

Some of the factors that play into this have been highlighted during the course of this discussion. It is important to note that while these measures appear simple, they can appear as significant behavioral changes to the individuals involved. There is an understanding of the role bed nets play in malaria prevention; the challenge lies in increasing uptake among new and existing users of bed nets. Campaigns that address this process of behavioral change might be of use in increasing the utilization of bed nets. Community approaches that integrate social monitoring to target such processes of behavioral changes have been shown to be more successful in instilling change.²¹ Instead of individual campaigns, interventions that involve small communities helping each other in encouraging change might be of greater benefit.

On a positive note, it appears that there is a clear understanding that children under the age of five are a vulnerable group to malaria infection. Their presence within

the household and birth within the last five years were both found to be positive predictors of ITN ownership. Public health efforts addressing this risk group should thus be continued to avoid any decrease in ITN coverage of young children. A much needed point of emphasis will be the actual use of bed nets by children and not non-pregnant adults when the number of nets within the household is limited. While this might challenge existing norms, it is essential in increasing protection for groups at the greatest risk. The public health system already has systems in place for increasing protection of its vulnerable population by distributing free nets. The current system for this distribution can be improved by having nurses that go into the community to distribute bed nets. This will be especially beneficial in rural areas where women are more likely to have home deliveries.

Another effort to maximize existing resources might be to promote treatment of currently untreated bed nets. Although 42% of households in the DHS survey report having a mosquito bed net for sleeping, only 34% of these households state that they have at least insecticide treated net. While this appears to be only a difference of 8% between households that have treated nets and those that do not, it does not take into consideration that some households might possess more than one net. This results in a potentially large pool of untreated nets that can be treated with insecticide to afford better protection against malaria infection. Again, the promotion of treated nets in communities that are very comfortable with their current use of untreated nets will involve interventions that target behavioral change.

While this study provides considerable insight into the bed net use as a tool for malaria prevention, there are certain limitations, one of which is the data used. The DHS

is an excellent source of information for several demographic and health indicators, however, it does not encompass the full breadth and depth of information often required for health studies. Community characteristics, such as the presence of health clinics, have been implicated as a determinant of net use [22]. However, the limitation of the existing cross-sectional data prevents us from studying this factor. Other variables that might have been of interest include alternative prevention methods, and user preferences towards bed net use. These variables were targeted during the fieldwork analysis and we were able to obtain a better understanding of the roles they play. However, therein lies another limitation of our study – the sample size. The qualitative field study sampled forty women in four different regions, which is a relatively small sample size. Furthermore, each of the study sites has unique characteristics that inherently influence individuals' approach towards the ownership of bed nets. These characteristics further complicate interventions that might be directed at increasing utilization of bed nets. While there are aspects of our findings that can be generalized, it remains important to consider the unique, individual characteristics of locations before implementing public health programs. The role of bed nets in malaria prevention remains a complex, but vital issue that will continue to benefit from further research within the field.

Appendix A: Interview Guide

- 1) What is your age
- 2) How many people usually live in your household
- 3) How many children do you have
- 4) Tell me what you know about malaria
- 5) How does malaria get transmitted
- 6) Tell me what you know about bed nets
- 7) Do you think bed nets prevent you from getting malaria
- 8) Do you own bed nets
- 9) How often are the bed nets in your households used
- 10) Are there any times when the bed nets in your household are not used? Why?
- 11) How do you decide who sleeps under the bed nets in your home
- 12) If NO to Q8, what are the reasons for which you don't own bed nets?
- 13) Would you like to use bed nets?
- 14) How do you think the government can assist you in getting a bed net
- 15) Apart from bed nets, what other steps can take to prevent you from getting malaria.
- 16) Do you practice any of these steps? Why or why not?
- 17) In your culture, are there any cultural beliefs about fever, malaria or bednets? Tell me about it
- 18) Do these beliefs influence how you think about malaria or bed nets
- 19) Are there any community/national programs you know about that address malaria
- 20) Is there anything else you would like to add to our discussion about malaria and bed nets before we round up.

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