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Malaria Preventive Behaviour among Rural Households in the North West Region of Cameroon

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Abstract

Malaria remains a major threat to life in Cameroon and in the North West Region in particular. This threat is especially common in rural areas despite the fact that it is preventable and treatable. It is from the above count that this study examines the role of; Household income, Family Size, Gender and Age of household head, Educational level of the Household head, Knowledge on signs, symptoms, and prevention of malaria among Households in the North West Region of Cameroon. This study used data collected from 6341 households selected from ten health districts with the highest malaria prevalence in the North West Region. Data were analyzed using ordered logit Regression. The findings of this study reveal the significant ability of; gender, age, marital status and educational attainments of household heads; household per capita income; household size; knowledge on malaria prevention/transmission, in predicting households' malaria prevention seeking behaviors in the North West Region of Cameroon. There is also evidence of the knowledge gap on the signs, causes, and prevention of malaria. The study strongly recommends sensitization campaigns; creation of community-based malaria control committees; sponsored media programs; household empowerment programs and free distribution of Insecticide Treated Bed Nets, as ways of curbing the prevalence of malaria in the North West Region in particular and Cameroon in general.

Keywords: Malaria; Malaria prevention methods; Household heads; Signs and symptoms of malaria

Introduction

Malaria presents one of the greatest and most significant public health dangers in sub-Saharan Africa, despite the fact that it can be treated and prevented [1]. Evidence according to Mbako et al. [2] claims that malaria with an estimated global incidence of 214 million new cases, also registered 438,000 deaths in 2015. Sub-Saharan Africa (SSA) dominated the global figures, accounting for over 80% of new cases and about 78% of deaths, the main threat is on children under five years of age and pregnant women because of immature immunity and immune suppression respectively [3]. More recently in 2017, approximately 219 million cases of malaria resulting to 435000 deaths were recorded in 90 countries, out of which 92% and 93% of the malaria cases and deaths were recorded in WHO African Region [4]. From the above, it is observed that the overwhelming global burden of malaria remains in SSA because of clearly identified environmental risk factors that favor transmission of *Plasmodium* parasites since the stability and intensity of malaria transmission in any given area is largely determined by climate, hydrology and local mosquito ecology [5].

Cameroon is one of the countries of the SSA is not left out given that in Cameroon, the estimated mortality rate for malaria stood at 116 per 1,000 persons and is above those of the African region which stood at 104 per 1,000 persons as well as neighboring countries such as the Central African Republic [6]. Moreover, according to the 2011 Malaria Indicator Survey, the average prevalence of malaria parasitemia in children under the age of five was 33.3% [6]. Also, statistics from the National Malaria Control Program's (NMCP) annual report in 2015 suspected malaria caused 30% of all medical consultations; 21% of all-cause visits resulted in a diagnosis of laboratory-confirmed malaria. In health facilities, 19% of deaths were attributed to malaria, and 48% of all hospital admissions were due to suspicion of severe malaria [7].

In the North West region of Cameroon, morbidity due to malaria as a percentage of total morbidity was 19% in 2015 and 20% in 2016 and this is a little wonder given that there were free Insecticides Treated Mosquito Nets (ITNs) distribution in the North West Region in before and even in 2016 [8]. Some findings reveal that in the North West Region the incidence of malaria is higher in the rural areas than the urban areas. This is evident by the fact that in same report by Tchekountouo and Col [8] while the regional average of malaria incidence for the North West Region was 19% and 20% of total morbidity in 2015 and 2016 respectively, the leading districts were rural health districts of Ako, Njikwa and Wum with 60%, 44% and 40% of total morbidity in 2015 and 55%, 47% and 46% of total morbidity in 2016 respectively.

Based on the above, it is clear that despite being preventable, malaria remains a major threat to life in Cameroon in general and in the North West Region, especially in the rural areas. Furthermore, there are efforts deployed by the National Malaria Control Program (NMCP) and partners to reduce the influence of malaria in rural households by more than 80% since 2006 [9]. Findings have revealed that although the effect of malaria has significantly reduced in rural households in Cameroon between 2006 and 2008, a recent study [8] shows that the trend has been on the increase from less than 10% in 2008 to above 40% in 2016 in some areas notable in Ako Health Districts (55%), Njikwa Health District (47%) and Wum Health District (46%). Furthermore, the actual coverage and use of malaria services and commodities are still significantly behind the targets set in

line with the Abuja commitments and the Global Malaria Action Plan goals on universal coverage for 2010 [9].

Likewise, Wonghi et al. [9], attributed blames to low acceptability of proposed interventions by the targeted populations leading to low utilization of the available preventive and treatment services. The use of ITNs is not commensurate with their possession due to insufficient knowledge on recommended malaria treatment and preventive interventions. As a consequence, more than 60% of patients indulge in inappropriate health seeking behaviors including wrong symptomatic diagnoses and auto medication with wrong drugs [9]. With regards to governance, the malaria prevention/control drugs and commodities have been liberalized favoring, therefore, their high commercialization in a poorly regulated set up [10]. This implies that the poor are likely to suffer disproportionately from the rich in their efforts to prevent and control malaria. Considering also the findings of Diiro et al. [11]; access to public health information; residing in villages with higher experience in malaria prevention and knowledge on the cause and transmission of malaria, significantly increase the number of malaria prevention practices adopted in both male- and female-headed households. The issue of malaria prevention must be treated with more heat than light. It is from the above count that this study is designed to examine the role played by income, family size, gender and educational levels on malaria preventive behaviors among rural households in the North West Region of Cameroon. Furthermore, this paper is also designed to examine the extent to which malaria prevention has been effective in the North West Region of Cameroon. Findings from this study will hopefully guarantee the opportunities for improvement in the quality of malaria prevention both by individuals, private institutions and the government of Cameroon and beyond.

Haven gone through the first section of this study, the remainder of this paper is organized as follows: section II reviews literature, section III presents the analytical methodology, and the findings are reported in section IV. The conclusion and policy recommendations for improving malaria prevention are presented in section V.

Literature review

Malaria transmission is much more difficult to control in SSA than in other places partly due to a high level of poverty and insufficient health infrastructure which allow for chronic *Plasmodium falciparum* infections to survive undisturbed in human hosts until they are transmitted by long-lived and anthropophilic vectors that are the most efficient in the world [5]. Untreated and drug-resistant malaria infections can persist in humans for months or years, and SSA mosquito vectors such as *Anopheles gambiae, Anopheles arabiensis,* and *Anopheles funestuscan* pick up the parasites and pass them onto other victims [12]. Thus stable endemic malaria can manifest itself in SSA where people are exposed to at least one mosquito bite per week and transmission is undetectable [12]. Furthermore, results from studies explained that malaria transmission is often facilitated in Sub-Saharan Africa because of environmental degradation; poor drainage and clearing of vegetation among other practices. These promote the proliferation of mosquito species such as *Anopheles gambiae* which propagates itself in small, bright, transient water bodies, notably artificial habitats associated with human activities [13].

However, malaria risk is inequitably distributed, not only at global and regional levels but also at the household level because poor housing, education and access to health care services among others cause a vicious cycle between increased exposure, reduced ability to pay for treatment and intensified household cost [14]. Thus malaria, poverty, and environmental change are inextricably linked and remain closely associated across most of SSA households today.

Given the fact that research is on-going, there are strong indications that new drugs and vaccines for malaria will become available in the future, but most of these remain years away from realization and will not be sufficient to break the transmission cycle in most African settings. This is true due to the fact that Sub-Saharan Africa countries are homes to the world's most efficient malaria vectors where transmission levels are hundreds or thousands of times higher than those of the threshold required to maintaining endemicity [12]. This means that preventive measures and practices can do much good to the endemic areas than curative measures. Most common methods used to prevent the spread of the disease, or to protect individuals in areas where malaria is endemic, include prophylactic drugs, mosquito eradication, and the prevention of mosquito bites by the use of ITNs and application of insect repellents among others [1]. The continued existence of malaria in an area requires a combination of high human population density, high mosquito population density, and high rates of transmission from humans to mosquitoes and from mosquitoes to humans and preventive activities have been seen to have broken the chain.

Studies have been conducted across time and space in relation to this study and the findings reveal that malaria is still rife and perennial in Cameroon despite remarkable progress in controlling the disease and according to Mbako et al. [2] Factors Influencing the Prevalence of Malaria in Cameroon are Community Education on malaria prevention. Community health education is the spread of knowledge on prevention and control of diseases and this is supported by Diiro et al. [11]; Lassi et al. [15]; Escott and Walley, [16]; Harris and Reza [17] and thus calls for education of target groups like school teachers, students and pupils, mothers, caregivers, and households to enhance community acceptability and promote behaviour change.

Also, community Mobilisation on malaria prevention which involves the formation of support groups, motivating and engaging whole communities to get involved in health interventions especially rural communities to participate in improving health reflects the underlying value for social justice, and promotes their contribution to decisions that affect them was also previewed to affect the prevalence of malaria [2,11,15,18,19].

Identified as another driver was Community Health Promotion to prevent malaria which involves environmental modification and proper water, sanitation, and hygiene practices to control disease-causing agents such as mosquitoes and it is pivotal in breaking the infection cycle. This emphasizes integrated and comprehensive primary prevention, through direct education and involvement of the general population in specific activities such as environmental management and proper water, sanitation and hygiene practices, a synergistic implementation of these interventions is likely to improve knowledge, attitude and practice, and yield positive changes at the individual, household and community levels, with long term health benefits [2,15,20].

Also, the role of income and formal education cannot be undermined as poorer and less educated households are more vulnerable and exposed to the malaria vectors and lack the knowledge, financial and material resources to adopt better preventive and control strategies [11,14] while the former also stressed the role of the gender of household head and household size in the malaria prevention seeking behavior.

Other significant factors worthy of note in this study are the healthcare system and governance interacting with individual behavior. It is stressed that individual behavior, health care system and governance structure are interconnected to and interact with community education, mobilization, and health promotion. While Community health could be influenced by individual behavior, perception and willingness to change by individuals can likely influence community behavior. Health care systems address quality of services, access, equity, capacity for better health care delivery and emergency preparedness. Good governance structures and strong political commitment are pivotal in ensuring a well-functioning health system which forms a package that can be used to ensure prevention and control of such diseases [2,21].

The bulk of the literature has revealed that the selected variables are related with malaria prevention in other parts of the world and even in some parts of Africa which are similar to that of Diiro et al. [11] in Kenya. To the best of our knowledge, none of these studies have been conducted in Cameroon. While most of the studies have employed descriptive and binary choice regression techniques for their data analysis, Diiro et al. [11] in Kenya utilized a similar but limited technique employed by this study.

Materials and Methods

Analytical methodology

This paper covers a period of three years ranging from February 2015 to January 2018. This was aimed at enabling the researchers to adequately cover the study areas in the North West Region of Cameroon. The total population of the ten health districts is 824,514 people distributed averagely into 137,419 households (using an average household size of 6 persons), which is about 41% of the regional total. Ten percent of the households were randomly selected from each district and coded giving a total of 13,742 questionnaires distributed to the various health districts, based on the quarter of population they contribute to the total population of the sample area (Table 1).

Health District	Population of 2016	2016 Malaria prevalence	Rank	Number of household (Ave size=6)	% of District HH to total	Sample
Ako	46795	55%	1	7799	5.7	783
Njikwa	19096	47%	2	3183	2.3	316
Wum	129401	46%	3	21567	15.7	2157
Santa	74200	39%	4	12367	9	1237
Batibo	86639	36%	5	14440	10.4	1429
Benakuma	57674	35%	6	9612	7	962
Tubah	55868	35%	7	9311	6.8	934
Nwa	73084	34%	8	12181	8.9	1223
Ndop	215084	33%	9	35847	26.1	3587
Bafut	66673	33%	10	11112	8.1	1113
Total	**82,4514**			**137419**	**100**	**13,742**

Source prepared by authors using statistics from Tchekountouo and Col [8]

Table 1: Sample data from different health districts.

However, after the administration of the questionnaires to the selected households, only 6,393 respondents duly filed and submitted their questionnaires. After checking for consistency, 52 questionnaires were discarded for inconsistency thus 6,341 questionnaires were retained in the study. Based on the above, the research designed for this work is the explained exploratory survey research where all the households were carefully identified with the assistance of local administrations, cultural groups, religious bodies, and school authorities.

The theoretical underpinning for this study follows a basic concept of utility maximization and household production of health. This framework starts with the modeling of the selection of malaria preventive option(s), owing to the fact that the household is at a malaria risk zone given the specific household characteristics and quality of the prevention option(s).

The formulated model being of discrete choice, so the estimates are for the probability that a household selects given malaria preventive option(s) given the specific features of the households such as income, household size, the gender of household head and knowledge about the malaria prevention among others and the quality of the option. In that respect, the study assumes that households make rational decisions regarding malaria prevention, and thus choose malaria prevention practices that maximize their expected net benefits. Thus households decide to adopt a given malaria prevention practice(s) if its utility is higher than for all other choices.

A behavioral model of malaria prevention demand was then estimated. Demand in this context is defined as the probability of choosing different types of malaria prevention practices in a malaria risk area, given the relevant characteristics of the individual and household. This model adopted and modified from the work of Animated et al. [22], and was summarized by formulates the utility that a person derives from choosing a particular malaria prevention option, that is equation 1,

$$U_j = Q\left(X_i, Z_j\right) + E \qquad (1)$$

In this formulation, utility "U" derived from choosing malaria preventive option "j" is a function of X which represents a set of individual or household characteristics that do not vary with discrete choice such as income, household size, gender of household head and knowledge about malaria prevention among others and Z_j which is a set of choice specific variables which vary across the discrete choices. In this designation, Z_j refers to the quality of preventive option(s) j and is a function of the characteristics (quality) of that malaria preventive option which varies across the options. While E captures the unexplained variation in malaria preventive practices. This formulation is also consistent with a recent study by Diiro et al. [11] among rural households in Kenya but of the choice, specific attributes Z which is an extension brought by this study and analytically this study uses Ordered Logit technique as opposed to the poison technique used by the former.

The literature on strategy preferences mainly treats preferences as categorically ordered variables, undertaking values such as "none, low, average, high and total" on the basis of which scales are assigned. Other studies have analyzed the adoption of individual options, by

estimating individual binary choice models. Insights from the work of Diiro et al. [11] shows that this may be inefficient because agents make simultaneous choices.

Solís et al. [23] transform the count ordered variable for adoption into a binomial variable by, for example, assigning a value of one when adoption was high or total and zero otherwise. This is highly subjective, especially with the older population. Diiro et al. [11] further noted that most of these approaches may introduce measurement errors in the dependent variable and also a stepwise or partial adoption process may not be measured adequately by a dichotomous dependent variable and thus adopted a count model to analyze the adoption of malaria prevention strategies which is seemingly more reliable than the others. Our study adopts this model and further attribute weights to the different malaria prevention strategies since the effectiveness and scope of the different strategies in preventing malaria differ. Thus our dependent variable is a count variable defined as the probability that a household chooses a category of malaria prevention option or number of malaria prevention options. Suppose the underline process as specified in Equation (2) as

$$y^{*} = \beta_i X_i + \varepsilon \qquad (2)$$

Where y^{*} is the exact but unobserved dependent variable (the malaria prevention option used); X is a vector of independent variables; Ɛ is the error term and β are regression coefficients estimated. Further suppose that while we cannot observe y^{*}, we instead can only observe the categories of response, meaning that;

$$y = \begin{cases} 0 & if \quad y^{*} \le \mu_1 \\ 1 & if \quad \mu_1 < y^{*} \le \mu_2 \\ 2 & if \quad \mu_2 < y^{*} \le \mu_3 \\ : & \\ . & \\ N & if \quad \mu_N < y^{*} \end{cases}$$

Where μ_i are the externally imposed endpoints of the observable categories. Thus the Ordered Logit technique is adopted with the use of the observations on y which are a form of censored data on y^{*} that fit the vector of β_i as estimated parameters

An Ordered Logit model for an ordinal response Yi with C categories is defined by a set of C-1 equations where the cumulative probabilities $gc_i = \Pr(Y_I \le yc\, x_i)$ are related to a linear predictor $\beta_i X_i + \varepsilon t$ through the logit function: $\log it(g_{ci}/(1-g_{ci})) = \alpha_c - \beta_i x_i; \quad c = 1, 2, 3.... c-1$

The parameters αc is called thresholds or cut-off points, are in increasing order.

The dependent variable being type of malaria prevention options adopted was measured as a weighted type of options used by the household to prevent malaria and the weight was ascribed based on the ability and the scope of each of the options to effectively prevent malaria. Among the prevention options identified by this study were practices for personal protection (Taking anti-malaria or Prophylactic drugs) given the weight, 1 each; Practices to prevent mosquito bites (Always closing doors and windows, Use repellents, Sleep under ITNs) given the weight 2 each and Practices to eradicate mosquitoes (clear buses around, Good drainage system, Use insects sprays) given the weight 3. The choice of the weights depends on how holistic the practices are. Where the first set (practices for personal protection) are of a narrow scope since they are limited only to individual prevention, while the second set (Practices to prevent mosquito bites) can control beyond individual level but can only effectively control only within a house while the third set (Mosquitoes eradication) is more holistic since it can prevent malaria from individual level through homes and even to the neighborhood.

The independent variables used in this study as it is well justified in the literature include Income: which captures the average household monthly income from both primary and other activities (measured in terms FCFA) divided by the household size. Thus income was basically measured per head to avoid the adverse effect of household size on the role played by income in the malaria prevention practices. However, household size was also used as an independent variable to isolate its effect on malaria prevention practices. Gender of household head was also used as a dummy (male=1, female=0) since literature elsewhere [11] reveals its discriminating effect on malaria prevention practices. Knowledge about malaria signs, cause, and prevention: measured by rating the level of awareness of the household head in terms of signs of malaria, what causes malaria and how malaria is prevented. Also, age of household heads, highest educational level attained by the household heads, reasons for the choice of malaria prevention options adopted, prevention option adopted by people in the neighborhood (neighborhood effect) and a dummy for malaria sensitization campaigns were all used in the study.

This study involved a total sample of 6341 households randomly selected from the first ten health districts of the North West Region which according to Tchekountouo and Col [8], are those with the leading incidence of malaria. This study focused on the household rather than individual level because malaria prevention options adopted hardly vary within a household since it is the household head that usually takes such major decisions. That is the reason why the household head was most preferred in the research.

Results

The reliability test of Cronbach Alpha predicted a scale reliability coefficient of 0.72 indicating that there was a high internal consistency among the responses and hence the data were reliable for further analysis.

The findings in Table 2 shows that majority of the respondents (77%) actually identified the true cause of malaria among the alternatives which is mosquito bites. However, given that malaria is a major public health challenge in the tropics, SSA and Cameroon in particular and it is the major cause of morbidity and mortality in these regions, the more than 21% of the respondents who still either don't know the cause of malaria, or consider overwork or witchcraft as causes of malaria, is still a cause for concern and portrays some level of knowledge gap that need to be bridged.

Knowledge of the cause of malaria	How is malaria caused?	Frequency	Percent (%)
No	I don't know	32	0.5
	Overwork	211	3.3
	Witchcraft	1094	17.3

	Sub Total	1337	21.08
Yes	Mosquito bites	4883	77.0
	Sub Total	4883	77.0
	Missing System	121	1.9
Total		**6341**	**100.0**
Source: Authors computing from field results using stat 14			

Table 2: Knowledge of the causes of malaria.

In relation to knowledge of at least one of the signs of malaria, Table 3 shows that 92.2% of the respondents were able to identify at least a possible sign of malaria while 7.8% of the respondents couldn't identify even a single sign of malaria. However, among those that were able to identify a sign of malaria, the majority of them indicated high body temperature as the predominant sign they use to conclude that an individual is suffering from malaria. This is true especially for children who cannot actually express the way they are feeling.

Knowledge about Signs of Malaria	What particular sign tells you that someone is suffering from malaria	Frequency	Percent (%)
No	I don't know	492	7.8
	Sub Total	**492**	**7.8**
Yes	Body weakness	369	5.8
	High temperature	3156	49.8
	Headache	857	13.5
	Vomiting	245	3.9
	Shivering	384	6.1
	Mouth bitterness/loss of appetite	236	3.7
	Joint pains	602	9.5
	Sub Total	**5849**	**92.2**
	Total	**6341**	**100.0**
Source: Authors computing from field results using stat 14			

Table 3: Knowledge of signs of malaria.

Table 4 presents information on the level of awareness of the possible malaria prevention strategies and the table reveals that up to 27.5% of the respondents didn't know any of the possible effective methods to prevent malaria. This is evident by the fact that while some of them (0.6%) said they didn't know any malaria prevention strategies, others said it can be prevented through good personal hygiene (11.5%), avoid excessive heat (5.9%) eating balanced diet (7.4%) while even to some (2.1%). malaria can't be prevented. This also reveals some reasonable level of a knowledge gap in terms of malaria prevention strategies which is even slightly more than the knowledge gap in relation to the cause of malaria. However, 72.5% of the respondents were able to identify possible malaria prevention techniques among which 31.8% of them indicated mosquito eradication techniques of; clearing buses around homes (23.4%), creating good drainage system (6.3%) and lastly use of insecticide sprays (2.1%). Also, 37.1% of the respondents indicated techniques to prevent mosquito bites as the most effective ways to prevent malaria and specifically, 25.2% of them indicated sleeping under ITNs, 9.8% of them indicated always closing of doors and windows and 25 of them indicated the use of repellents. On the other hand, 3.6% of them indicated that the use of prophylactic drugs was the best way to prevent malaria. In sum the dominant choices of the respondents on the best malaria prevention strategy are firstly sleeping under ITNs, secondly clearing of bushes around homes and thirdly by always closing doors and windows.

Knowledge of malaria Prevention Methods	How best can malaria be prevented		Frequency	Percent (%)
No	I don't know		38	0.6
	Good personal hygiene	732	11.5	
	Avoid excessive heat	375	5.9	
	Can ' t be prevented	132	2.1	
	Eat a balanced diet	469	7.4	
	Sub Total	**1746**	**27.5**	
Yes	Type	Prevention method	Frequency	Percent
	Mosquito eradication	Clear bushes around homes	1482	23.4
		Good drainage system	401	6.3
		Use insecticide sprays	130	2.1
		Sub Total	2013	31.8
	Prevention of mosquito bites	Always close doors and windows	622	9.8
		Use repellents	127	2.0
		Sleep under a ITNs	1601	25.2
		Sub Total	2350	37.1
	Prophylactic Drugs	Taking anti-malaria drugs	229	3.6
		Sub Total	229	3.6

	Sub Total	**4592**	**72.5**	
	Missing System		3	0.0
	Total	**6341**	**100.0**	
Source: Authors computing from field results using stat 14				

Table 4: Knowledge of malaria prevention methods.

Table 5 shows that 30.1% of the respondents indicated that there is no malaria prevention strategy they use and majority of the respondents (37%) use strategies to prevent mosquito bites as the predominant prevention strategy with sleeping under the ITNs taking the lead, followed by closing the doors and windows always and then use of repellents to send away mosquitoes. The second popular alternatives are the techniques to eradicate mosquitoes lead by the clearing of bushes, creating good drainage and using insecticide sprays while taking anti-malaria drugs was the least popular option. The findings again suggest that the most widely used options to prevent malaria are in the following order; sleeping under ITNs, clearing of bushes around homes and always closing doors and windows. These findings present a little worry, given that the study area is a malaria-prone area, it is surprising to observe that more than 30% of the people don't adopt any malaria prevention strategy.

Malaria prevention method predominantly used	**Which malaria prevention method do you predominantly used**	**Frequency**	**Percent (%)**
None		1959	30.1
Type	Prevention method	Frequency	Percent
Mosquito eradication	Clear buses around	1455	22.9
	Good drainage system	353	5.6
	Use insects spray	115	1.8
	Sub Total	**1923**	**30.3**
Prevention of mosquito bites	Always close doors and windows	654	10.3
	Use repellents	87	1.4
	Sleep under an ITNs	1653	26.1
	Sub Total	**2394**	**37.8**
Prophylactic drugs	Taking anti-malaria drugs	65	1.0
	Sub Total	**65**	**1.0**
Total		**6341**	**100.0**

Source: Authors computing from field results using stat 14

Table 5: Malaria prevention method predominantly used.

From Table 6, it is observed that gender of the household head is a male dummy (male=1, female=0) and the mean shows that there were more males than females household heads since the mean value is greater than 0.5. Age group was categorized into 4 groups; marital status was a dummy for married and the mean being less than 0.5, showing that the study involved more single individuals than the married. However, the singles included unmarried, divorcees and widows/widowers. Educational attainment was also categorized into 7 groups starting from no education, right up to Ph.D. holders.

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Gender male	6213	0.6598423	0.4984249	0	1
Age	6213	1.968775	0.7527522	1	4
Marital status married	6341	0.4445671	0.4969569	0	1
Educational level	6243	3.958674	1.540718	1	7
Income	6265	2.500466	1.503243	1	6
Household size	6301	4.721256	1.780754	0	8
Knowledge sign	6341	0.9233559	0.2660468	0	1
Knowledge cause	6232	0.7889923	0.4080566	0	1
Knowledge of prevision	6213	0.7231611	0.4474722	0	1
Number of prevention methods used	6341	2.273932	1.512262	1	7
Type of prevention method used	6341	1.96357	0.7855743	1	3
Neighbour effect	6322	1.64352	0.7264728	1	3
Reason for choice	6279	2.347426	1.253638	1	5
Sensitisation yes	6279	0.7514394	0.432214	0	1
Frequency of sensitization	6315	2.725593	1.104571	1	5
Source: Authors computing from field results using stat 14					

Table 6: Summary of descriptive analysis.

The interest of the correlation analysis was to test whether they exist any strong linear relationship between any pairs of the independent variables to indicate the presence of multicollinearity between the variables. The results reveal that none of the relationships is very strong and so we advanced to run the Ordered Logit analysis bearing in mind that there is no multicollinearity in the analysis (Table 7).

	Gender	**Age**	**MS**	**Educ**	**Inc**	**HHS**	**Know Signs**	**Know Cause**	**Know Prev**	**Reason**	**Neighb**	**Sens**
Gender	1.00											
Age	0.16	1.00										

MS	0.03	0.25	1.00									
Educ	0.28	0.02	-0.04	1.00								
Inc	0.23	0.17	0.41	0.57	1.00							
HHS	-0.11	0.20	0.10	-0.14	0.13	1.00						
Know Signs	-0.29	-0.34	-0.20	-0.24	-0.34	-0.31	1.00					
Know Cause	0.32	0.15	-0.21	0.17	0.06	-0.38	-0.14	1.00				
Know Prev	-0.04	0.12	0.10	0.18	0.32	-0.08	-0.17	0.41	1.00			
Reason	-0.09	0.25	0.23	-0.31	-0.06	0.19	0.02	-0.04	0.08	1.00		
Neighb	-0.07	-0.01	0.08	0.02	0.06	0.08	0.03	0.01	0.06	0.15	1.00	
Sens	0.21	-0.32	-0.04	0.39	0.34	-0.13	0.01	0.12	0.17	-0.37	0.07	1.00
Source: Authors computing from field results using stat 14												

Table 7: Correlation analysis.

The results presented in Table 8 shows the Ordered Logit regression results run with the robust standard error method to eliminate any possibility of heteroscedasticity existing in the results. Result (1) shows the coefficients (log odds) of the model with Type of malaria prevention strategy used as the dependent variable with the types ordered according to the coverage of the prevention strategy. Result (2) presented results of the same situation as in (1) but with the restriction of two variables (knowledge of the cause of malaria and neighborhood effect), which were not significant in the result (1). For result (3) the analysis was done with the number of malaria prevention strategies used as the dependent variable while result (4) is the result of the same situation in (3) but with restriction of income and knowledge of the signs of malaria since they were not significant in the first model. The restrictions were in a bid to check the relevance of the restricted variables in the model so as to justify their inclusion or exclusion. This was to be effected using the Likelihood ratio test which was not possible when the analyses were run using robust standard errors but without the robust the likelihood ratio tests predicted the relative importance of the restricted variables to justify their presence in the model and thus we interpret only results (1) and (3) since they are results from the unrestricted models (Table 8).

	(1)	**(2)**	**(3)**	**(4)**
Variables	**Type of prevention method used**	**Type of prevention method used**	**Number of prevention methods used**	**Number of prevention methods used**
Gender male	-0.482***	-0.459***	-0.857***	-0.563***
	(0.111)	(0.122)	(0.255)	(0.143)
Age	0.250***	0.267***	0.899***	1.003***
	(0.0506)	(0.0483)	(0.105)	(0.0896)
Marital S married	2.946***	2.942***	1.058***	1.034***
	(0.161)	(0.152)	(0.126)	(0.105)
Educational level	1.205***	1.203***	-0.0593**	-0.0591**
	(0.0705)	(0.0672)	(0.0294)	(0.0294)
Income	0.700***	0.701***	0.00810	
	(0.0736)	(0.0732)	(0.0529)	
Household size	0.776***	0.758***	0.221***	0.177***
	(0.0798)	(0.0652)	(0.0295)	(0.0173)
Know malaria signs	2.669***	2.631***	0.965	
	(0.227)	(0.194)	(0.605)	
Know malaria cause	0.264		1.656***	1.430***
	(0.173)		(0.135)	(0.146)
Know malaria prev	7.352***	7.340***	1.501***	1.491***
	(0.396)	(0.379)	(0.126)	(0.0939)
Reason cheap	-5.095***	-5.125***	-2.344***	-2.076***
	(0.156)	(0.161)	(0.183)	(0.153)
Reason available	-1.621***	-1.629***	-2.314***	-2.280***
	(0.0820)	(0.0745)	(0.187)	(0.146)
Reason I know	-4.355***	-4.349***	-17.93***	-19.07***
	(0.170)	(0.169)	(0.245)	(0.214)
Reason none	-7.379***	-7.500***	-0.210	-0.386*
	(0.266)	(0.343)	(0.345)	(0.228)
Neighborhood effect	-0.00509		-1.660***	-1.522***
	(0.0200)		(0.0812)	(0.0428)
Sensitisation	2.703***	2.721***	-0.594***	-0.461***
	(0.0914)	(0.102)	(0.137)	(0.0903)

Constant cut1	-2.338***	-2.661***	-1.004	0.314
	(0.364)	(0.230)	(1.259)	(0.326)
Constant cut2	1.598***	1.277***	0.369	1.675***
	(0.444)	(0.292)	(1.237)	(0.326)
Constant cut3			1.528	2.808***
			(1.221)	(0.322)
Constant cut4			2.685**	3.932***
			(1.197)	(0.313)
Constant cut5			4.007***	5.223***
			(1.180)	(0.339)
Constant cut6			5.815***	6.991***
			(1.164)	(0.364)
Observations	**6,232**	**6,232**	**6,232**	**6,232**
Robust standard errors in parentheses: ***p<0.01, **p<0.05, *p<0.1				

Table 8: Ordered logit results with restrictions and varying dependent variable.

Controlling for other effects, the coefficient of gender all across shows that male household heads are less likely to adopt malaria prevention strategies that are of a wider scope than female household heads and male household heads are less likely to adopt multiple prevention strategies than their female counterparts. Specifically, the coefficients show that a unit increase in the number of male-headed households relative to their female counterpart will reduce the ordered log odds of adopting a more holistic malaria prevention strategy by 0.48 units and the ordered log odds of adopting more malaria prevention strategy will decrease by 0.857 units. This means in other words that female household heads are more likely to adopt prevention strategies of a wider scope and adopt more malaria prevention options than their male counterpart. This effect is statistically significant at 1% level of significance and thus, gender significantly affects malaria prevention behavior of households in the North West Region of Cameroon.

Also, with the effects of other variables held constant, a unit increase in age of household head increases the ordered log odds in favour of adopting malaria prevention options that have a wider coverage by 0.250 units against prevention options of a narrow scope and also increases the ordered log odds of adopting more malaria prevention options by 0.899 units compared to adopting single or even no prevention option. This means that older household heads more likely to adopt holistic and more malaria prevention than younger household heads. The effect of age is also significant at 1% level of significance implying that age of household head significantly determines the malaria prevention behavior of households in the North West Region of Cameroon.

Furthermore with other effects held constant, a unit increase in the number of married household heads relative to their single counterparts increases the ordered log odds of adopting a malaria prevention option that has a wider coverage by 2.946 units and increases the ordered log odds of increasing the number of malaria prevention options adopted by 1.058 units. This means that married household heads are more likely to adopt a holistic and many malaria prevention options than single household heads. This effect is statistically significant at 1% level of significance, implying that the marital status of household heads significantly determine the malaria prevention behavior of households in the North West Region of Cameroon.

In line with the educational attainment of the household heads, the results reveal that more educated household heads are more likely to adopt malaria prevention options that have wider coverage than those of narrow coverage and they are rather less likely to adopt more malaria prevention options than the less educated household heads. The results specifically show that a unit increase in the educational attainment of the household head increases their ordered log odds of choosing a malaria prevention option that has a wider coverage by 1.205 units and but rather reduces the ordered log odds of increasing the number of malaria prevention strategies by 0.0593 units. This shows that more educated households mostly adopt single or few malaria prevention options that are more holistic in nature. The effect of educational attainment on the choice of the type of malaria prevention is significant at 1% and its effect on the number of malaria prevention adopted is significant at 5% level of significance. This means that educational attainment significantly affects the type and number of malaria prevention options adopted by households in the North West Region of Cameroon.

Also, the coefficients of household income per capita with other effects held constant shows that increase in per capita income results to increase in the likelihood of adopting a more holistic malaria prevention option and also increases the likelihood of increasing the number of malaria prevention options adopted. The results specifically show as a household moves from a lower income per capita bracket to a higher one, the ordered log odds of adopting a malaria prevention strategy that has a wider coverage increases by 0.700 units while the ordered log odds in favor of increasing the number of malaria option increases by 0.00810 units. The effect of income on the type of malaria prevention option adopted is significant at 1% level but its effect on the number of malaria prevention options adopted is insignificant. This means that household income per capita significantly affects the type of malaria prevention options adopted by households in the North West Region of Cameroon, but insignificantly affect the number of malaria prevention options adopted by households in the North West Region of Cameroon.

More so, examining the results on household size's effect while controlling for other effects reveal that an increase in the household size increases the likelihood of adopting both holistic malaria prevention options and more malaria prevention options. More insight of the results shows that a unit increase in the household size increases the ordered log odds of the household adopting a holistic malaria prevention option by 0.776 units and increases the ordered log odds of the household adopting more malaria prevention techniques by 0.221 units. Both effects are significant at 1% level of significance, predicting that household size significantly affects the malaria prevention behavior of households in the North West Region of Cameroon.

Also, knowledge of the signs, cause and prevention options of malaria all positively affect the type and number of malaria prevention options adopted by households in the North West Region of Cameroon. Specifically, knowing the signs of malaria, cause of malaria and malaria prevention options increases the ordered log odds of adopting a holistic malaria prevention option by 2.669 units, 0.264

units and 7.352 units respectively and also increases the ordered log odds in favor of increasing the number of malaria prevention options adopted by 0.965 units, 1.656 units and 1.501 units respectively. However, the effects of knowledge of signs, cause, and prevention strategies of malaria are all significant except for the effect of knowledge of signs of malaria on a number of malaria prevention options adopted and the effect on knowledge of the cause of malaria, on the type of malaria prevention option adopted. This means that knowledge especially of the different possible malaria prevention options; signs of malaria and cause of malaria significantly affect malaria prevention behavior of households in the North West Region of Cameroon.

Furthermore, the reason for the choice of malaria prevention option(s) adopted all significantly affect malaria prevention behavior of households in the North West Region of Cameroon. The results specifically show that with the reason for the choice of malaria prevention option(s) being that it is cheaper, it is readily available, it is what they know and no reason compared to the reason being that it is free of charge reduces the likelihood of households adopting more holistic and many malaria prevention strategies. This means that any reason for the adoption of malaria prevention strategies other than it is free of charge; reduce the ordered log odds of households going in for more holistic and many malaria prevention options. The effects of all the reasons for malaria prevention options significantly affect the type and number of malaria prevention options adopted by households in the North West Region of Cameroon except for the case of choosing for no reason which is insignificant in the effects on the number of malaria prevention options adopted by households in the North West Region of Cameroon.

Neighborhood effects negatively affect the coverage and number of malaria prevention strategies adopted by households in the North West Region of Cameroon. This implies that people quite often want to adopt different malaria prevention strategies from what a majority of their neighbors are adopting which shows some opportunistic behavior among households in the region. This means that when the majority of neighbors to a household adopt more holistic malaria prevention options, the household will rather adopt a more individualistic prevention option and the more the number of options neighbors adopt the lesser the number of options the household will adopt. This effect is, however, significant only on the number of malaria prevention options adopted but not on the coverage of the options.

Also, malaria sensitization campaigns significantly affect both the type and the number of malaria prevention options adopted by households in the North West Region of Cameroon. Precisely, having attended a malaria sensitization campaign compared to not attending it increases the ordered log odds of adopting a more holistic malaria prevention strategy by 2.703 units but reduces the ordered log odds of increasing the number of malaria prevention strategies adopted by 0.594 units. This means that as household heads attend malaria sensitization campaign, they tend to adopt fewer but holistic malaria prevention strategies compared to not attending the sensitization campaign.

Ancillary parameters (cut1, cut2, cut3, cut4, cut5, cut6, and cut7) are the cut points used to differentiate the adjacent levels of the response variable. A threshold can then be defined to be a point on the latent variable (dependent variable) that results in the different observed values on the proxy variable. For the model with types of malaria prevention options being the dependent variable (say result 1) we had three options and so two cut points are predicted while for the model with the number of malaria prevention options adopted being the dependent variable we had 7 options hence, 6 cut points. Explaining the cut points, for instance, cut1 in the result (1) of -2.338 shows that any variable with the coefficient of -2.338 or less on the underlying latent variable that gave rise to our type of malaria prevention option adopted will be considered as individualistic practices, assuming all other coefficients equal to zero.

For the overall significance of the model the Likelihood Ratio (LR) Chi-Square test that at least one of the predictors' regression coefficient is not equal to zero in the model revealed that it is significant at 1% level of significance for all the estimations predicting that at least one of the regression coefficients in the model is not equal to zero. And for the goodness of fits, different R-squares were estimated. McFadden's Pseudo R-squares of 0.426 and its adjusted value of 0.422 showed 42.2% predictive power of the explanatory variables while others show even much higher predictive power such as ML (Cox-Snell) R-squared (59.4%) Cragg-Uhler (Nagelkerke) R-squared (67.5%), McKelvey and Zavoina's R-squared (80.3%) and Adjusted Count R-Square (75%). This shows that the model is well fitted.

Post-estimation tests such as the link test for model specification predicted that hat is significant and hat squared variable for the estimation is insignificant, it means the linear combination of the variables in the model are significantly justified and hence the model is correctly specified and there is the absence of multicollinearity in the analysis. The marginal test is also significant revealing the marginal means, predictive margins, marginal effects, and average marginal effects in the estimation.

Discussion and Conclusion

The findings of this study revealed the significant ability of gender of household heads; age of household heads; their marital statuses; their educational attainments; household per capita income; household size; knowledge of the signs and preventive options of malaria; reasons for adoption and sensitization in predicting households' malaria prevention seeking behaviours in the North West Region of Cameroon when type of malaria prevention options is used as the proxy to malaria seeking behavior. There is also evidence of a knowledge gap in terms of signs, causes, and prevention strategies of malaria.

From the above counts, this study strongly recommends that in order to improve upon malaria prevention efforts, households should be well sensitized on the causes, signs and prevention options of malaria. This can be achieved through sensitization campaigns; the creation of community-based malaria control committees and sponsored media programs. Such may target especially male household heads, single parents and less educated parents and emphases should be placed on the more holistic and sustainable malaria prevention strategies. Thus the government needs to increase its current budget on health by about 42% to meet up with this target. This is equally applicable to private health care institutions.

Special tax fund against malaria prevention at local council areas needs to be put in place to meet the needs of the needy. Also, households should be empowered through creating more income generating activities for households especially women empowerment activities which may raise the income of households, thereby enabling them to afford more and holistic approaches to malaria preventions.

Also, improving the formal education of parents can improve on their malaria prevention seeking behaviors. This can be achieved by creating more and flexible learning facilities and further subsidizing education, especially for adults. In this case, education should not only be seen for investment but also for consumption, self-development, and national awareness and for self-actualization.

From the findings, it is clear those communal efforts for the prevention of malaria may be very effective as it may help eradicate mosquitoes in the community as a whole. Thus community works and communal behaviors are recommended to households instead of opportunistic behaviors which don't have any lasting effect on malaria prevention.

Finally, further distribution of free ITNs and other facilities to control malaria such as insecticides and anti-malaria drugs should be encouraged not only to pregnant women but at least each household in the North West region in particular and Cameroon at large.

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