KNOWLEDGE, ATTITUDE AND PRACTICE OF MALARIA VECTOR CONTROL IN MAIDUGURI, NORTHEASTERN NIGERIA: A HOUSEHOLD-BASED CROSS-SECTIONAL SURVEY

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ABSTRACT

Background: *Malaria is a tropical disease that is a major public health problem in Nigeria, with an estimated 100 million cases and over 300 thousand deaths per year. Herein, we conducted a cross sectional phenomenological household survey to determine the knowledge, attitude and practice (KAP) of Malaria vector control in Maiduguri, Northeastern Nigeria.*

Methods: *A close-ended structured questionnaire was administered to participants from June 2019 to September 2019. A total of 90 consented participants (Mean Age ±S.D=26.17±16.09; S^2=259.14; C/var=61.51%; male: female=1:2), comprising of household heads or their spouses, were sampled at random for this study.*

Results: *51.1% (46/90) of the participants had tertiary education, 75.6% (68/90) have a monthly household income of 25 USD or less, 40.0% (36/90) of the households comprise of one shared bedroom while 53.3% (48/90) of the households have a population of 8 or more. 96.7% (87/90) of respondents have heard of malaria, where 68.9% (62/90) learned about it from experience and 15.6% (14/90) from radio programs. Only 17.8% (16/90) of respondents mentioned Plasmodium spp as the etiologic agent of malaria. 93.3% (84/90) of respondents attributed malaria transmission to the bites of mosquitoes. Most respondents (67.8%) mentioned stagnant water bodies as the breeding site for mosquitoes. 66.7% (60/90) of respondents use insecticide treated nets (ITNs) to prevent mosquito bites, 13.3% (12/90) use coil incense while 5.6% (5/90) use indoor residual spray (IRS).*

Conclusion: *The use of ITNs was observed to be predominant in this study. This choice can largely be attributed to its affordability and long term usage.*

Keywords: *Malaria, Awareness, Vector control, Malaria Transmission, ITN, IRS.*

INTRODUCTION

Malaria is a vector-borne parasitic disease that is caused by any of the five specie of *Plasmodium* (*P. falciparum, P. vivax, P. ovale, P. malariae and P. knowlesi*). Every year, there are about 219 million cases of Malaria and more than 400 000 deaths globally.[1] Children under 5 years account for 61% of all malaria

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deaths and a staggering 90% of all malaria deaths occur in sub-saharan Africa. Nigeria accounts for 25% of global malaria cases and 24% of global malaria deaths.[2] Of the 10 highest burden countries in Africa, Nigeria and Ghana have the highest absolute increase in cases of malaria from 2017 to 2018.[1] Malaria transmission occurs throughout the year in Nigeria with variation in intensity of transmission across the regions attributed to difference in climatic conditions.[3]

Malaria parasites are transmitted from an infected person to an uninfected person through the bites of female anopheles mosquito. All five (5) specie of *Plasmodium* are transmitted by the anopheles mosquitoes but not all specie of the anopheles mosquito transmits malaria parasites.[2] Majority of malaria cases in Nigeria have been attributed to *P. falciparum*. The rate of transmission is of more intensity in places where the lifespan of the female anopheles mosquito is longer.[4] Such longevity is critically important in malaria transmission, as the period of development of the parasite into a transmissible infective form inside the mosquito is usually 7-10 days. However, mosquito lifespan is a function of intrinsic, genetic, as well as environmental factors. For instance, the strong human biting habit of the African vector species is one of the reasons why approximately 90% of the world's malaria cases occur in Africa. To drastically reduce the incidence of malaria infection, the chain of transmission must be interrupted and vector control is at the heart of it. Infact, Malaria control is heavily dependent on our ability to control the mosquito population.[4]

Maiduguri is the most populous city in the Northeastern sub-region of Nigeria. Most parts of the city are characterized by low standards of sanitation with poor drainage system, indiscriminate efflux of waste water from homes into community surroundings, and improper waste disposal system.[5,6] These factors coupled with the high population density within the metropolis has increased the vulnerability of its inhabitants to malaria. Malaria infection in Maiduguri is mesoendemic and its transmission seasonal. The mosquito vector population density fluctuates across the two seasons of the year.[7] It is well established that effective vector control can halt the spread of malaria and make a major contribution towards advancing human and economic development. Aside from direct health benefits, reductions in vector-borne diseases enable greater productivity and growth, reduce household poverty, increase equity and women's empowerment, and strengthen health systems.[8] In malaria prevention, vector control can be thought of as the elimination of contact between mosquitoes and humans. This is either in the form of killing the vector using physical or chemical agents, or placing a barrier between the vector and the human population, thereby preventing contact and by extension, bites. The major household vector control methods in usage include indoor residual spraying (IRS) of houses with long-lasting insecticide formulations, sleeping under insecticide-treated nets (ITNs), use of mosquito coil incense, and application of insecticide treated body emulsions.[9]

Several studies have reported the misconceptions about malaria and its control in various communities, especially in Africa.[10,11] This has led to unsatisfactory results in the control of malaria in those communities. For malaria control to be effective, communities must be able to implement tailored-household vector control measures, and this largely depends on the knowledge of malaria and its control among members of those communities. This will further assist in the implementation of large-scale malaria control programmes in those communities. It is against this background that this study was formulated. It seeks to examine the state of awareness about Malaria and the practice of malaria vector control among the population of Maiduguri metropolis in Northeastern Nigeria.

METHODOLOGY

Study Area

The study was conducted in Maiduguri Metropolis, Northeastern Nigeria. Maiduguri is the capital of Borno State. It lies on latitude 11.8311° N, 13.1510° E and is 326m above sea level. The average temperature in Maiduguri is 25.8°C /78.4°F. The annual rainfall is 613mm/24.1inch. It has a land area of 50,778 square kilometers.[12] Maiduguri, also called Yerwa, is located along the seasonal Ngadda (Alo) River, the waters of which disappear into the Firki ("black cotton") swamps of Lake Chad, Northeast of the city. The population comprise of mostly crop farmers, fishermen, herdsmen and traders.[13] Based on the national census conducted in 2006, Maiduguri has an estimated population of 1 197 497.[14] However, the figure may differ with the influx/efflux of internally displaced persons due to insurgency that has affected the entire region since the year 2007.

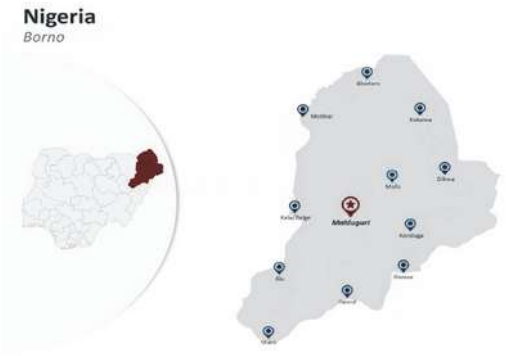

Figure 1: Map of Borno State showing Maiduguri metropolis

Study population

The target population comprise of households in Maiduguri metropolis. It consists of respondents that are 15 years of age and above who are residents of Maiduguri metropolis. Participation was voluntary and close-ended structured questionnaire was administered.

Sample size determination

Sample size was determined using the formula:[15] $N = Z_{1-\alpha/2}^2 p(1-p)/d^2$

Where:

$Z_{1-\alpha/2}$ = standard normal variate (at 5% type 1 error ($P<0.05$) it is 1.96).

p = Expected proportion in population based on previous studies or pilot studies (94.0%)[10].

d = Absolute error (0.05).

Thus, Sample size N = 87.

Inclusion Criteria
Households within Maiduguri Metropolis. Questionnaire was administered to the household head. In his absence, the spouse is interviewed. In the absence of either spouse, the widow or widower was interviewed. Unmarried single household heads were also interviewed.

Exclusion Criteria
Households outside Maiduguri metropolis. Households where the head and/or the spouse are not available.

Sampling technique/Study design
The study was a cross-sectional phenomenological household survey conducted between June 2019 and September 2019 in Maiduguri, Northeastern Nigeria. Ninety (90) households were randomly selected for inclusion in the study.

Method of Data Collection
Data was collected in the form of responses from household heads to close ended structured questionnaires. The questionnaire was divided into four sections. Section A consists of questions used to assess the bio-data of respondents. Section B consists of questions used to assess the household characteristics of respondents. Section C consists of questions used to assess the general knowledge of malaria among respondents and Section D assesses the knowledge of malaria vector/vector control method practiced by respondents. Informed verbal consent was obtained from the household heads or their spouses. Questionnaires were prepared in English and verbally translated into the local language during face to face interview sessions.

Data Analysis
Each completed questionnaire was reviewed for completeness before analysis. All ninety (90) questionnaires were duly filled and returned. Data were grouped as frequencies and percentages and presented in tabular form.

RESULTS
The demographic properties of the respondents revealed that 67.8% were females and 32.2% were males. 65.6% were 30 years old or less while 34.4% were 31 years old and above. 71.1% were married, 23.3% were single while 5.5% were either divorced or widowed. 51.1% were employed while 48.9% were unemployed. The job categories of the respondents include Civil servants (26.7%), Traders (18.9%), and Farmers (4.4%). 51.1% have finished their tertiary education while 48.9% have at most a secondary school leaving certificate (Table 1).

75.6% of the respondents have a monthly income of 25 USD or less. 40% of the households examined consist of people living in one shared bedroom. 53.3% of the households have a population of 8 or more (Table 2).

Table 1: Socio-Demographic properties of respondents sampled in Maiduguri metropolis

Demographic properties of respondents	Frequency	% Frequency	Cumulative %
Sex			
Male	29	32.2	32.2
Female	61	67.8	100
Total	90	100	
Age (years)			
- -	59	65.6	65.6
31-60	29	32.2	97.8
≥61	2	2.2	100
Total	90	100	
Marital status			
Married	64	71.1	71.1
Single	21	23.3	94.4
Divorced	2	2.2	96.6
Widowed	3	3.3	100
Total	90	100	
Occupation			
Civil servant	24	26.7	26.7
Trader	17	18.9	45.6
Farmer	4	4.4	50.0
Commercial driver	1	1.1	51.1
House wife	15	16.7	67.8
None	29	32.2	100
Total	90	100	
Level of Education			
Primary	5	5.6	5.6
Secondary	39	43.3	48.9
Tertiary	46	51.1	100
Total	90	100	

Table 2: Household characteristics of respondents sampled in Maiduguri metropolis

Household Characteristics	Frequency	% Frequency	% Cumulative
Monthly income (USD)			
⩽ 25	68	75.6	75.6
25.1- 517	19	21.1	96.7
517.1-1035	2	2.2	98.9
⩾ 1035.1	1	1.1	100
Total	90	100	
Residential unit			
One bedroom	36	40.0	40.0
Two bedrooms	23	25.6	65.6
Three bedrooms	14	15.6	81.2
Four bedrooms	17	18.8	100
Total	90	100	
No. of persons/household			
<4	21	23.3	23.3
4-8	21	23.3	46.6
>8	48	53.3	100
Total	90	100	

Knowledge of malaria among respondents has shown that 96.7% have heard of malaria disease. 68.9% stated that they learned about the disease from experience. 15.6% mentioned local radio stations as their source of information. 52.2% believed that malaria is caused by the bite of mosquito while 27.8% and 17.8% mentioned dirty-stagnant water and *Plasmodium* parasite respectively. 61.1% attributed malaria transmission to the bites of any mosquito, 32.2% said that mosquitoes that have bitten malaria patients are the agents that transmit malaria. 96.7% mentioned fever, headache and chills as the signs and symptoms of Malaria (Table 3).

67.8% of the respondents mentioned stagnant water as the breeding site of mosquitoes while 25.6% mentioned dirty surroundings. 40.0% believed that applying chemical insecticides prevents the breeding of mosquitoes while 28.9% mentioned clearing surroundings of dirt. 66.7% of respondents use insecticide treated nets as a means of malaria vector control, 13.3% use mosquito coil incense while 6.7% prefer the elimination of mosquito breeding sites (Table 4).

Table 3: Knowledge/Awareness of Malaria among respondents sampled in Maiduguri metropolis

Knowledge of Malaria	Frequency	% Frequency	Cumulative %
Ever heard of malaria			
Yes	87	96.7	96.7
No	3	3.3	100
Total	90	100	
Source of Info.			
Home	3	3.3	3.3
Radio stations	14	15.6	18.9
Hospital/dispensaries	9	10.0	28.9
Suffered from malaria	62	68.9	97.8
Others	2	2.2	100
Total	90	100	
Cause of malaria			
Germs	1	1.1	1.1
Dirty stagnant water	25	27.8	28.9
Mosquito bite	47	52.2	81.1
Plasmodium parasite	16	17.8	98.9
--	1	1.1	100
Total	90	100	
Means of transmission			
Bite of any mosquito	55	61.1	61.1
Bite of mosquito that has bitten a malaria patient	29	32.2	93.3
Contact with Malaria patient	4	4.4	97.7
Exposure to rain	2	2.2	100
Total	90	100	
Signs and Symptoms			
Fever, headache, chills	87	96.7	96.7
Joint and muscle pain	0	0.0	96.7
Nausea/vomit	0	0.0	96.7
Others	3	3.3	100
Total	90	100	

Table 4: Knowledge and Practice of Malaria vector control among respondents sampled in Maiduguri metropolis

Malaria vector control	Frequency	% Frequency	Cumulative %
Mosquito breeding area			
Stagnant water	61	67.8	67.8
Dirty area	23	25.6	93.4
Tall Grass	4	4.4	97.8
Others	2	2.2	100
Total	90	100	
Ways of preventing mosquito breeding			
Cleaning of house surroundings	26	28.9	28.9
Draining of stagnant water	19	21.1	50.0
Clearing of grass around the house	8	8.9	58.9
Applying chemicals	36	40.0	98.9
Others	1	1.1	100
Total	90	100	
Mosquito control methods used			
Use of insecticide treated net	60	66.7	66.7
Use of indoor residual sprays	5	5.6	72.3
Eliminate mosquito breeding site	6	6.7	79.0
Using mosquito coil incense	12	13.3	92.3
Treatment	2	2.2	94.5
Fumigation and fire smoking	3	3.3	97.8
DDT spraying	0	0.0	97.8
Others	2	2.2	100
Total	90	100	

DISCUSSION

Knowledge of malaria and effective malaria vector control practice is a prerequisite for the containment of the spread of malaria within the household, and the community at large. Awareness of the disease and its attendant risk factors necessary for transmission is a tool that can shape the decision-making process and can provide an informed approach towards malaria prevention in a community. In this study, the awareness of malaria is very highly positive among respondents. They cited experience as the means through which they get to know about the disease. This is similar to the reports of [16]. Malaria is endemic in Maiduguri and indeed, Northeastern Nigeria. This is unconnected with the preponderance of factors such as overcrowding and high population density, coupled with the ever-increasing mosquito vector population. The mosquito population can be found throughout the year, with fluctuations in vector density reflecting changes in time/season (highest during the wet season and least during the dry season). The continued sustenance of these factors has ensured that malaria remains an endemic disease in Maiduguri and as such, vast majority of the population are aware or have at some time, suffered from the disease.

However, the knowledge of the specific cause of malaria among respondents was very poor. Most of them cited bites of any mosquito as a cause of malaria infection. Only a few mentioned the bite of a mosquito that has previously bitten a malaria positive individual as the means of acquiring malaria disease, and few mentioned the Protozoan parasite (*Plasmodium* spp) as the agent responsible for causing malaria. Good knowledge of the cause of malaria among households is important. Understanding the fact that malaria is only transmitted by a mosquito that has previously bitten a malaria positive individual will enable households make informed decision such as reducing overcrowding and the implementation of an effective mosquito control method within the household in the event that a member of the household is suffering from the disease.

It is notable that a significant number of respondents in this study cited stagnant water as the most important breeding site for mosquitoes within Maiduguri metropolis. They further recommend that draining such stagnant water bodies and clearing surroundings of dirt as the most effective means of preventing or eliminating the breeding sites of mosquitoes. Several authors

have reported the significance of stagnant water as a breeding site for mosquitoes in both urban and rural communities.[17-19] However, Maiduguri is a semi-arid area that is dry in most parts of the year. With the exception of the rainy season, the only source of water for breeding of larval forms of the mosquito is stagnant water being released from homes, restaurants and other facilities. Such stagnant water bodies are prevalent within the metropolis. Elimination of these sites can significantly reduce the breeding rate and by extension, the total mosquito population in the community.

It was observed that the majority of the respondents in this study used insecticide treated nets (ITNs) as a means of mosquito vector control. Similar finding was reported by [20] in a study conducted in Northwestern Tanzania. The use of ITNs represents a cost-effective means of malaria prevention and as such, a suitable alternative to households in resource constrained or low-income communities like Maiduguri. ITNs serve as a physical barrier between mosquitoes and members of a household, and the insecticide impregnated into it repels or kill the mosquitoes. In malaria endemic communities where the use of ITNs is prevalent, a phenomenon called the "community effect" results. It is a situation that leads to the reduction of the overall mosquito population thereby reducing malaria transmission. [21]

Contrary findings were reported elsewhere. [22-24] In Lobito town of Angola, the use of insecticide canisters (IRS) was reported as the most predominant mosquito control method practiced by the locals.[6] Although ITNs were cheaper than IRS in Lobito town, the respondents cited discomfort, increased temperature/heat and difficulty to use as some of the problems associated with the use of ITNs. The low level of IRS usage observed in this study is associated with the high cost of each canister in Maiduguri metropolis ($\geqslant$ 4USD/canister). This is common among most resource constrained communities where the lack of IRS use is tied to its affordability by households.

ITNs and IRS are highly cost-effective vector control strategies, depending on the economic status of the community involved. ITNs are more cost-effective than IRS in a highly endemic low-income setting like Maiduguri, especially if high ITN coverage can be achieved with some demographic targeting. A free ITN distribution campaign is the most efficient way to rapidly increase ITN coverage [25] and ensures high level of compliance in the community. This will go a long way in containing the population growth of the vector and by extension, check mate the transmission of malaria in the community.

CONCLUSION

In this study, the general knowledge about malaria and its transmission was observed to be good among respondents. However, their knowledge of the etiologic agent of the disease was quite poor. The status of mosquito as a vector of malaria was observed to be a common knowledge among respondents, including its breeding sites. The respondents overwhelmingly mentioned the practice of sleeping under insecticide treated

bed nets (ITNs) as the most preferred malaria vector control measure. With the very low household income observed among respondents, it can be deduced that the wide usage of ITNs in Maiduguri metropolis is connected to its low-cost/affordability and longer duration of usage compared with other vector control methods such as IRS.

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