

Study on Breeding Sites, Disease Transmission and Control of Mosquitoes in Zamfara State, Nigeria

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ABSTRACT

Background and Objective: Mosquitoes serve as vectors for the transmission of many diseases like, filariasis, malaria, dengue fever, yellow fever, Chikungunya, West Nile virus, Zika virus and other arboviruses by injecting or ingesting disease-causing organisms to humans through the bite. They cause discomfort and kill more people (over 700,000) each year than any other animal. This study was conducted to determine community awareness of breeding sites, disease transmission and control of mosquitoes in Zamfara State. **Materials and Methods:** A semi-structured questionnaires were administered to 600 volunteers to obtain the required information and only male and female adult volunteers of ≥ 18 years were interviewed to ensure better understanding and responses on the subject matter. **Results:** This study showed that 72.5% the overall percentage of respondents do not have any knowledge about mosquito breeding sites while 27.5% are aware of different breeding sites. With regard to mosquito-borne diseases, an overall percentage of 93.5% mentioned malaria as the only disease they know to be transmitted by mosquitoes while 6.5% mentioned malaria and lymphatic filariasis only. Control strategies against mosquitoes indicated that the majority of the respondents (32.8%) use mosquito bed nets, followed by other conventional methods, in which only 10.0% were using plant-repellent materials to control mosquitoes and 7.7% are not using any of the control methods. **Conclusion:** The results showed inadequate awareness among the people of Zamfara State in terms of mosquito breeding places and other mosquito-borne diseases apart from malaria. However, the respondents are using a variety of mosquito control strategies including traditional methods.

KEYWORDS

Awareness, breeding sites, diseases, transmission, mosquitoes, Zamfara

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INTRODUCTION

Mosquitoes are insects that belong to the same group as true flies of the Order, Diptera. Within that order, they constitute the family culicidae with about 3,556 valid species worldwide¹. Their slender, elongated and segmented body is covered with scales as are the veins of the wings². They are also characterized by a pair of wings, three pairs of long hair-like legs, elongated piercing mouthparts and feathery antennae of which those of males are generally bushier than those of female^{3,4}. Adult sizes may range from 3-9 mm⁵.



Mosquitoes played an important role in many ecosystems, they serve as food for many animals (e.g., birds, fish, frogs, dragonflies, spiders etc.) and pollinators for many plants^{6,7}. However, some species of mosquitoes serve as vectors for many disease-causing organisms⁸. The adult males and females take sugar meals from nectar and other plant juices to obtain their energy. In most species, however, the females require the proteins and iron obtained from a blood meal in order to mature their eggs^{8,9}. Thousands of female mosquito species obtained blood meal from several host taxa such as, mammals, birds, reptiles, amphibians and some fishes including other arthropods¹⁰. Different species of mosquitoes show preferences and in many cases, narrow restrictions as to host animals¹¹.

Mosquitoes have more than 150 proteins receptors on their antennae and proboscises that help them to locate the hosts through the body odour, carbon dioxide and heat emitted from a person or animal and to figure out a particular puddle of water that has enough nutrients to support their larvae¹². Many species of female mosquitoes are capable to inject and/or ingest disease-causing organisms into or from the body of humans and other animals through their bites, they are therefore, the vectors with high transmission capacity for pathogens that cause diseases like, filariasis, malaria, dengue fever, yellow fever, Chikungunya, West Nile virus, Zika virus and other arboviruses. They are reported to kill approximately 750,000 people each year than any other animal¹³.

Mosquito-borne diseases remain a major problem in the world, particularly in tropical and subtropical regions. This is because the burden of these diseases contributes significantly to a social disability, stigmatization, poverty, economic losses, etc. and can even lead to death¹⁴. Therefore, avoiding mosquito bites is the best way to reduce the risk of mosquito borne diseases⁷. As such, there is ample reason to take every possible measure to avoid mosquito bites even without taking into account their terrible and stinging itchiness. The primary goal of mosquito control is to prevent the occurrence of mosquito-borne diseases in humans and domestic animals¹³.

All necessary protections against mosquito bites are similar to that of other mosquito-spread infections¹⁵. Protection against mosquito bites can be achieved through the use of one or a combination of the following, mosquito bed nets, insecticides, mosquito coils, repellent plant materials, repellent creams on exposed skin, mats, screening, vaporizers, wearing of loose long sleeves, long trousers, closed footwear and socks, sleeping under fan or in an air-conditioned room, destructions of mosquito breeding sites, etc. This is in addition to the provision of basic health education to the communities. Mosquito control measures depend on the type of vector species, mosquito biology, epidemiological context, cost and acceptability of control material by people¹⁶.

A lack of knowledge about mosquito breeding sites and the diseases they transmit can largely contribute to the vast spread of many mosquito-borne diseases within the community. The absence of data on community knowledge on breeding sites, disease transmission and mosquito control strategies in Zamfara State was the basis that, the study was conducted to provide information on the level of peoples' awareness about various mosquito-breeding sites and assessed their knowledge about diseases that are transmitted through the bites of mosquitoes. This is in addition to the determination of various mosquito control strategies and practices in Zamfara State.

MATERIALS AND METHODS

Study area: This study was carried out from January, 2021 to June, 2021. The study area is Zamfara State, located in the Northwestern part of Nigeria. The state lies between Latitude 10°50'00"-13°38'00"N and Longitude 4°16'00"-7°13'00"E and occupied a total land area of 38,418 km²¹⁷. The state is bordered

to the North by Niger Republic and to the Southeast by Kaduna State. In the East, it is bordered by Katsina State, to the North by Sokoto and Kebbi States and to the Southwest, it is bordered by Niger State¹⁸. Zamfara State consists of 14 Local Government Areas and it is divided into three senatorial zones such as Zamfara North Zone comprising of Kaura Namoda, Shinkafi, Zurmi and Birnin Magaji, Zamfara Central comprising of Gusau, Tsafe, Bungudu and Maru and the Zamfara West zone which comprised of Maradun, Bakura, Anka, Bukkuyum, Gummi and Talata-Mafara¹⁷.

The Local Government Areas randomly selected for this study were, Gusau LGA which is located between Latitude 12°9'0-2.15°N and Longitude 6°40'00-6.67°E with an area of 3,364 km² and an estimated population of 545,548 as at 21st March, 2017, Talata Mafara LGA which is located between Latitude 12°21'00-12°34'00"N and Longitude 6°04'00-6°04'00"E with an area of 1,430 km² and estimated population of 306,606¹⁹ and Kaura Namoda LGA which is located between Latitude 12°35'38-12°36'00"N and longitude 6°34'67-6°35'23"E, with an area of 868 km² and an estimated population of 405,723.

Ethical clearance: Before the commencement of the study, Zamfara State Health Research Ethics Committee Ministry of Health approved (Ethics reference No. ZSHREC/01/05/2017).

Questionnaire administration: A semi-structured questionnaire as described by Boynton²⁰ was used to determine the mosquito breeding sites, diseases spread by mosquitoes and mosquito control strategies in Zamfara State. The questionnaire was validated for reliability as described by Bolarinwa²¹. It was also prepared in English language and contained volunteer's socio-demographic data and questions relating to where, do the mosquitoes breed? Which disease(s) do you think are transmitted by mosquitoes? Which plant materials do you use to control mosquitoes? and What do you use to control mosquitoes? The questionnaires were administered through a simple random sampling method to 200 participants in each of the 3 Local Government Areas (LGAs), these gave a total of 600 participants and only male and female adult volunteers of ≥ 18 years were interviewed to ensure better understanding and responses on the subject matter.

Statistical analysis: Participants' responses about the awareness of mosquito breeding places, diseases spread by mosquitoes and various control strategies against mosquitoes were expressed using frequency percentage. The p-value less than 0.05 were considered significant.

RESULTS

Responses on community awareness about mosquito breeding sites in Zamfara State: The results of this study showed an overall percentage of 435 (72.5%) of the respondents who do not have any knowledge about mosquito breeding sites. While among the few respondents that know the mosquito breeding sites, 35 (5.8%) mentioned gutters, followed by 26 (4.3%) that mentioned ponds, 24 (4.0%) mentioned ditches, 20 (3.3%) mentioned wells, 19 (3.2%) mentioned discarded open plastic or metal containers, 16 (2.7%) mentioned old/discarded tyres, 15 (2.5%) mentioned earthen water pots and 10 (1.7%) mentioned tree holes (Table 1).

Responses on community awareness of mosquito disease transmission in Zamfara State: With regard to diseases transmitted by mosquitoes, an overall percentage of 561 (93.5%) of the respondents mentioned malaria as the only disease they know to be transmitted by mosquitoes while 39 (6.5%) mentioned malaria and lymphatic filariasis. The highest percentage of respondents that mentioned only malaria were found in Talata Mafara with 191 (95.5%), followed by 187 (93.5%) in Kaura Namoda and the

least 183 (91.5%) in Gusau. While those that mentioned malaria and lymphatic filariasis have the highest percentage in Gusau with 17 (8.5%), followed by Kaura Namoda with 13 (6.5%) and least of 9 (4.5%) in Talata Mafara (Table 2).

Responses on the local mosquito control strategies in Zamfara State: The result showed that 197 (32.8%) uses bed nets, followed by 157 (26.2%) uses mosquito coil, then 60 (10.0%) uses plant materials, 57 (9.5%) uses insecticide spray, then 49 (8.2%) uses either fans or air conditions, then 46 (7.7%) that are not using any control method, then 27 (4.5%) uses mosquito repellents and the least of 7 (1.7%) use to cover their body completely with blanket/bedsheet. However, there was variation in the percentage of respondents recorded from the Local Government Areas. In Gusau and Kaura Namoda, the highest percentage of 79 (39.5%) and 63 (31.5%), respectively were using bed nets, followed by other methods while in Talata Mafara, the highest percentage of 72 (36.0%) were using mosquito coils, followed by other methods (Table 3).

Responses on the use of plant materials to control mosquitoes in Zamfara State: Out of the 60 respondents that use plant materials to control mosquitoes in the study area, 14 (20.9%) use *Hyptis suaveolens* (Sarakkuwar sauro), followed by 12 (17.9%) that use orange peel (Bawon lemu), followed by 10 (14.9%) that use *Tapinanthus sessilifolius* (Kuduji), then 8 (11.9%) that use *Ocimum gratissimum* (Doidoya), followed by 6 (9.0%) that use *Azadirachta indica* (Dogonyaro), followed by 5 (7.5%) that use leaves of *Sorghum bicolor* (Dawa) to drive mosquitoes away from the rooms, followed by 3 (4.5%) that use millet hulls and least percentage of 2 (3.0%) use seeds of *Xylopia aethiopica* (Kimba) to repels mosquitoes (Table 4).

Table 1: Responses on community awareness about mosquito breeding sites in Zamfara State

Study area	Where do the mosquitoes breed?										Total No. (%)
	Gutter No. (%)	Pond No. (%)	Ditch No. (%)	Well No. (%)	Discarded open plastic/metal container No. (%)	Old tyre No. (%)	Earthen water pot No. (%)	Tree hole No. (%)	Don't know No. (%)		
Gusau	14 (7.0)	9 (4.5)	7 (3.5)	11 (5.5)	6 (3.0)	8 (4.0)	2 (1.0)	4 (2.0)	139 (69.5)	200 (100)	
Talata Mafara	9 (4.5)	10 (5.0)	8 (4.0)	6 (3.0)	5 (2.5)	3 (1.5)	7 (3.5)	2 (1.0)	150 (75.0)	200 (100)	
Kaura Namoda	12 (6.0)	7 (3.5)	9 (4.5)	3 (1.5)	8 (4.0)	5 (2.5)	6 (3.0)	4 (2.0)	146 (73.0)	200 (100)	
Total	35 (5.8)	26 (4.3)	24 (4.0)	20 (3.3)	19 (3.2)	16 (2.7)	15 (2.5)	10 (1.7)	435 (72.5)	600 (100)	

Table 2: Responses on community awareness about mosquito disease transmission in Zamfara State

Study area	Which disease(s) do you think are transmitted by mosquitoes?			Total No. (%)
	Malaria (%)	Malaria and lymphatic filariasis (%)		
Gusau	183 (91.5)	17 (8.5)	200 (100)	
Talata Mafara	191 (95.5)	9 (4.5)	200 (100)	
Kaura Namoda	187 (93.5)	13 (6.5)	200 (100)	
Total	561 (93.5)	39 (6.5)	600 (100)	

Table 3: Responses on the local mosquito control strategies in Zamfara State

Study area	What do you use to control mosquitoes?									Total No. (%)
	Bed net No. (%)	Mosquito coil No. (%)	Plant materials No. (%)	Insecticide spray No. (%)	Fans/air conditions No. (%)	None of the methods No. (%)	Repellent cream No. (%)	Covering of the body No. (%)		
Gusau	79 (39.5)	39 (19.5)	14 (7.0)	21 (10.5)	20 (10.0)	11 (5.5)	13 (6.5)	3 (1.5)	200 (100)	
Talata Mafara	55 (27.5)	72 (36.0)	25 (12.5)	9 (4.5)	11 (5.5)	21 (10.5)	5 (2.5)	2 (1.0)	200 (100)	
Kaura Namoda	63 (31.5)	46 (23.0)	21 (10.5)	27 (13.5)	18 (9.0)	14 (7.0)	9 (4.5)	2 (1.0)	200 (100)	
Total	197 (32.8)	157 (26.2)	60 (10.0)	57 (9.5)	49 (8.2)	46 (7.7)	27 (4.5)	7 (1.7)	600 (100)	

Table 4: Responses on the use of plant materials to control mosquitoes in Zamfara State

Botanical name	Common name	Local name	Part use	Mode of administration	Number (%)
<i>Hyptis suaveolens</i>	Pignut	Sarakkuwar sauro	Whole plant	Hang fresh plants in the room or direct burning of the plant to produce smoke	14 (20.9)
<i>Citrus sinensis</i>	Sweet orange	Lemun zaki	Peels of fruits	Direct burning of dried orange peels to generate smoke in the room	12 (17.9)
<i>Tapinanthus sessilifolius</i>	African mistletoe	Kuduji	Whole plant	Hang whole plant in the room or direct burning of the plant to produce smoke	10 (14.9)
<i>Ocimum gratissimum</i>	Scent leaves	Doidoya	Whole plant	Hang whole plant in the room or direct burning of fresh or dry leaves to produce smoke	8 (11.9)
<i>Azadirachta indica</i>	Neem tree	Dogonyaro	Leaves	Direct burning of the fresh or dried leaves to produce smoke in the room	6 (9.0)
<i>Sorghum bicolor</i>	Sorghum	Dawa	Leaves	Fresh leaves of the plant are used to drive mosquitoes away from the room	5 (7.5)
<i>Pennisetum glaucum</i>	Pearl millet	Gero	Millet hulls	Direct burning of dried millet hulls to generate smoke in the room	3 (4.5)
<i>Xylopiya aethiopica</i>	Ethiopian pepper	Kimba	Seeds	Direct burning of the dried seed to produce smoke in the room	2 (3.0)
Total	-	-	-	-	60 (100)

DISCUSSION

This study showed that various mosquito-breeding sites exist in Zamfara State, but only a few respondents are aware of the existence of these breeding sites. The lack of knowledge of the participants on mosquito breeding places could be attributed to the failure of community health workers to impart basic knowledge about various outdoor and indoor mosquito-breeding places to their community. Effective reduction of mosquito breeding places can only be achieved when people are able to recognise the mosquito breeding places and of course, the larvae of mosquitoes, which may be acquired through community health education. These observations agreed with the report of Espinoza-Gomez *et al.*²². In the same line, similar findings were reported by Sharma *et al.*²³ and Roselin and Srisanthanakrishnan²⁴. Contrary to these findings, Yerpude *et al.*²⁵, reported from the findings of their studies that, the majority of the respondents are aware of the various mosquito breeding places.

The communities' awareness of the diseases transmitted by mosquitoes is very poor. The majority of the respondents mentioned only malaria, with very few mentioning filariasis. A similar result was reported by Roselin *et al.*²⁴. It was generally observed that the respondents acquired knowledge about malaria from health education programs at hospitals, radio/television stations and other communication media, in addition to the experience acquired from the disease (malaria) itself. Probably, other diseases that are being transmitted by mosquitoes like lymphatic filariasis, dengue, Japanese encephalitis, Chikungunya, kala-azar etc., that are also dangerous in terms of morbidity and mortality were neglected by the health workers during health education campaigns to the communities. Campaigns must, therefore, convey other diseases transmitted by mosquitoes apart from malaria.

The finding that, the majority of the respondents use bed nets as mosquito control strategies in Zamfara State was not in line with the findings of Joseph *et al.*²⁶ those who reported the use of mosquito repellent creams as the commonest prevention method used by people, but was found to be similar with the findings of Hogarh *et al.*²⁷ and Finda *et al.*²⁸. While, Surendran *et al.*²⁹ reported from their studies that, the commonest and most frequently used preventive measures against mosquito bites by people are burning mosquito coils.

The highest percentage of people found using mosquito bed nets was in Gusau, the state capital of Zamfara, where people are closer to health facilities and access to public health awareness. The level of its acceptability to the people could be attributed to the better protection it serves against a variety of insects and its availability within localities, in addition to public health enlightenment about the danger of malaria by health workers. Another reason is the distribution of the nets from the Nigerian government in collaboration with donor agencies (like, Unicef, CDC, Usaid and Who) who provided insecticide-treated nets (ITNs) and long-lasting insecticide-treated nets (LLINs) most of which had been distributed free-of-charge. These observations are consistent with that of previous studies conducted elsewhere by Taremwa *et al.*³⁰.

Burning mosquito coils the second most preventive measure against mosquito bites in Zamfara State, might be due to affordability problem in terms of economic status that hinders some people to purchase the net or lack of access to obtain the nets given out by the government free of charge. Onwujekwe *et al.*³¹ reported similar observations in their previous study.

It was quite surprising that some of the respondents in this study are not using any of the mosquito preventive methods. Although, a similar finding was reported by Munzhedzi *et al.*³², who obtained 2% of their study participants that are not using any mosquito preventive measures. This attitude could be due to the lack of awareness about the danger of malaria and other mosquito transmitted diseases by the people because the use of personal protective measures against mosquitoes is influenced by the knowledge and past experience of the diseases they cause.

Mosquitoes and the diseases they transmit are of great public health concern, prior to this study, many people in the study area are ignorant of many mosquito-borne diseases and various mosquito breeding sites. However, through this study many participants are now aware of various mosquito-borne diseases and breeding sites, a knowledge that will improve their practices to avoid mosquito bites and to be able to destroy nearby mosquito breeding places. Nevertheless, it is recommended that government, non-governmental organisations, scholars and concerned individuals should put more emphasis on educating people to know much about the danger of mosquitoes and how to avoid them through several interventions. This study is limited to responses obtained from the volunteered participants, it does not involve any experimental findings. Further study is also recommended to find out the efficacy of the repellent plants mentioned therein.

CONCLUSION

The results showed inadequate awareness among the people of Zamfara State in terms of mosquito breeding places and other mosquito-borne diseases apart from malaria. However, the respondents are using a variety of mosquito control strategies including traditional methods.

SIGNIFICANCE STATEMENT

The results of this study revealed that the majority of people in Zamfara State do not know mosquito breeding sites, not to talk of mosquito larvae and that almost all of them are aware of malaria as a mosquito-transmitted disease with very few mentioning filariasis, but they are not aware of other mosquito-transmitted diseases. Therefore, intensive mosquito control programs through several interventions such as; educating people about various mosquito related diseases, their breeding habitats and the free distribution of ITNs and LLINs, are highly needed by the people of Zamfara State.

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