

Entomological Survey Of Mosquitoes Responsible For The Transmission Of Lymphatic Filariasis In Three Endemic Villages Of Kano State, Nigeria

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Citation

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Abstract

We conducted an entomological survey of mosquito vectors to determine the abundance of the different species and identify those responsible for the transmission of lymphatic filariasis in three endemic villages of Kano State, Nigeria. Houses were randomly selected for mosquito collection. The Pyrethrum Knock Down (PKD) using Bygon as an insecticide of choice was used in spraying the indoor resting mosquitoes. A total of 1,604 comprising of 1,291 females and 513 males were collected. The abundance of mosquito was found to depend on the prevailing weather conditions at the time of collection and the nature of the settlements in the villages. The species composition and abundance of the 718 dissected mosquitoes were: *Anopheles gambiae* 325, *An. funestus* 263, *An. zimani* 1, *C. quinquefasciatus* 124 and *Aedes* sp. 5. Only one *Culex quinquefasciatus* was infected with four larvae (L3) in its thorax at Buda village. The infection and infectivity rates were 0.14% and 0.00 respectively. The overall infection and infectivity rates were 0.07% and 0.0% respectively.

INTRODUCTION

Infection by the filarial parasite, *Wuchereria bancrofti*, is the most common cause of lymphatic filariasis (LF), accounting globally for approximately 90% of all infections (Lenhart et al. 2006). The disease is transmitted by species of mosquitoes of the genera *Aedes*, *Anopheles*, *Culex* and *Mansonia* (Nissen et al. 2002). Worldwide, over 120 million people are infected with lymphatic filariasis, with 20% of the global population (over 1.1 billion people) at risk for infection (WHO, 1997a). In Africa, the prevalence of lymphatic filariasis is especially striking, affecting over 40 million people in the sub-Saharan region alone (Dunyo et al. 2005). Overall, Africa is thought to account for 40% of all cases of lymphatic filariasis in the world (Gyapong and Amuyunzu-Nyamongo, 1999). Lymphatic filariasis is a major public health problem and strikes vulnerable people of all ages and both sexes (Anosike et al. 2005). The disease has been established to cause considerable socio-economic burden to affected communities in many tropical and sub-tropical countries (WHO, 1997a).

The common clinical manifestations of lymphatic filariasis are acute attacks of adenolymphangitis and disfiguring

conditions such as hydrocoele and lymphoedema/elephantiasis (Ahurlu et al. 2001). Because of the debilitating nature of these manifestations and the large numbers of individuals affected, lymphatic filariasis has been identified as one of the leading causes of permanent and long – term disability in the world (WHO, 1995). The disease results in loss of work, productivity, direct and indirect economic loss and functional impairment (Pani et al. 1995; Ramaiah et al. 1996c, 1997a,b; Ramu et al. 1996).

The World Health Assembly targeted lymphatic filariasis for elimination mainly through a strategy of mass drug administration (MDA) (Abel et al. 2002). The effectiveness of the lymphatic filariasis elimination depends on upon the consumption of the recommended drug by the affected population (Mariappan, 2007). However, implementation of MDA led to diverse problems in some communities (urban areas, remote areas, migrant population and minority groups), with high rates of non-compliance having caused low treatment coverage (Gyapong and Twum-Danso, 2006). Although, MDA alone has been shown to suppress transmission of lymphatic filariasis in many areas where it has been implemented, it is often accompanied by

resurgence once there is residual infection in the population. Therefore, sustainability of transmission suppression of lymphatic filariasis could be achieved only through integration of different strategies of vector control along with MDA (Mariappan, 2007). Besides, monitoring of the success of the lymphatic filariasis elimination programme depends on entomological studies of the mosquito vectors that transmit the disease in endemic communities (Das and Ramaiah, 2002). This investigation is an attempt to determine the abundance of different species of mosquitoes as well as identify those responsible for the transmission of lymphatic filariasis in three endemic villages in Kano State, Nigeria.

MATERIALS AND METHODS

THE STUDY AREA

Kano State is located in the North-western part of Nigeria. The state is situated between latitudes and longitudes, north of the equator and east of Greenwich respectively which is determined as follows: North 10° 37', North 10° 33', East 7° 34' and 9° 29' respectively. The State is bordered in the east by Jigawa State, on the west by Katsina State, to the south by Kaduna and Bauchi States. It covers a total area of 20,760 SqKm with 1,754,200 hectares of arable land and 75,000 hectares of forest vegetation and grazing lands. It has an estimated population of about 9,383,332 million people (NPC, 2006).

The state is situated on the Sahel savannah region of West Africa and its climatic condition is tropical having rainy and dry seasons. The length of the wet season is about 100-150 days or five months (from mid-May to mid-October of each year). Rainfall pattern is unimodal; with an average rainfall of 600mm. The dry season lasts for about seven months (from mid-October to mid-May of each year). However, there is the dominance of North Easterly winds, the Harmattan which is cold and dry that extends from November to February of each year. The average maximum and minimum temperature fluctuates throughout the year.

The annual mean ranges from 30°C to 35°C. High temperatures are recorded during March to May annually while the lowest 13°C (sometimes it goes down as low as 10°C) is from December to January.

For easy administration the state is divided into 44 local government areas (LGAs). The three LGAs where this study was carried out are Garko located in southern part, Dawakin-Tofa found in the north and Gabasawa in the east.

SURVEY OF VECTORS OF LYMPHATIC FILARIASIS IN THE THREE VILLAGES

The aim of this study is to determine the abundance of the different species of mosquitoes as well as identify the species of mosquito vector(s) responsible for the transmission of lymphatic filariasis in the three villages of Marke, Buda, Gunduwa located in Dawakin-Tofa, Garko and Gabasawa LGAs respectively. These three villages in an earlier study were found to be endemic for lymphatic filariasis with a prevalence of 1.6%.

COLLECTION AND DISSECTION OF MOSQUITOES

A number of houses in each village were randomly selected for catching and collection of mosquitoes. The purpose of the investigation was explained to the head and members of each of the household selected. Permission to enter each of the household was sought and the right to refuse or withdraw at any time was respected. All catches were done indoors using the Pyrethrum Knock Down (PKD) or Pyrethrum Spray Collection (PSC) methods (Anosike et al., 2005). The catches were done from 6.00 to 10:00 hr (local time) weekly for four months from April to July in 2007. At least two rooms were selected in each house for the collection. All occupants, animals, exposed food were first removed from the rooms. White spray sheets each of (at least 2 x 2m) were spread to cover the floor of the room. All doors and windows were closed and the room was sprayed with Bygone (Pyrethrum). The spray was directed at all potential escape routes such as closed doors, windows, eaves, and roof ceiling.

Collection of the mosquitoes was done after 15 minutes by means of a pair of forceps and emptied into labelled Petri-dishes. The date of collection and the number of catches and number of rooms sprayed were recorded for each household in a note book. The prevailing weather conditions at the time of collection and the nature of the settlements as well as activities that favour the breeding of mosquito or otherwise were observed and recorded at the time of collection.

IDENTIFICATION AND DISSECTION OF MOSQUITOES

The female mosquitoes collected from each household were dissected under a dissecting microscope immediately after collection in the field. A mosquito was placed on the middle of a none-grease slide and identified into genus or species level based on morphological features outlined in Gillett,

(1972) under an x40 microscope. The mosquito was separated into head, thorax and abdomen. The head and abdomen were placed on either sides of the slide respectively while the thorax was placed at the middle of the slide. The last two abdominal segments were removed to determine the parity status of the mosquito. The parity status measures whether a female mosquito has completed at least one cycle of reproduction which starts with a blood meal and ends in oviposition as against the nulliparous that are yet to lay eggs. Each of the parts was put into a drop of normal saline and squashed by means of the two dissecting pins. The content of the squashed three parts (head, thorax and abdomen) were observed under a light microscope (using x40 objective) for the presence of larval stages L1/L2 and L3 and microfilariae. Identification of the third stage larvae were on the morphological features outline in WHO, (1997b). Observations were carefully recorded in a record book.

The data generated was using simple frequencies and percentages; and then presented in tabular forms. Infection and infectivity rates respectively were calculated using the formulae below:

Figure 1

$$\text{Infection Rate} = \frac{\text{Number of infected mosquitoes}}{\text{Total number of mosquitoes dissected}} \times 100$$

$$\text{Infectivity Rate} = \frac{\text{Number of mosquitoes with L3 larva}}{\text{Total number of mosquitoes dissected}} \times 100$$

RESULTS

COLLECTION OF MOSQUITOES

A total of 1,604 mosquitoes comprising 1,291 females and 513 males were collected from 196 houses in the three villages (Table, I). More mosquitoes were collected in Gunduwa (852 from 105 houses), followed by Marke (448 from 54 houses) and Buda (348 from 37 houses). The overall mean number of mosquitoes caught per house was 8.2; Buda had the highest 9.4, followed by Marke 8.3 and the least was in Gunduwa 8.1. However, the abundance of mosquitoes was observed to depend on the nature of settlements, whether or not animals are reared at the back yard and perhaps the weather prevalent at the time of collection. For example, the high abundance of mosquitoes recorded in Gunduwa was because there is a hamlet, Wailari that has scattered type of settlement and thatched buildings and in most cases animals were raised at the back yards of the

houses. In that hamlet alone, 653 mosquitoes were caught from 21 compounds indicating a mean number of mosquitoes per house to be 31 as against 199 mosquitoes from the other four hamlets combined from 84 houses with mean number of mosquitoes caught per house to be 2.3. In Buda, mosquito abundance declined with a break in the rainfall.

Figure 2

Study Sites	No. of households where collection was done	No. of persons in the compounds	Total/mean number of mosquitoes per house
Marke	54	285	448(8.3)
Gunduwa	105	676	852(8.1)
Buda	37	230	348(9.4)
Total	196	1191	1604(8.2)

Table I: Mosquitoes collected from the study area

DISSECTION AND IDENTIFICATION OF MOSQUITOES

Of the 1,291 female mosquitoes collected from the three villages, 718 were dissected (Table, II). Only dissected mosquitoes were identified to species level. The parity status of mosquito species composed of 39 nulliparous, 643 gravid and 36 parous. Of the 718 mosquitoes dissected, the most abundant species was *Anopheles gambiae*, (325) and the least was *An. Zimani*, (1) (Table, III). Only one mosquito, *Culex quinquefasciatus* was found to be infected with four larvae (L3) in its thorax at Buda village. The overall infection and infectivity rates were 0.14% and 0.0% respectively. The infection and infectivity rates for Buda where the infection was observed in only one mosquito were 0.7% and 0.0% respectively.

Figure 3

Table II: Number of mosquitoes dissected from the study sites

Study Sites	No. of mosquitoes dissected	Parity Status			No. with mff
		N/Parous	Gravid	Parous	
Marke	336	27	295	22	0
Gunduwa	230	10	204	12	0
Buda	152	02	144	02	1
Total	718	39	643	36	1

Figure 4

Table III: Species composition of dissected mosquitoes

Study village	<i>Anopheles gambiae</i>	<i>An. funestus</i>	<i>An. zimani</i>	<i>Culex quinquefasciatus</i>	<i>Aedes</i>	Total
Marke	197	106	0	33	0	336
Gunduwa	69	118	1	37	5	230
Buda	59	39	0	54	0	152
Total	325	263	1	124	5	718

DISCUSSION

The abundance of mosquitoes, which translates into high or low harvest, was observed to depend on the weather prevalent at the time of collection, the number of houses sampled, the nature of the settlements in the villages and hamlets that make up the villages and animal husbandry practices. High harvest was seen when it rained and in general thatched houses seems to harbour more mosquitoes than unthatched. For instance, Gunduwa village had the highest abundance of mosquitoes because more houses were sampled and the nature of settlements at one of the hamlets, Wailari. The village has scattered type of settlement and majority of the houses are of the thatched type. In addition, animals (cows and goats) are reared at the backyards of most of the houses. The decline in mosquito abundance at Buda was due to a break in rainfall at the time of the mosquito collection. In order of increasing abundance the following mosquitoes were identified and dissected: *Anopheles zimani*, *Aedes* sp., *An. funestus*, *Culex quinquefasciatus* and *An. gambiae*. The *Anopheles* species were more abundant in Marke because it is more of a rural setting and that the village is located near a large water body, which provides excellent breeding sites. On the other hand *Culex quinquefasciatus* was more abundant in Buda because the village is more of a semi-urban setting which provides breeding sites for this species.

An. gambiae, *An. funestus* and *Culex quinquefasciatus*, which have been encountered in these villages, have been incriminated as vectors of lymphatic filariasis in various part of Africa. For example, *An. gambiae*, *An. funestus* and *Culex quinquefasciatus* have been incriminated as vectors in an irrigation community in southern Ghana by Dzodzomenyo et al. (1999) and in Ebonyi State, Nigeria (Anosike et al. 2005). *An. funestus* and *An. gambiae* were found to be the vectors in three communities in Uganda by Onapa et al. (2001) while Merelo-Lobo et al. 2003 identified *An. arabiensis*, *An.*

gambiae, *An. funestus* and *Mansonia* sp. as vectors in Lower Shire Valley, Southern Malawi. Udonsi, (1988) identified *An. gambiae* and *Culex pipiens* as vectors of lymphatic filariasis in Igwun River Basin, Nigeria. Lenhart et al. (2007) implicated *An. gambiae*, *An. funestus* and *An. arabiensis* as major vectors from 13 villages in central Nigeria.

In this study, infection was seen in only one *Culex quinquefasciatus*, this goes to confirm the increasing importance of this species in the transmission of lymphatic filariasis in Africa. Moreover, *Culex* transmitted filariasis have already been reported in Bauchi State by Anosike (1996) which share a similar climatic condition with Kano State. As observed by Anosike et al. (2005), this finding is potentially worrying for many areas of West Africa where *W. bancrofti* is endemic and *C. quinquefasciatus* is rapidly becoming more abundant but where local compatibility between the parasite and the mosquitoes has not yet appeared.

The low infection rate recorded in this study may be because mosquito collection and dissection was not done during the period of peak transmission. It could also be because the prevalence of lymphatic filariasis is low which an indication of light transmission in the villages. In addition, fewer mosquitoes from spray catches would be infective than those from human landing catches as infective larvae are lost during feeding (McMahon et al. 1981). In this study, majority of the mosquitoes collected through the spray method were blood-fed and gravid females.

This investigation apart from given an insight into the abundance of mosquito species, has incriminated *Culex quinquefasciatus* as a vector. It also identified *An. gambiae*, *An. funestus* and *Aedes* that have been found to serve as vectors in different parts of Nigeria. This therefore provides a baseline information for integrating vector control into the nation's Lymphatic filariasis elimination programme. However, investigations covering longer period of time and involving more villages is recommended.

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