ASSESSMENT OF ENDOPHILIC MOSQUITOES AND PARITY STATUS AS CONTINUOUS MEANS OF LYMPHATIC FILARIASIS TRANSMISSION IN SELECTED COMMUNITIES, ONDO STATE, NIGERIA

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Abstract: Mosquitoes are known to transmit lymphatic filariasis (LF) which causes varying disease conditions in humans. This study assessed indoor mosquitoes and their parity status in some communities of Ose Local Government Area, Ondo State, Nigeria. Endophilic mosquitoes were collected from 122 consented participants' houses of various building structures using the Pyrethrum Spray Catch method. The mosquitoes were identified morphologically using taxonomic keys and dissected for parity using standard procedures. Results showed that from the 760 females collected, *Anopheles gambiae* complex were 84.9%, *Anopheles funestus* group (13.1%), *Anopheles mocheti* (1.2%), *Mansonia* sp. (0.5%) and *Culex* sp. (0.3%). Highest collection of 338 (44.6%) mosquitoes were obtained from houses in Idogun community while houses in Imeri community had the lowest 122 (16.1%), however no significant difference (p>0.05) exist between the number of mosquitoes caught and the communities. On parity and infectivity status of the mosquitoes, 558 (73.4%) of the female mosquitoes were nulliparous. The monthly abundance of mosquitoes were July (136), August (146), September (168), October (130), November (102), and December (76). Analyzing housing type and number of mosquitoes collected, it was observed that the least amount of female mosquitoes (20) was caught in the Block houses. Other entomological indices showed the Indoor Resting Density to be 6.85 and Human Biting Rate (0.40). The presences of the different species of mosquitoes are indicative that any could serve as possible vectors in the transmission of LF in the communities.

Keywords: Endophilic mosquitoes, lymphatic filariasis, Nigeria, Ondo State, parity status

Introduction

Mosquitoes which belong to the class Insecta are readily distinguished from other insects by their conspicuous projecting proboscis and scales on their wings and veins. According to Simon-Oke and Ayeni (2015), the females feed on blood which provides additional nutrition for their eggs. They apparently are attracted to human and animals by moisture, lactic acid, carbondioxide and body heat (Gillies, 1980). Depending on specie genera (*Anopheles*, *Culex* and *Aedes*), most mosquito exhibit complex life cycle mechanism and also act as nuisance pests due to their biting behavior (Makworo *et al.*, 2017).

Diseases of public health importance transmitted by mosquitoes include: malaria, filariasis, dengue fever, yellow fever and arboviruses. These diseases in general affect hundreds of millions of people every year, causing immense suffering, economic loss, low productivity, work related absenteeism and hindering development worldwide (Dalhatu *et al.*, 2016). Furthermore, they constitute a very important component in the determinants of insect-borne diseases of public health importance, especially in places where the availability of diverse water bodies like sewage, water-holding containers, gutters and water puddles support their breeding (Afolabi *et al.*, 2019).

Surveillance of the adult mosquitoes has been observed to be an important tool in epidemiology and control of mosquito-borne diseases (Adeleke *et al.*, 2010). In Nigeria, mosquitoes have been implicated in the transmission of diseases like malaria, lymphatic Filariasis (LF) and Yellow Fever (YF). These have been reported by studies by Okorie *et al.* (2013), Morakinyo *et al.* (2018) and Nwachukwu *et al.* (2020). Various entomological surveys carried in parts of Nigeria had established mosquitoes from 2 genera to transmit lymphatic filariasis. They include; The *Anopheles gambiae s.l, An. funestus, Culex pipens fatigans, C. quinquefasciatus, An. gambiae s.s.* and *An. arabiensis* (Udonsi *et al.*, 1988; Mbah and Njoku, 2004; Awolola *et al.*, 2006; Lehart *et al.*, 2007; Agi and Ebenezer, 2009; Amaechi *et al.*, 2011; Ngele and Adewale, 2012; Udujih *et al.*, 2012; Amaechi *et al.*, 2014; Itina *et al.*, 2014; Manyi *et al.*, 2014). Adekunle *et al.*, (2016) reported a lymphatic filariasis prevalence of 27% in parts of Ose Local Government Area but no incriminating vector was reported. This provided the need to assess the types of endophilic mosquitoes and their parity. This is aimed at providing information on the incriminating species that could be involved in the transmission of LF in the study area.

Materials and Methods

Study area

The communities (Idoani, Idogun and Imeri) as shown in Fig. 1 are located in Ose Local Government Area (LGA) in Ondo State, Southwest Nigeria. The LGA lies between Latitude 3˚ 91' 39 N and Longitude 7˚ 50' 11 E. The Ose River is located after Idogun community. Various occupations engaged by people in these study area includes farming, trading and artisans.

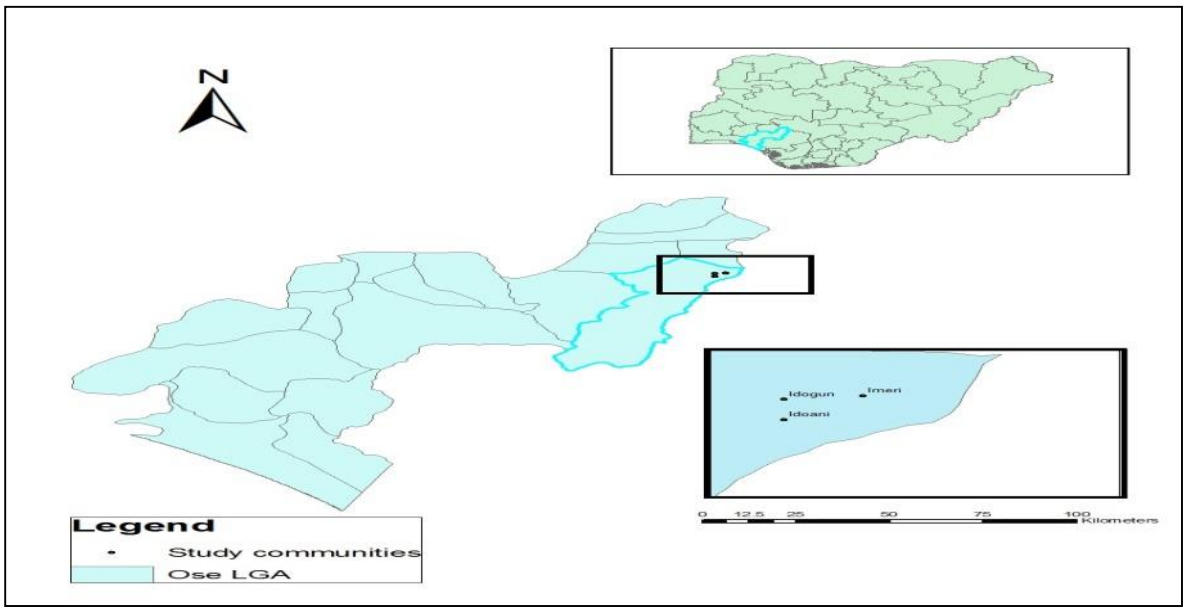

Fig 1: Map showing the three communities sampled for entomological studies

Ethical approval/consent for the study

Ethical approval letter was obtained from the Ethic Review Committee of the Federal Medical Centre, Owo, Ondo State. The purpose of research was explained to the community members and informed consents were obtained from consented participants. All consented participants' houses in the study area were numbered and selection of houses was done using the stratified sampling technique. A total of one hundred and twenty-two houses (with representatives; mud (houses constructed with mud), cement (houses not well constructed) and blocked (concrete houses well-constructed, painted and windows well-fitted) were sampled from the three communities.

Collection and preservation of endophilic mosquitoes

The trapping of adult endophilic adult mosquitoes was done using the Pyrethrum spray collection (PSC) method which involved knocking down resting mosquitoes in an enclosed given space using a pyrethriod-based insecticide aerosol. Early in the morning, between 06:00 am and 08:00 am, white light-colored sheets were laid down on the floor of the chosen room wall to wall with the windows and doors closed. Each room was sprayed with the insecticide and 20 minutes later, the knocked down mosquitoes on the sheet were picked up with forceps and collected into labeled sample bottles containing 70% ethanol. The bottles were transported to the Biological Sciences Laboratory, Osun State University to be counted and identified (Itina *et al.,* 2014).

Identification of mosquitoes using morphological keys

The mosquitoes were first counted and separated by sex and identified to species level using x40 dissecting microscope and guided by the standard morphological keys of Gillett and Smith (1972). Males were noted and discarded. Parity was checked using the procedure described by Denotiva (1962).

Dissection of mosquitoes

Using a dissecting microscope, each mosquito was separated into head, thorax and abdomen and observed for the presence of microfilariae stages (L_1/L_2 and $L_{3)}$ as described by WHO (1997).

Data analysis

The percentage abundance of identified mosquitoes in respect to location was calculated. The data were subjected to Chi square test analysis using Statistical Package for Social Sciences (Version 22). The Indoor-Resting Density (IRD), Monthly Biting Rate (MBR) and Human Biting Rate (HBR) were calculated according to WHO (2003).

Results and Discussion

A total of 854 endophyllic adult mosquitoes were collected from the study area with female mosquitoes constituting 760(88.9%) and males 94(11.1%). The distribution of female mosquito species after been identified by using standard morphological features is shown in Table 1. *Anopheles gambiae* (644, 84.9%) was the most abundant in the study area. Idogun with 338(44.6%) was the most infested community (Table 1). Fig. 2 showed that there was a steady rise in the abundance of mosquitoes from July to September where there was a peak with 168 mosquitoes and a drop from September all the way to December (76 mosquitoes). The Monthly Biting Rate (MBR) as also observed in Fig. 2 showed increased MBR from July to September (315 monthly bites) and a drop from September to December with 147.3 monthly bites.

Table 1: Distribution of Female species across the communities

Mosquitoes caught and identified by morphological characteristics	**Idoani (%)**	**Idogun (%)**	**Imeri (%)**	**Total**
Anopheles gambiae complex	256 (85.4)	282 (83.4)	106 (86.8)	**644 (84.7)**
Anopheles funestus group	40 (13.4)	46 (13.6)	16 (13.2)	**102 (13.4)**
Anopheles mocheti	0 (0)	8 (2.4)	0 (0)	**8 (1.1)**
Mansonia sp	2 (0.6)	2 (0.6)	0 (0)	**4 (0.5)**
Culex sp	2 (0.6)	0 (0)	0 (0)	**2 (0.3)**
Total	**300 (39.3)**	**338 (44.6)**	**122 (16.1)**	**760 (100)**

% - Percentage

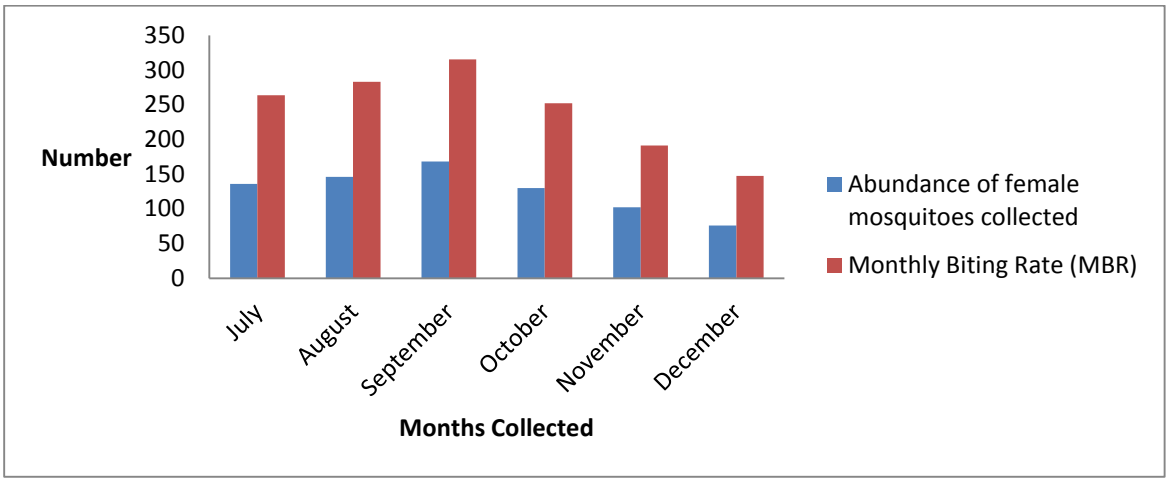

Fig 2: Abundance of female mosquitoes collected monthly and their monthly biting rate

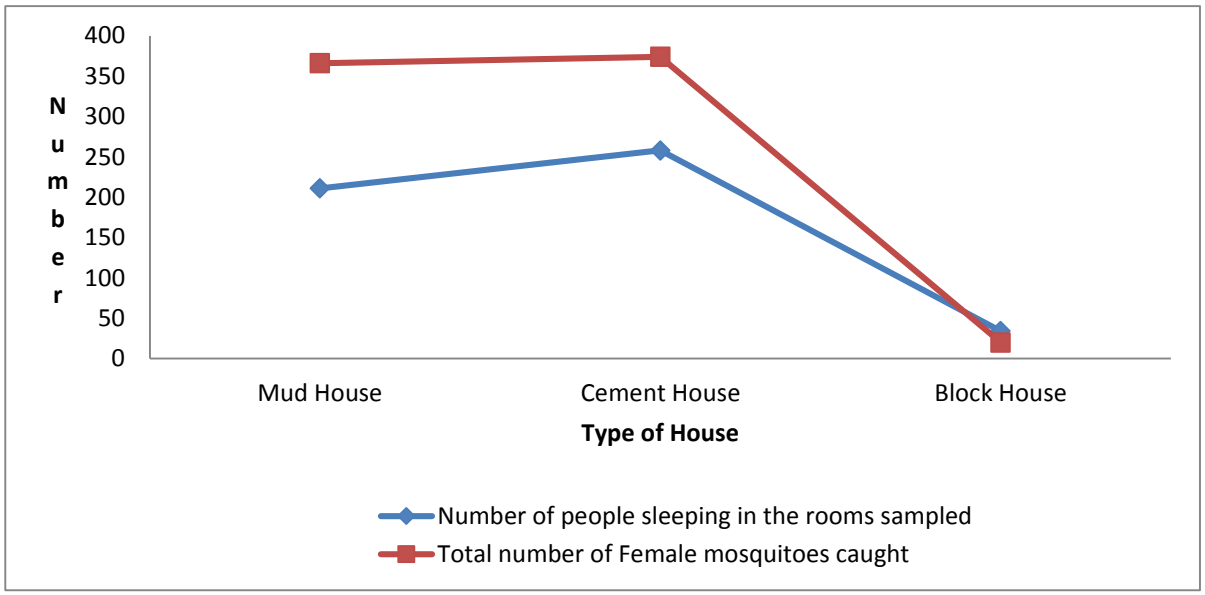

Fig 3: Distribution of mosquitoes in relation to type of house in the study area

Figure 3 below indicated that the highest numbers of female mosquitoes (374) were caught in rooms built with cement. There was no significant difference ($p>0.05$) in the abundance of mosquito species among the locations in the study area.
Table 2 indicated that 558 (73.4%) of the female mosquitoes were nulliparous. The Entomological Indices (EI) analysis as shown in Table 3 showed that IRD and HBR were 6.85 and 0.40, respectively.

Table 2: Parity and infectivity status of mosquitoes collected

House locations	Total No. of Females Dissected (%)	No. of Nulliparous Flies (%)	No. of Parous Flies (%)
Idoani	300(39.3)	222(74.5)	76(37.6)
Idogun	338(44.6)	246(72.7)	92(45.4)
Imeri	122(16.1)	90(73.7)	34(16.8)
Total	**760(100.0)**	**558(73.4)**	**202(26.6)**

*No. – Number; % - Percentage

Table 3: Indices of female *Anopheles* spp. in the study area

Indices	Study area
Number of Houses	122
Number of Houses harboring Female *Anopheles* spp.	110
% of Houses harboring Female *Anopheles* spp.	90.2%
Number of Female *Anopheles* spp. caught	754
Indoor Resting Density (IRD)	6.85
Number of people sleeping in the sampled rooms in the study area	503
Number of Blood-fed Female *Anopheles* spp.	202
Human Biting Rate (HBR)	0.40

% - Percentage

This study established the presence of three genera of mosquito species (*Anopheles* spp, *Culex* sp. and *Mansonia* sp.) in the study area. *Anopheles* spp (99.2%) was observed to be the most abundant. This may not be unconnected with the poor environmental hygiene practices which could result to availability of numerous breeding sites (small pools and

puddles) in the communities. This was lesser than the studies by Simon-Oke *et al.* (2015) and Afolabi *et al.* (2019) who reported 4 genera respectively in other parts of Ondo State. Opoku *et al*. (2005) had opined that *Anopheles* spp. is known to adapt to wider range of habitats with low nutrient status and higher oxygen levels. The presence of *Culex* sp. indicates the evolving possibility of the species into semi-urban areas with presence of behavioral adaptations of humans which include man-made polluted gutters/run offs or blocked drainages conducive sites for their breeding. The observed presence (4, 0.5%) of *Mansonia* sp. was indicative that another genus existed in the study area. Adeleke *et al.* (2010) in previous works in Abeokuta, Ogun State observed that infestations by *Mansonia* sp. are associated with poor sanitation. Other genera of mosquitos reported in other parts of Nigeria include; Coquilletidia, Aedes, Culiseta, Eretampodite, Sabethes and Toxorhynchiites (Adeleke *et al*., 2010; Amaechi *et al.*, 2014; Simon-Oke and Ayeni, 2015; Ikpeama *et al.*, 2017; Lamidi *et al.*, 2017; Afolabi *et al.*, 2019).

There was a steady rise in mosquito abundance with a peak in the month of September. This is in addition to the Monthly Biting Rate (MBR). This could probably be attributed to increase in rainfall within the period in addition to unhygienic environment which could increase the breeding sites of more mosquitoes and inadvertently affect humans. The study observed a higher number of mosquitoes in cement houses, contrary to reports of Chadee *et al.* (2012) that higher numbers of mosquitoes were recovered from poorly constructed house types. Our observations may stem from the fact that more members of the communities lived in cement houses and mosquitoes are generally attributed to the presence of blood meal, which further affirms earlier reports by Adeleke *et al*. (2010) that mosquitoes could have also been trapped indoors while searching for host after their emergence from breeding sites. House types and other factors have been found to have a profound effect in the prevalence of vector borne diseases as it is generally believed that living in the poorest houses in unhygienic environment increases the risks of being exposed to vector borne diseases (Uttah, 2013). Furthermore, Morakinyo *et al.* (2018) opined that improved housing is a promising means to support a more integrated and sustainable approach towards mosquito borne diseases.

The parity rate and age composition of female mosquitoes are paramount parameters because they reflect the epidemiological importance of physiological age in vector populations as each blood meal increases the chance of a female becoming infected with a parasite (Barbosa *et al.*, 2016). Adeleke *et al.* (2010) were of the opinion that the high number of nulliparous mosquitoes could be an indication of continuous productivity of the mosquitoes from breeding sites which supplied the study area with young mosquitoes. High populations of nulliparous mosquitoes were also reported by Okorie *et al.* (2014) in Ibadan in South-West Nigeria.

Indoor Resting Density (IRD) showed that averages of 7 mosquitoes were found in one house per night in the study area. This was higher than the IRD reported by Umar *et al.* (2015) in Bauchi, Northeastern Nigeria. The IRD which influences the vectorial role of mosquitoes in the transmission of its diseases is one of the tools used by World Health Organization in its Indoor Residual Spraying (IRS) intervention. The differences between both studies could be attributed to the differences in the study locations, availability of natural breeding sites and varying environmental factors that favors breeding such as temperature, rainfall and humidity. On the possible transmission of LF, dissections made on the mosquitoes showed that none of the mosquitoes collected were infected with microfilariae of *Wuchereria bancrofti*. However, Adekunle *et al.* (2016) had reported LF prevalence of 27% using the sero-prevalence assay method. The high presence of mosquitoes in the study area calls for stronger and effective monitoring in combating resurgence of LF.

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Competing Interests

The authors declare that they have no competing interests.

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