MOSQUITO VECTORS AND THEIR EPIDEMIOLOGICAL IMPLICATIONS IN THE VICINITIES OF OSUN STATE UNIVERSITY MAIN CAMPUS, OSOGBO, NIGERIA

Monsuru A. Adeleke*

* Public Health Entomology and Parasitology Unit, Department of Zoology, P.M.B 4494, Osun State University, Osogbo, NIGERIA. E-mail: monsuruadeleke@gmail.com

[Adeleke, M. A. 2019. Mosquito vectors and their epidemiological implications in the vicinities of Osun State University Main Campus, Osogbo, Nigeria. Munis Entomology & Zoology, 14 (1): 287-293**]**

ABSTRACT: Mosquitoes are vectors of deadly and debilitating diseases. Proper understanding of the distribution and bionomics of these insects plays an important role in planning effective control measures. The present study was therefore conducted to provide information on larval habitats and species composition of mosquito vectors within the vicinities of Osun State University Main Campus, Osogbo, Nigeria. Larval sampling within the campus and adult collections from selected ten students' hostels were carried out in the wet season over three years (2015-2017) using standard entomological protocols. Five species of mosquitoes namely, *Aedes aegypti, Ae. vittatus, Eretmapodite chrystogaster, Culex quinquefasciatus* and *Anopheles gambiae sensu lato* were found either singly or in sympatry at the breeding sites. Three hundred and twenty six (326) endophagic mosquitoes were collected at the selected hostels during the study period. Of these, 177(53.8%) were *C. quinquefasciatus* while *Ae. aegypti* 64(20.4%), *Mansonia africana* 41(12.5%), *An. gambiae* s.l 31(9.4%) and *Coquillettidia maculipennis* 13(3.95%) constituted the rest of mosquitoes collected. The population of *C. quinquefasciatus* was statistically higher than other mosquitoes ($p<0.05$) but the differences in abundance among other species were not statistically significant ($p>0.05$). The mosquito abundance increased as wet season progressed but the differences in monthly collection were not significant ($p>0.05$). The mosquitoes collected are known vectors of dengue fever, malaria, yellow fever and bancroftian filariasis (elephantiasis), of which the high prevalence of these diseases have been reported in Osogbo metropolis or its adjoining communities. There is therefore need for the management of Osun State University to institute periodic public health education for the students on various mosquito control and preventive measures in order to reduce the risks of mosquito-borne diseases in the study area.

KEY WORDS: Mosquitoes, larvae, diseases, epidemiology, Osogbo

Mosquitoes are the most deadly insect vectors in both tropical and temperate regions of the world. The insect transmits diseases that are known to affect both poor and rich and virtually everyone in the world is at the risk of mosquito-borne disease(s) except in Antarctic region where survival of mosquitoes appears impossible (Amusan et al., 2003; Adeleke & Onakhinor, 2017). Malaria, dengue fever, yellow fever, bancroftian filariasis, and Zika virus are few among the diseases transmitted by mosquitoes. (Idowu et al., 2012). Malaria is the leading cause of mortality mostly in sub-Saharan Africa and Nigeria, perhaps, bears the highest brunt of the disease (WHO, 2014).

It has been observed that the intensity of transmission of mosquito-borne diseases varies significantly in spatio-temporal distribution owing to several factors (Okogun et al., 2005; Adebote et al., 2011). The chief among these factors are species diversity and abundance, seasonal population dynamics, vectorial capacity and biting/feeding habits of the vectors (Mbanugo & Okpalononuju, 2003; Amusan et al., 2003). Therefore, accurate knowledge on the biology,

distribution and behaviour of local population of mosquitoes are pivotal towards planning effective mosquito control in each locality.

Until recently, information rarely exists on mosquito fauna in Osogbo metropolis (Adeleke et al., 2013). Osun State University main campus is located outskirt of Osogbo metropolis and it is hypothesized that the species composition of the mosquito vectors around the vicinities of the campus may vary temporally from those found within the metropolis. The present study was therefore conducted to provide information the mosquito vectors within the vicinities of Osun State University Main Campus, Osogbo, Nigeria for the utilization of the University management and other policy makers in planning effective measures to reduce the risks of vector borne diseases in the study area.

MATERIALS AND METHODS

Study Area

The study was conducted at the main campus of Osun State University Osogbo. The campus lies on the latitude 7^{0} 45^{1} and longitude 4^{0} 36^{1} along Oke-Baale-Ibokun Road, in the outskirt of Osogbo. The town usually experiences two seasons; wet (April–October) and dry (November-March) seasons. The campus has over four thousand students but only two hundred students in Nursing Science programme are currently accommodated in the hostel located inside the campus in line with the requirements of National Universities Commission and Nursing and Midwives Council of Nigeria.

Mosquito Larval prospection

Larval prospection was conducted during the wet season in 2015 and 2016. All potential breeding sites which include ground pools, open drains, containers and water runoffs were checked for the breeding of mosquitoes. The mosquitoes were collected with the aid of scoopers. Mosquito larvae recovered were transferred to plastic containers and kept inside the Zoology Laboratory (at 25^{o}C), in the Faculty of Basic and Applied Sciences, Osun State University, Osogbo. The larvae were allowed to emerge into adults for easy identification.

Collection of Adult mosquitoes

The only student hostel in the campus (Armorit Nursing Hostel) and other nine randomly selected hostels (outside the campus) were surveyed for endophagic adult mosquitoes. In each selected hostel, two rooms were used for weekly collection of mosquitoes. Mosquitoes were collected by spray and catch through the application of insecticidal aerosols (19 hour in the early part of the night and 6 hour in the morning) and dead mosquitoes that fell on the white clothes spread on the floor were recovered. The mosquitoes were kept inside petri dishes and transported to the Zoology laboratory for identification. The collection was done between June and August, 2017.

Identification of the mosquitoes

The mosquitoes were identified with the aid of dissecting microscope using morphological features described by Gillet (1975) and Gillies & Coetzee (1987).

Ethical consideration

Informed consent was obtained from the residents of each room used for the study after explaining the importance of the study to them before the commencement of sample collection.

Data analysis

The data were subjected to chi-square analysis to determine the differences in abundance of adult mosquitoes collected. The analysis was performed using SPSS version 17.0

RESULTS

Eight locations were prospected for larvae of mosquitoes in 2015 and 2016. Of the eight locations, only six yielded the larvae of mosquitoes. The information on locations, types of the breeding sites and mosquitoes collected were presented in Table 1. Five species of mosquitoes namely *Aedes aegypti, Ae, vittatus, Eretmapodite chrystogaster, Culex quinquefasciatus* and *Anopheles gambiae sensu lato* were found either singly or in sympatry at the breeding sites.

Three hundred and twenty six (326) endophagic mosquitoes were collected at the selected hostels during the study period. Of these, 177(53.8%) were *Cx. quinquefasciatus* while *Ae. Aegypti* 64(20.4%), *Mansonia africana* 41(12.5%), *An. gambiae* s.l. 31(9.4%) and *Coquillettidia maculipennis* 13(3.95%) constituted the rest of mosquitoes collected (Table 2). The preponderance of *C. quinquefasciatus* was statistically higher than other mosquitoes ($p<0.05$) but the differences in abundance among other species were not statistically significant ($p>0.05$). The mosquito abundance increased as wet season progressed but the differences in monthly collection were not significant ($p>0.05$). August had the highest abundance 134 (41.1%) followed by July (38.9%) and June (19.9%) (Table 2). The species distribution within the study months showed that there was increase the numbers of *C. quinquefasciatus* collected as wet season progressed but the majority of *Anopheles gambiae* s.l. were collected in June and August.

DISCUSSION

The ability of an insect vector to develop and survive in an environment is an integral part of its vectorial competence. Mosquitoes require conducive aquatic environment with necessary nutrients for the development and survival of the pre-imaginal stages of the insect (Adeleke et al., 2008). The presence and abundance of insect vectors are directly associated with disease transmission (Mbanugo & Okpalaonuju, 2003). The breeding of six species of the mosquitoes within the University premises and biting of five species of endophagic adults within, and at the adjoining residential areas to the campus showed that the environment support the survival of mosquitoes. The results of the present study compare favourably with previous report on mosquito vectors in Osogbo metropolis (Adeleke et al., 2013), albeit, with few variations. Unlike previous study which reported the preponderance of *Ae. aegypti* breeding sites, the breeding sites of *An. gambiae* s.l. dominated other species encountered during larval prospection. The occurrence of more man-made breeding sites (such as containers and discarded tyres) in the metropolis could have accounted for this variation. *Ae. aegypti* is known for his preference for man-made receptacles and tree-holes (Onyido et al., 2009; Onyido et al., 2011).

In the present survey, most of the breeding sites are ground pool/open drains which are known breeding sites of *An. gambiae* s.l. The topography and on-going construction sites in the campus permit collection of pool of water at various locations which eventually serve as breeding sites for *Anopheles* mosquitoes. The absence of *Ae. albopictus*, hitherto found in the metropolis could be due to its preference for discarded tyres as breeding sites (Mbanugo & Okpalononuju, 2003). Contrary to the scenarios found in Osogbo metropolis, only one discarded tyre was found in the campus harbouring mosquito vectors. *Aedes albopictus* has been known to thrive explosively in areas where used tyres contribute significantly to the breeding of mosquitoes (Reyes-Villanueva et al., 2013) as the

species was presumed to have been transported from Asia and America to Nigeria through 'second -hand' tyre trading (Mbanugo & Okpalononuju, 2003).

Despite the wide occurrence of the breeding sites of *An. gambiae* s.l., the adult population caught indoor was significantly lower than *C. quinquefasciatus*. The reasons accounting for this variation could be premised on two factors; namely sex ratio of emerging adults and survival/longevity of *An. gambiae* s.l. in the environment. It has been reported that more males than females do emerge from the breeding sites (Mbanugo & Okpalononuju, 2003). Moreover, *C. quinquefasciatus* is known to breed in confined areas such as soak-away pits and wells which are not easily accessible during larval sampling (Adeleke et al., 2008). The relatively high number of *Ae. aegypti* caught indoor is interesting as the species is known for its endophilic and nocturnal biting behaviour (Gillet, 1972; Service, 1999). The fact that the sampling was done in the early hour of dusk could have accounted for the results obtained. *Aedes* mosquitoes are nocturnal but their biting could still be experienced up to 18- 19 hour of the day (Service, 1989). Similar results have also been reported in Abeokuta and Lagos (Amusan et al., 2003; Adeoye et al., 2012). The variation in the abundance of the mosquitoes during the period of the study may be attributed to the abundance of rainfall. Heavy rainfall does wash away the breeding sites of *Anopheles* and other ground pool breeding mosquitoes (Adeleke et al., 2010).

It is important to stress that all the mosquitoes collected in both larval and adult sampling (with exception of *Eretmapodite* species) are efficient vectors of many deadly and debilitating tropical diseases. Therefore, the results of the present study have serious epidemiological/public health implications on the humans living inside the campus and adjoining hostels. Apart from malaria that is ranked as most deadly tropical disease in Africa, *An. gambiae* s.l has been described as most efficient transmitter of elephantiasis, a debilitating disease caused by a filarial nematode, *Wuchereria bancrofti* in many rural communities in Africa (Ukpai & Eluwa, 2010). *Culex quinquefasciatus* and *M. africanus* are also known to be important in the transmission of elephantiasis in urban area. Osun State University main campus is situated on the outskirts of Osogbo and share boundaries with many rural communities. According to the report of Federal Ministry of Health (unpublished survey reports for 2016 and 2017 but available at the State Ministry of Health, Abere, Osogbo), many communities in Osun State are endemic for elephantiasis and annual treatment with Albendazole combined with ivermectin/paraziquantel has commenced in Osun Central Senatorial district for the control of the infection. Osogbo Local Government (where the campus is located) and Egbeda village (about 2 kilometre to the campus along Osogbo-Ibokun road) are endemic for elephantiasis. Going by the proximity of the campus to endemic communities, and the biting of *An. gambiae* s.l., *C. quinquefasciatus,* and *M. africanus* in the campus and the adjoining hostels, it could be epidemiologically expressed that the residents of the study area are at risk of malaria and elephantiasis.

Without prejudice to history, only yellow fever is known in Africa whereas dengue fever is regarded as alien to the region (Fagbami et al., 1977; Amarasinghe et al., 2011). Dengue fever is known to be prevalent in Asian countries and later in Latin and North America through tyre trading (Reyes-Villanueva et al., 2013). The infection is efficiently vectored by *Ae. aegypti* and *Ae. albopictus* (Mohapatra et al., 2012) while other *Aedes* species serve as secondary vectors. Recent studies in Nigeria showed that the antibody of dengue fever is currently circulating in many states (Baba et al., 2009, 2013; Faneye et al., 2013). A survey of the viral infection among febrile patients in Osogbo metropolis in 2015 (Adeleke et al., 2016)

reported high prevalence of IgG antibody in the participants. A follow up study in 2017 based on IgM antibody also confirmed ongoing circulation of dengue virus among the blood donors in Osogbo metropolis (Muhibi et al., 2017). The ability of the *Aedes* mosquitoes to harbour and transmit dengue virus through ovarian infectivity is one the channels that is worsening the episode of mortality due to dengue epidemics (Reyes-Villanueva et al., 2013). Even though, there are ongoing efforts to understand the mode of development and transmission of dengue virus by *Aedes* mosquitoes in Osogbo and its environs, the fact that the virus is currently circulating in the metropolis and the vectors are readily available at the study area suggest that the residents within and outside the campus are at the risk of dengue infection.

It has been argued in the past that most of the cases of failed malaria treatment in the hospitals may not be totally due to the drug failure but as a result of co-morbidity of malaria and dengue fever (Adeleke et al., 2015). The argument was premised on the fact about 33% of febrile patients are co-infected by both dengue fever and malaria in Osogbo. A further genetic and molecular study on the presence of artemisin-resistant genes in Osogbo metropolis showed that none of the *Plamsodium falciparum* circulating among the febrile patients possessed resistant genes (Nassar et al., 2016). It, therefore, becomes imperative for the inclusion of screening for dengue fever in presumptive cases of drug failures in the management of malaria and dengue fever in the metropolis.

CONCLUSION AND RECOMMENDATION

In conclusion, the present study has documented information on the mosquito vectors in Osun State University Main campus and the potential public health implications. This information becomes necessary for the utilization of the University Management, policy makers in the Ministry of Health and organizations involved in the control and management of vector –borne diseases. It can therefore be recommended that the Management of Osun State University should institute periodic public health education for the students on the various mosquito control/preventive measures. This will be apt in reducing man-vector contact and the resources to be channelled in the management of mosquito-borne diseases by the students and the University Management.

ACKNOWLEDGEMENT

The Author thanks Miss Joseph, J.I and other field scientists who assisted during this study.

LITERATURE CITED

Adeboote, D. A., Kogi, E., Oniye, S. J. & Akoye, F. 2011. Epidemiological significance of the breeding of mosquitoes in discarded automobile tyres in Zaria, Northern Nigeria. Journal of Communicable Diseases, 43 (3): 183-192.

Adeleke, M. A., Mafiana, C. F., Idowu, A. B., Adekunle, M. F. & Sam-Wobo, S. O. 2008. Mosquito larval habitats and public health implication in Abeokuta, Ogun State, Nigeria. Tanzania Journal of Health Research, 10 (2): 103-107.

Adeleke, M. A., Mafiana, C. F., Idowu, A. B., Sam-Wobo, S. O. & Idowu, O. A. 2010. Population dynamics of indoor sampled mosquitoes and their implication in disease transmission in Abeokuta, South- Western Nigeria. Journal of Vector Borne Diseases, 47: 33-38.

Adeleke, M. A., Adebimpe, W. O., Hassan, A. O., Oladejo, S. O., Olaoye, I., Olatunde, G. O. & Adewole, T. 2013. Larval habitats of mosquito fauna in Osogbo metropolis, South-Western Nigeria. Asian Pacific Journal of Tropical Biomedicine, 3 (9): 673-677.

Adeleke, M. A., Muibi, M. A., Ajayi, E. I. O., Idowu, O. A., Famodimu, M. T., Olaniyan, S. O. & Hassan, A. N. 2016. Dengue virus specific immunoglobin G Antibodies among patients with febrile conditions in Osogbo, Southwestern Nigeria. Tropical Biomedicine, 33 (2): 1-6.

Amarasinghe, A., Kuritsk, J. N., Letson, G. W. & Margolis, H. S. 2011. Dengue virus infection in Africa. Emerging Infectious Diseases, 17 (8): 1349-54.

Amusan, A. A. S., Mafiana, C. F., Idowu, A. B. & Oke, O. A. 2003. A survey of adult mosquitoes in the hostels of the University of Agriculture, Abeokuta, Ogun State, Nigeria. Nigeria Journal of Parasitology, 24: 167-172.
Baba, M. M., Marie-Francois, S., Vornadam, A. V., Adeniji, J. A., Diop, O. & Olaleye, D. 2009. Dengue virus infections in patients suspected of malaria/typhoid in Nigeria. Journal of American Science, 5 (5): 129-134.
Baba, M., Louge, C. H., Oderinde, B., Abdul Maleek, H., Williams, J., Lewis, J., Laws, T. R., Hewson, R., Alessandro, M. & Diagro, P. 2013. Evidence of arbovirus co-infection in suspected febrile malaria and typhoid patients in Nigeria. Journal for infections in Developing Countries, 7 (1): 51-59.
Fagbami A. H., Monath T. P. & Fabiyi, A. 1977. Dengue virus infections in Nigeria: a survey for antibodies in monkeys and humans. Trans. R. Soc. Trop. Med. Hyg., 71: 60-65.
Faneye, A., Idika, N., Motayo, B. O., Adesanmi, A. & Afocha, E. 2013. Serelogical evidence of recent dengue virus infection among febrile children in a Semi-arid zone.
Gillet, J. D. 1972. Common African mosquitoes and their medical importance. William Heinemann Medical Books Limited, London. 189 pp.
Idowu, O. A., Adeleke, M. A. & Aina, T. M. 2012. Assessment of indoor breeding activities of mosquitoes during the dry season in Abeokuta, southwestern/ Nigeria. Journal of Environmental Health Research, 12 (1): 25-30.
Mbanugo, J. I. & Okpalononuju, C. N. 2003. Surveillance of Mosquito Vectors in some habitats of Akwa Metropolis, Anambra, Nigeria. Nigerian journal of Parasitology, 24: 185-190.
Mohapatra, M. K., Patra, P. & Agrawala, R. 2012. Manifestation and outcome of concurrent malaria and dengue infection. Journal of Vector Borne Diseases, 49 (4): 262-265.
Muhibi, M. A., Adeleke, M. A., Shittu, B. T. & Jeremiah, Z. A. 2017. Dengue virus infection among blood donors in Osogbo, Southwestern Nigeria. American Journal of Biomedical Sciences, 9 (3): 113-118.
Nassar, A. S., Alao, M., Ekpo, O., Adeleke, M. & Muibi, M. A. 2016. Artemisinin resistance marker of *Plasmodium falciparum* in Osogbo Metropolis, Southwest Nigeria. Nigerian Journal of Parasitology, 37 (2): 257-260.
Okogun, G. R. A., Anosike, J. C., Okere, A. N. & Nwoke, B. E. B. 2005. Ecology of mosquitoes of Nigeria. Journal of Vector Borne Diseases, 42: 1-8.
Onyido, A. E., Ozumba, N. A., Ezike, V. I., Nwosu, E. O., Amadi, E. S., Obiukwu, M. O., Chukwukezie, O. C. & Umeanaeto, P. U. 2011. Breeding and biting activities of yellow fever mosquitoes in two urban communities with dilapidating infrastructures. Nature and Science, 9 (9): 93-98.
Onyido, A. E., Ezike, V. I., Ozumba, N. A., Nwawkwo, A. C. N. & Nwosu, E. O. 2009. Breeding of *Aedesalbopictus*Skuse (Diptera: Culicidae) in water-holding containers around residential houses in Enugu, southeastern Nigeria. Nig. J. Parasitol., 30 (1): 15-19.
Reyes-Villanueva, F., Garza-Herdandez, J. A., Garcia-Munguia, A. M., Howard, A. F. V., Ortega-Morales., A. I., Adeleke, M. A. & Rodriguez-Perez, M. A. 2013. *Aedes albopictus* in northeast Mexico: update on adult distribution and first report of parasitism by *Ascogregaria taiwanensis*. Journal of Vector borne Diseases, 50 (3): 1-4.
Service, M. W. 1999. A Guide To Medical Entomology. Macmillian Press Ltd.,London, 189 pp.
Ukpai, O. M. & Eluwa, M. C. 2010. Lymphatic filariasis (LF) *Aedes albopictus*: a new entrant. The Zoologist, 8: 1-4.

Table 1. Larval prospection of potential breeding sites of mosquitoes at the main campus of Osun State University, Osogbo.

Locations	Types of breeding sites	Species of mosquitoes collected	Period of survey
Beside Faculty of Engineering building	Ground pool Plastic containers	*Anopheles gambiae* s.l. *Aedes aegypti* *Ae. vittatus*	2015 2016
Adjacent ATM stand	Ground pool	*An. gambiae* s.l.	2015
Beside College of Science, Engineering and Technology building	Ground pool	*An. gambiae* s.l. *Culex quinquefasciatus*	2015, 2016
Armorit Hostel (Nursing hostel)	Ground pool	*Anopheles gambiae* s.l.	2015

Mini Animal House, College of Health Sciences Laboratory Complex	Run-off	*Ae. aegypti* *Culex quinquefasciatus*	2015, 2016
Adjacent Administrative block	Discarded Tyres and iron roofing sheet	*Ae. aegypti* *Eretmapodite chrysogaster*	2016
Cafeteria block (up town)	Ground pool	None	2015, 2016
Beside UNIOSUN water factory	Ground pool	None	2015, 2016

Table 2. Species composition and relative abundance of adult mosquitoes at the student hostels within and outside the campus of Osun State University, Osogbo.

Mosquito species	Total collected	Percentage of abundance
Anopheles gambiae s.l.	31	9.4%
Mansonia africana	41	12.5%
Aedes aegypti	64	20.4%
Culex quinquefasciatus	177	53.8%
Coquillettidia maculipennis	13	3.95%
Total	326	100%

Table 3. Monthly abundance of adult mosquitoes at the student hostels between June and August, 2017.

Mosquito species	JUNE	JULY	AUGUST	TOTAL
Anopheles gambiae s.l.	15	1	14	31
Mansonia africana	7	30	4	41
Aedes aegypti	1	48	15	64
Culex quinquefasciatus	38	46	94	177
Coquillettidia maculipennis	4	2	7	13
Total	65 (19.9%)	127 (38.9%)	134 (41.1%)	326