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Full Length Research Article

SPECIES COMPOSITION OF MAN-BITING MOSQUITOES IN A STUDENTS POPULATED COMMUNITY IN ANAMBRA STATE

[1*]Irikannu, K. C., Ogbunude, M. C., and Agu, J. C.

[1]Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka

*** Corresponding author:** kc.irikannu@unizik.edu.ng

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Abstract

Mosquitoes are vectors of parasitic diseases among humans and animals. A survey of man-biting adult mosquitoes' species was conducted in Ifite Awka, Anambra State, to determine their distribution, abundance, physiological state and biting time. The outdoor and indoor biting mosquitoes were collected by human bait collection and pyrethrum-based insecticide knockdown methods respectively. Five human volunteers were involved in the outdoor collection and Raid® a pyrethroid-based insecticide was used in the indoor collection. Data collected were analysed using descriptive statistics and Chi-square tests. The 117 adult mosquitoes collected indoors comprised: 111(94.9%) *Culex quinquefasciatus* and 6(5.1%) *Anopheles gambiae* ($p<0.05$). Of the total indoor collection, 47(40.17%) were unfed, 19(16.24%) were freshly fed, 30(25.64%) were half gravid and 21(17.95%) were gravid ($p>0.05$). The 105 adult mosquitoes collected outdoors had *Culex quinquefasciatus* (88.6%; n = 93) as the most abundant, while *Aedes aegypti* and *Mansonia africana* both were collected in equal numbers 6(5.7%) each ($p<0.05$). The adult mosquitoes were collected during twilight hour between 5:00pm-8:00pm. *M. africana* biting peak was between 5.00pm and 5:15pm, *Ae. aegypti* between 5:45pm and 6:00pm, while *C. quinquefasciatus* peaked between 7:45pm and 8:00pm. This study revealed that mosquitoes earlier incriminated as vectors of certain parasitic diseases are biting both indoor and outdoor in the study area. Integrated vector control is recommended to curtail the biting nuisance of the mosquito vectors in the study area.

Keywords: Mosquitoes, Man-biting species, *Culex quinquefasciatus*, *Aedes aegypti*, *Mansonia africana,*

Introduction

Mosquitoes are well known vectors of human pathogens, including parasites and arboviruses. They are considered to be the main vectors of killer diseases such as

malaria, rift valley fever, dengue haemorrhagic fever, yellow fever, west Nile fever and chikungunya fever (Kabochi *et al.*, 2020; Tchankovo-Nguetcheu *et al.*, 2012). Mosquitoes have worldwide distribution and are found in both tropics and temperate regions of the world. Mosquito species belonging to some genera such as *Anopheles, Culex, Aedes* and *Mansonia* are common in the tropics or warm climate and lay their eggs on the open surface of all sorts of both permanent and temporary water collections or attach them to some partially submerged objects depending on the species (Onyido *et al.*, 2016; Egbuche *et al.,* 2019).

More than three thousand, five hundred mosquito species are distributed all over the world in a great variety of environment and most are found in the tropical and sub-tropical regions of the world with Nigeria inclusive. Certain mosquito species have innate preference for certain hosts. Some mosquitoes, such as *Anopheles gambiae* and *Aedes aegypti,* are considered to exhibit strong and consistent preferences for feeding on humans in both laboratory and fields contexts (Bride, 2016). Several of these species has been reported by various studies in Nigeria (Onwuzulike *et al*., 2021a; Onwuzulike *et al*., 2021b; Ikpo *et al*., 2021a; Ikpo *et al*., 2021b; Egbuche *et al.,* 2021; Egbuche *et al*., 2020 and Umeanaeto *et al*., 2017).

A lot of factors such as climate, vegetation cover and human ecology greatly influence mosquito distribution (Lawal *et al*., 2012; Egbuche *et al.,* 2020). Activities of mosquito vary from species to species. Some species are diurnal and others are nocturnal while many others are crepuscular mosquitoes' feeding behavior and breeding places are dependent on temperature, some mosquitoes are attracted to host with their choices, for example odour of skin, temperature, moisture or visual cues (Attaullah *et al.,* 2023). The objective of this study was to determine the composition of mosquito species, their distribution, biting time, resting behavior and the physiological state of indoor and outdoor man-biting mosquitoes in a student populated community of Anambra state.

MATERIALS AND METHODS

Study Area

The study was conducted in Ifite Awka in Anambra State, Nigeria. The area has commercial houses and hostels housing thousands of students attending Nnamdi Azikiwe University, Awka which is also located within the same community. The area has several business establishments and activities which keeps people outdoors both day and night. Ifite Awka is located within geographical coordinates 6° 12′ 21″ N to 6° 18′ 89″ N latitude and 7° 2′ 24″ E to 7° 7′ 09″ E longitude. The average annual rainfall of the area is around 2000mm, which experiences a tropical climate with wet and dry seasons. The average annual temperature range of the area is between 25-31°C.

Study Design

The study is a cross-sectional survey of adult mosquitoes species composition and their physiological state in systematically selected houses and environment within Ifite Awka community. The study was conducted between May - June, 2025.

Ethical Consideration and Advocacy Visits

Prior to the study, an advocacy visits were made to the study community with an introductory letter from the head of the department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka. Occupants of houses marked for mosquito sampling were sensitized about the project. Their consents were obtained for the use of their environment for the study.

Collection of Indoor Man-Biting and Resting Mosquitoes Species

Indoor biting and resting adult mosquitoes were collected from the community using pyrethroid-based insecticide knock down (PKD) collection method as described by Onyido *et al* (2016). The adult mosquitoes were collected from living rooms where people sleep each night. Collection was done from 6:00am-8:00am (local time). A pyrethroid-based insecticide aerosol, Raid® was sprayed in the rooms after spreading white sheets of cloth on every flat surfaces within the room. At the end of the 20 minutes after spraying, the white spread sheets earlier laid on the floor, were folded starting from the edges to ensure that no knocked down mosquito escaped. It was taken outside and spread out again to collect the knocked down mosquitoes using a pair of entomological forceps into damp-petri dishes.

Physiological State of the Indoor Man-Biting Mosquitoes Species

The physiological states of female mosquitoes collected indoors was determined in order to observe mosquitoes that had blood meal and those that had not fed. The mosquitoes were grouped into four categories; unfed, freshly fed, half gravid and gravid (Service, 1985).

Collection of Outdoor Man-Biting Mosquitoes Species

Outdoor man-biting mosquitoes were collected using human-bait collection (HBC) method as described by Onyido *et al*., (2016). The collections were done quarter-hourly for two nights from 5:00pm-8:00pm (local time). Five human volunteers previously vaccinated for yellow fever were involved in the collections. While sitting down, the volunteers rolled up the sleeves of their shirts and pairs of trousers to expose the hands and legs to mosquitoes. The volunteers sat some distances away from each other. They continuously searched for mosquitoes alighting on their bodies to take bloodmeals. The mosquitoes were then collected with a test-tube vial and sealed with a ball of cotton wool. The time of each collection was recorded and grouped into quarter-hourly collections.

Morphological Identification of the Mosquitoes collected

At the end of each collection period, all the mosquitoes collected were properly labelled and sent to the Laboratory unit of the Department of Parasitology and Entomology, Nnamdi Azikiwe University Awka for identification. The mosquitoes were identified using the gross morphology of the species especially the body colour, patches of scales on the palps, antennae, proboscis, patches of pale and black scales on the wings and legs and the terminal abdominal segments using standard keys (Gillies and De Meillon, 1968; Gillet, 1972).

Data Analysis

Data collected from the study were presented in Tables using descriptive statistics such as percentages and line graphs. Test of statistical significance was conducted using SPSS Version 25.0, and at 5 % level of significance. Chi-square (χ^2) goodness of fit test was used to compare the relative abundance of the mosquito species collected in each of indoor and outdoor survey. Chi-square (χ^2) test of proportion was used to compare the proportions of the two indoor mosquitoes that were at least fed.

Results

Of the 117(100%) adult female mosquitoes collected indoors, *C. quinquefasciatus* 111(94.9%) was the most abundance while *Anopheles gambiae* was the least 6(5.1%) (Table 1). There was a significant difference in the relative abundance of the two mosquito species collected indoor ($\chi^2 = 94.231$, $df = 1$, $p = 0.000$)

Table 1: Abundance of indoor man-biting mosquitoes in the study area

Mosquito Species	Number collected	Relative Abundance
Culex quinquifasciatus	111	94.9%
Anopheles gambiae	6	5.1%
Total	117	100%

Of the total collection, 47(40.17%) were unfed, 19(16.24%) were freshly fed, 30(25.64%) were half gravid and 21(17.95%) were gravid (Table 2.). The proportion of *An. gambiae* that at least had blood meal (fed to half gravid state) was 83.33% (n = 5) whereas that of *C. quinquefasciatus* was 58.56% (n = 65). However, the difference in the proportion of mosquitoes in 'at least fed state' between the two species identified indoors was not statistically significant (χ^2 = 1.454, *df* = 1, p = 0.228).

Table 2: Abdominal grading of indoor man-biting adult mosquito collected to determine their physiological state.

Mosquito species	Physiological state				Total (%)
	Unfed (%)	Freshly fed (%)	Half gravid (%)	Gravid (%)	
An. gambiae	1(16.67)	4(66.67)	1(16.67)	0(0.00)	6(5.13)
C. quinquefasciatus	46(41.44)	15(13.5)	29(26.13)	21(18.92)	111(94.87)
Total	47(40.17)	19(16.24)	30(25.64)	21(17.95)	117(100.00)

A total of 105(100%) adult mosquitoes were collected outdoors. *C. quinquefasciatus* 93(88.6%) was the most abundance, while *Ae. aegypti* and *M. africana* both were collected in equal numbers 6(5.7%) each (Table 3). There was a significant difference in the relative abundance of the three mosquito species collected outdoor (χ^2 = 144.171, *df* = 2, p = 0.000)

Table 3: Abundance of outdoor man-biting mosquito species in the study area

Mosquito Species	Number collected	Relative Abundance
Culex quinquefasciatus	93	88.6%
Aedes aegypti	6	5.7%
Mansonia africana	6	5.7%
Total	105	100

The quarter-hourly biting pattern of adult mosquitoes collected outdoors were recorded. The adult mosquitoes were collected during twilight hour between 5:00pm-8:00pm. *M. africana* biting peak was between 5.00pm and 5:15pm, *Ae. aegypti* between 5:45pm and 6:00pm, while *C. quinquefasciatus* peaked between 7:45pm and 8:00pm (Figure 1).

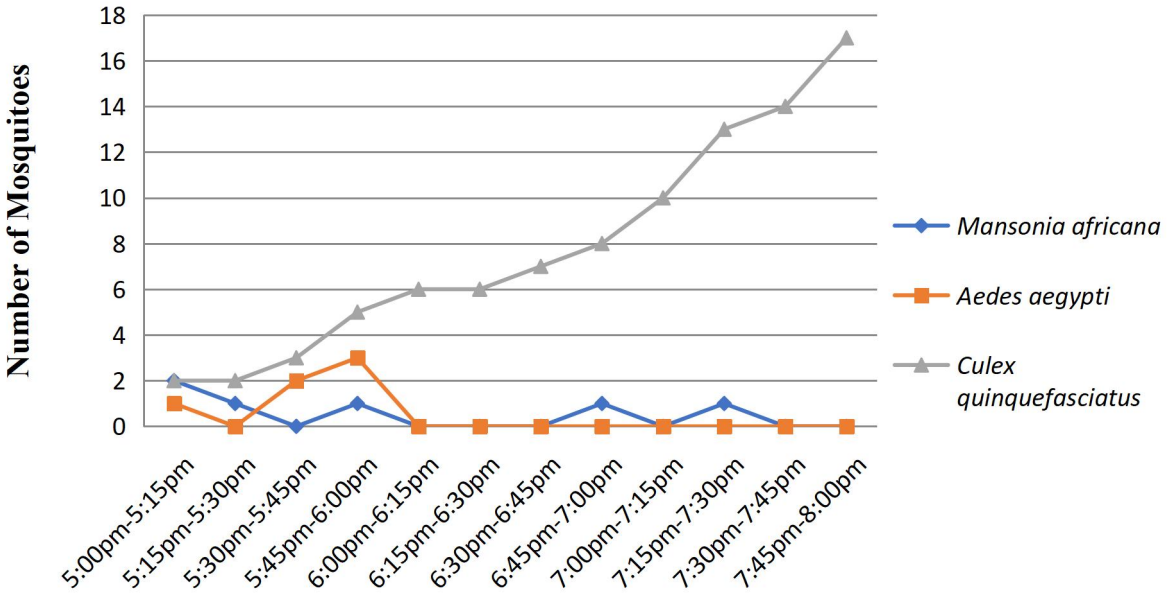


Figure 1: Quarter-hourly collection of outdoor man-biting and resting mosquito species in Ifite, Awka South L.G.A, Anambra State.

Discussion

In this study, only two species of mosquitoes namely: *C. quinquefasciatus* and *An. gambiae* were collected indoors, with *C. quinquefasciatus* being significantly higher in abundance. These observed indoor species of mosquitoes are known vectors of parasitic diseases and have been reported in some other studies. However, Egbuche *et al.,* (2021) reported higher abundance of *An. gambiae* than *C. quinquefasciatus,* among species of mosquitoes collected indoors. Our findings corroborate with Ogbuefi *et al.* (2023) who reported that *C. quinquefasciatus* has a high survival and fecundity rate and as such usually outnumber other species in population in their study. Ifejika *et al.* (2025) reported that both *C. quinquefasciatus* and *An. gambiae* bite humans both indoors and outdoors in other communities. Both species have also been reported biting indoor in Amansea, Ebenebe and Awka communities (Onwuzulike *et al*., 2021a), while Egbuche *et al.* (2020) reported *An. gambiae* in Aguleri, Igbariam and Nsugbe all in Anambra State. These reports shows that these mosquito species are wide spread in their activities in various communities in the same proximity with our study area.

Out of the total number mosquitoes collected indoors, 40.17% were unfed, while 16.24% were freshly fed, others were either half gravid or gravid. This contrast another observation in a similar study near the study area where unfed mosquitoes recorded were 28.64% while freshly fed were 42.70%. (Irikannu *et al*., 2022). The observation of freshly fed indoor biting mosquitoes in the study indicates that, when infected, the vectors can effectively transmit pathogens to their victims during sleep (Onwuzulike *et al*., 2021b; Irikannu *et al*., 2020). This will be more concerning if many in the community do not utilize insecticide treated mosquito nets and other forms of protection against the vectors.

Three mosquito species were collected outdoors. These include *C. quinquefasciatus* (88.6%) which was the most abundance. *Ae. aegypti* and *M. africana* were collected in equal population (5.7%) each. Other studies equally reported that, among individual

species, *C. quinquefasciatus* recorded the highest diversity and dominance values, followed by *Ae. aegypti* (Ifejika *et al*., 2025). In a different ecological setting, Egbuche *et al.,* (2021) reported *Mansonia uniformis,* followed by *Mansonia africana* as the most abundant mosquito species outdoor. The preponderance of proven mosquito vectors species of public health diseases such as *C. quinquefasciatus, Ae. aegypti* and *M. africana* in the community indicates that the community is exposed to a variety of mosquito bites and perhaps mosquito-borne diseases (Ekesiobi, 2025). The mosquitoes biting outdoor portend more dangers since most do not protect themselves against these vectors unless indoors at bedtime. It can be seen from our study that *C. quinquefasciatus* dominated both indoor and outdoor mosquito collections.

In the quarter-hourly biting pattern of adult mosquitoes collected outdoors in the twilight, *C. quinquefasciatus* had a biting peak between 7:45pm and 8:00pm, *M. africana* peaked between 5.00pm and 5:15pm while *Ae. aegypti* was between 5:45pm and 6:00pm. Irikannu *et al*. (2022) made similar observation in another study, where they reported that, *Ae. aegypti* had their peaks around the same time in Nteje, Anambra State. In contrast to our current findings, Ogbuefi *et al*. (2023) reported the biting peak of *M. africana* to be between 7:45pm to 8:00pm in the same study area, although they did not collect *Ae. aegypti*. It has been reported that an accurate knowledge of the biting time of mosquitoes is very crucial for the vector control and their diseases management (Ogbuefi *et al*., 2024).

Conclusion

A total of four mosquito species namely; *An. gambiae*, *Ae. aegypti*, *C. quinquefasciatus* and *M. africana* belonging to different genera were collected in the study. These mosquito species were earlier incriminated in different studies as vectors of various parasitic diseases such as malaria and lymphatic filariasis. Since they cause biting nuisance to humans both indoors and outdoors, they may be actively involved in disease transmission in the study area. Further investigation on their disease transmission activities in Ifite community is highly recommended. Integrated vector control is also recommended to curtail their biting nuisance and possible disease transmission.

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