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Mosquito species composition in Nibo community, Southeastern Nigeria

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Abstract
Mosquitoes are vectors of parasitic diseases in tropical regions of the world including Nigeria. This study investigated mosquito species prevalence in Nibo, Awka South Local Government Area, Anambra State, Nigeria. A cross-sectional survey was conducted between December 2025 to May 2026, spanning through the dry and wet seasons. Adult mosquitoes were sampled outdoors through Human Bait Collection (HBC), and indoors through Pyrethrum Knockdown Collection (HBC) methods. The vectors were identified morphologically using standard taxonomic keys. Data collected were analysed using descriptive statistics and Chi-square. A total 964 adult mosquitoes were collected in the study. Out of this number, 156 were collected outdoors during dry season. In the dry season outdoor collection, *Culex quinquefasciatus* 84(53.85%) was the most abundant. Others were; *Anopheles gambiae* 42(26.92%), and *Aedes aegypti* 30(19.23%). There was a significant association between the number of outdoor biting mosquito species collected during dry season (P<0.05; 0.000). Also, during the dry season, 180 adult mosquitoes were collected indoors. *C. quinquefasciatus* was the most abundant 133(73.89%), followed by *Ae. aegypti* 43(23.89%) and *An. gambiae* 4(2.22%). During the wet season, 273 mosquitoes were collected outdoors. Among them, *Ae. aegypti* was the most abundant species 108(39.56%), followed by *An. gambiae* 106(38.82%), and *C. quinquefasciatus* 59(21.61%). There was no significant association between the number of outdoor biting mosquito species collected during wet season (P>0.05; 0.596). During the wet season also, 355 mosquitoes were collected indoors. Of these, *An. gambiae* was the most abundant species 161(45.35%). Others were; *Ae. aegypti* 103(29.01%), and *C. quinquefasciatus* 91(25.63%). This study confirms the proliferation of mosquito vector species known as pathogen transmitters in the study area. Control measures targeted at the vectors, along with environmental sanitation and health education is recommended for the community.

Keywords: Mosquitoes, VECTORS, *Anopheles gambiae*, *Culex quinquefasciatus*, Nibo

Introduction
Mosquito vectors are an important epidemiological factor in the transmission of mosquito borne diseases in the tropics (Jafaru *et al*, 2025; Onwuzulike *et al*., 2021a). Mosquito-borne diseases are major health problems in Nigeria and other sub-Saharan Africa (Umeanaeto *et al*., 2017) [25]. Malaria is one of the most life-threatening parasitic diseases transmitted by mosquitoes, with huge resources spent in affected regions of the world for its control (Onyebueke *et al*., 2021) [23]. Apart from malaria, other mosquito-borne diseases such as yellow fever, dengue, Zika, chikunguya and west Nile virus have also accounted for huge economic losses, social disgrace, low productivity and sleeplessness among affected people (Lasisi *et al*., 2026; Umeanaeto *et al*., 2017 [16, 25]; Anosike *et al*., 2003).
Anopheles mosquito species has been reported to act as the vectors of malaria parasites. *An. gambiae* and *An. funestus* amongst others, when infected with sporozoites of malaria parasites can transmit them from one human to another (Onwuzulike *et al*. 2021b; Irikannu *et al*., 2019; Egbuche *et al*., 2020) [5, 11, 23]. Other mosquito species belonging to other genera such as *Aedes*, *Culex*, and *Toxorynchites* transmitting other diseases has also been reported in some studies (Okonkwo *et al*., 2014; Onyido *et al*., 2016) [20, 24]. In Nigeria, the most common species among these genera include; *Ae. agypti*, *Ae. albopictus*, *Ae. africanus*, *C. quinquefasciatus*, *C. tigripes*, *C. nigripalpus*, and *Toxorynchites viridibasis* (Irikannu *et al*., 2022; Irikannu *et al*., 2023; Okonkwo *et al*., 2014) [13, 14, 20].
These mosquitoes breed in various sites around human habitations and from there they emerge into adults to bite humans in their homes (Aribodor, 2012) [4]. It has also been reported that mosquitoes' population dynamics are closely influenced by the ecological conditions of their larval habitats (Lasisi *et al*., 2026) [16]. Certain human activity such as agricultural practices including irrigation, fish farming, and the practice of storing water in containers provide suitable breeding ground for anthropophilic mosquitoes, while poor housing conditions may increase man vector contact (Ogbuefi *et al*., 2023; Amusan *et al*., 2007) [2, 18].
In Nigeria, mosquito control largely depends on the use of chemical insecticides and Long-Lasting Insecticide-Treated Nets (LLINs) according to some studies (Onyebueke *et al*., 2021; Ogbuefi *et al*., 2023) [18, 23]. However, the excessive use of insecticides for the control of mosquitoes has led to certain mosquito vector species developing resistance to most insecticides (Ikpo *et al*., 2021) [10]. To effectively design control measures for these vectors, there is need to identify the species available in a geographical area. Therefore, this study investigated the mosquito species prevalent in the study area.

Materials and Methods
Stuy Area
This study was conducted in Nibo, Awka South Local Government Area, Anambra State, Nigeria. Nibo lies approximately between latitudes 6°15'N and 6°20'N and longitudes 7°05'E and 7°10'E. The area experiences a

tropical humid climate characterized by two distinct seasons: the wet season (March-October) and the dry season (November-February). Mean annual rainfall of the area ranges from 1500mm to 2000mm with most rainfall occurring in September. Average monthly temperatures vary between 25°C and 30°C, with highest temperature being recorded in February each year. Average relative humidity ranges from 68% to 90% during the wet season and dropping to between 50% and 67% during the dry season.

Community Visit and Sensitization

The community was visited prior to the study. Intent of the study was explained to the community members and permission to conduct the work within the community was obtained from households and community heads.

Ethical Considerations and Approval

Ethical approval for the study was obtained from the Research and Ethics Committee of the Anambra State Ministry of Health (MH/PRS/1244/VOL.279).

Study Design

A cross-sectional survey was employed. The study was conducted for a period of six month (December 2025 [12] - May 2026), covering both the dry season (December-February) and wet season (March–May).

Collection of Indoor Biting Adult Mosquitoes

Indoor biting and resting adult mosquitoes were collected using pyrethroid-based insecticide knock down collection (PKC) method, as described by Onyido *et al.* (2016) [24] with a slight modification. The adult mosquitoes were collected from rooms where people slept the previous night. Behind closed doors, a white spreadsheet was used to cover the floors from end to end. A pyrethroid-based insecticide was then sprayed in the room and allowed to remain for 15 minutes. The white spread sheets were folded and taken outside to collect the knocked down mosquitoes using a pair of entomological forceps into a damped petri dish.

Collection of Outdoor Biting Mosquitoes

Adult mosquitoes were was also collected outdoors using human-bait collection (HBC) method according to Onyido *et al*. (2016) [24]. The mosquitoes were collected between 4.00pm-8.00pm. The previously vaccinated volunteer collectors exposed their legs and hands for mosquito landing. Mosquitoes alighting on the volunteers were collected with the aid of test tube vials. The time of collection of each mosquito was properly recorded at 15 minutes interval.

Morphological Identification of Mosquitoes

Mosquito species identification was performed using standard taxonomic keys described in Gillies and De Meillon (1968) [9] and Gillet (1972) [8].

Data Analysis

Data collected from the study was presented with descriptive statistics such as percentages. Tables and graphs were used to present data. Analysis of variance and Chi-square was conducted where appropriate, using statistical package for social science (SPSS) software.

Results

A total of 964 adult mosquitoes were collected. A total of 156 of the adult mosquitoes were collected outdoors during the dry season. *C. quinquefasciatus* 84(53.85%) was the most abundant species. Others were *An. gambiae* 42(26.92%), and *Ae. aegypti* 30(19.23%) [Table 1]. There was a significant association between the number of outdoor biting mosquito species collected in the four villages during dry season (P<0.05; 0.000).

Table 1: Outdoor Biting Mosquito Species Collected in Nibo During the Dry Season

Mosquito species / **Villages**	***Anopheles gambiae (%)***	***Culex quinquefasciatus (%)***	***Aedes aegypti (%)***	**Total (%)**
Umuanum	15 (20.83)	36(50.00)	21(29.17)	72(46.15)
Ezeoye	0(0.00)	9(60.00)	6(40.00)	15(9.62)
Ifite	6(20.00)	24(80.00)	0(0.00)	30(19.23)
Umuenechi	21(53.85)	15(38.46)	3(7.69)	39(25.00)
Total	42(26.92)	84(53.85)	30(19.23)	156(100)

A total of 180 adult mosquitoes were collected indoors during the dry season. *C. quinquefasciatus* was the most abundant species 133(73.89%). Others were *Ae. aegypti* 43(23.89%) and *An. gambiae* 4(2.22%) [Table 2]. There was a significant association between the number of indoor biting mosquito species collected in the four villages during dry season (P<0.05; 0.000).

Table 2: Indoor Biting Mosquito Species Collected in Nibo During the Dry Season

Mosquito Species / **Villages**	***Anopheles gambiae (%)***	***Culex quinquefasciatus* (%)**	***Aedes agypti* (%)**	**Total (%)**
Umuanum	0 (0.00)	52(98.11)	1(1.89)	53(98.11)
Ezeoye	3 (6.00)	36(72.00)	11(22.00)	50(27.78)
Ifite	0 (0.00)	43(70.49)	18(29.51)	61(33.89)
Umuenechi	1 (6.25)	2(12.50)	13(81.25)	16(8.89)
Total	4(2.22%)	133(73.89%)	43(23.89%)	180(100%)

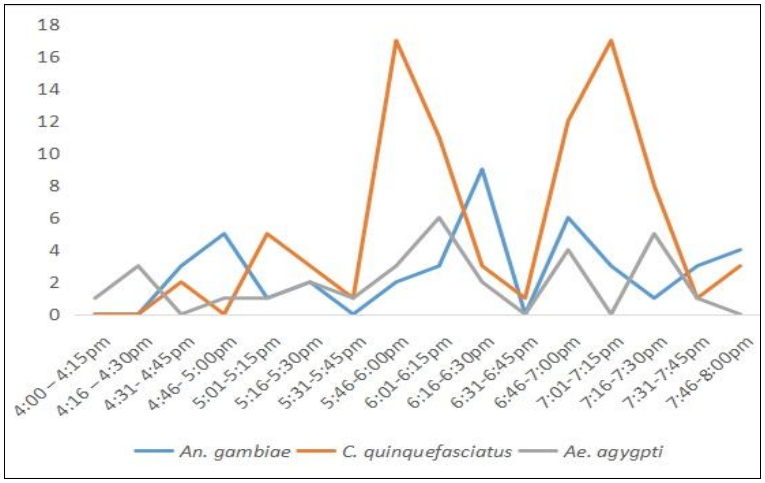

Fig 1: Outdoor Quarter-hourly Biting Pattern of Mosquitoes in Nibo During Dry Season

Figure 1 shows the landing pattern of the three, mosquito species collected outdoor during the dry season. The most abundant species, *C. quinquefasciatus* had its biting peak twice between 5:46pm-6:00pm and 7:01pm-7:15pm (Fig. 1).

During wet season, a total of 273 adult mosquitoes were collected outdoors. *Ae. aegypti* was the most abundant species 108(39.56%). Others were *An. gambiae* 106(38.82%), and *C. quinquefasciatus* 59(21.61%) [Table 3]. There was no significant association between the number of outdoor biting mosquito species collected in the four villages during wet season (P>0.05; 0.596).

Table 3: Outdoor Biting Mosquito Species Collected in Nibo During the Wet Season

Mosquito species / **Villages**	***Anopheles gambiae (%)***	***Culex quinquefasciatus (%)***	***Aedes aegypti (%)***	**Total (%)**
Umuanum	32(44.44)	14(19.44)	26(36.11)	72(26.37)
Ezeoye	29(34.52)	17(20.24)	38(45.24)	84(30.77)
Ifite	28(43.08)	14(21.54)	23(35.38)	65(23.81)
Umuenechi	17(32.69)	14(26.92)	21(40.39)	52(19.05)
Total	106(38.82)	59(21.61)	108 (39.56)	273(100)

Also, 355 adult mosquitoes were collected indoors during the wet season. *An. gambiae* was the most abundant species 161(45.35%). Others were *Ae. aegypti* 103(29.01%), and *C. quinquefasciatus* 91(25.63%) [Table 4]. There was a significant association in the number of indoor biting mosquito species collected in the four villages during wet season (P<0.05; 0.000).

Table 4: Indoor Biting Mosquito Species Collected in Nibo During the Wet Season

Mosquito Species / **Villages**	***Anopheles gambiae (%)***	***Culex quinquefasciatus (%)***	***Aedes aegypti (%)***	**Total (%)**
Umuanum	47(33.10)	39(27.47)	56(39.44)	142(40.00)
Ezeoye	33(47.14)	15(21.43)	22(31.43)	70(19.72)
Ifite	60(59.41)	23(22.77)	18(17.82)	101(28.45)
Umuenechi	21(50.00)	14(33.33)	7(16.67)	42(11.83)
Total	161(45.35)	91(25.63)	103(29.01)	355(100)

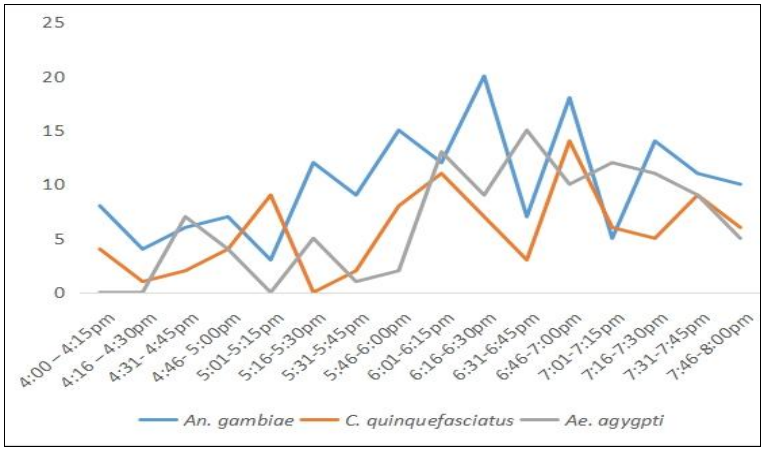

Fig 2: Outdoor Quarter-hourly Biting Pattern of Mosquitoes in Nibo Community During Wet Season

Figure 2 shows the twilight activities of mosquito species collected outdoor during the wet season. The landing pattern of all three species were overlapping each other (Fig. 2).

Discussion

A total of 964 mosquitoes were collected as adults. Other studies have reported varying population of mosquitoes in various locations. A study reported as high as 12,948 mosquito collections in Another community (Onwuzulike *et al*., 2021a). Onyido *et al.* (2016) [24] collected 1,150 mosquitoes in the current study community. Another study recorded 440 mosquitoes in Ifite, a nearby community (Ogbuefi *et al.*, 2023) [18]. Okeke *et al.* (2024) [19] also collected 440 mosquitoes within the Nnamdi Azikiwe University, Awka campus. The significant number of man-biting mosquito population collected in this study reveal the high level of biting nuisance caused by these vectors to the inhabitant of area.

The total collections included three mosquito species belonging to three genera namely; *An. gambiae*, *C. quinquefasciatus* and *Ae. Aegypti*. Alaba *et al.* (2026) [1] collected all three species in their study area in Egbeda, southwestern Nigeria. Nwabuoku *et al.* (2020) [5] also reported *An. gambiae*, *C. quinquefasciatus* and *Ae. Aegypti* in Port Harcourt metropolis, Rivers State. Ekesiobi (2025) [6] recorded the three species in Uga rural community, Anambra State. These species have been widely reported previously in many other studies in different locations (Irikannu *et al*., 2025; Umeanaeto *et al*., 2017; Ezihe *et al*. 2017; Onyido *et al*., 2016) [12, 24, 25]. The mosquito species recorded in this study are proven vectors of various parasitic and viral diseases. If the pathogens are present within the study population, the vectors may actively be involved in transmitting them during their human-vector contact.

During the dry season, *C. quinquefasciatus* was the most abundant mosquitoes biting both outdoor and indoor. Some studies reported that *C. quinquefasciatus* is presently regarded as a biting nuisance having no significant epidemiological importance yet (Uttah *et al*., 2013; Irikannu *et al*; 2025) [12, 26]. But in the wet season, *Ae. aegypti* was the most abundant species biting people outdoors during activities time in twilight hours. Some studies have also reported the mosquito species biting outdoors in their study area (Irikannu *et al*. 2023; Onyido *et al*., 2016) [14, 24]. *C. quinquefasciatus* is a resilient species and thus could bite all seasons, as they breed even in septic tanks and blocked drainages in both urban and rural centers in absence of rain.

During the wet season also, *An. gambiae* was the most abundant mosquito species biting humans indoors during night sleep. This corroborates with the findings of several studies that reported *Anopheles* species as midnight biters (Egbuche *et al*., 2020; Irikannu *et al*; 2019; Aribodor, 2012) [4, 5, 11]. The observation on the peak biting time of *An. gambiae* species could be helpful when designing a targeted control measures against the vectors.

Conclusion

The three, mosquito species recorded in this study namely; *An. gambiae*, *C. quinquefasciatus* and *Ae. aegypti* are known vectors of parasitic and viral diseases. The human-vector contact between the mosquitoes and inhabitants of the area during bloodmeal is an important epidemiological factor of disease transmission. To prevent any future viral or parasitic disease epidemic in the area, constant interventions with vector targeted control programs and health education should be implement by both government agencies and concerned non, governmental organisations.

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