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Seasonal and temporal distribution of mosquito species in Awka South local government area, Anambra state, Nigeria

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Abstract

Mosquito-borne diseases remain a major public health problem in Nigeria. This study investigated seasonal and temporal distribution of mosquito species in Awka South Local Government Area, Anambra State, Nigeria between November 2023 and October 2024. The aim was to determine the effects of rainfall, temperature, and relative humidity on mosquito species abundance and temporal distribution. Outdoor and indoor adult mosquitoes were collected using human landing catch (HLC) and pyrethroid knockdown method, respectively. A total of 616 mosquitoes were collected, comprising *Culex quinquefasciatus* (38.9%), *Aedes aegypti* (21.2%), *Aedes albopictus* (16.6%), *Anopheles gambiae* (12.2%), *Anopheles funestus* (3.9%), *Mansonia africana* (6.9%) and *Culex tritaeniorhynchus* (0.6%). The highest abundance occurred during months of elevated rainfall and high relative humidity. Regression analysis revealed a weak positive correlation between mosquito abundance and temperature ($R = 0.143$; $R^2 = 0.020$; $p = 0.658$), which was not significant. Relative humidity showed a strong positive correlation ($R = 0.915$; $R^2 = 0.837$; $p = 2.89 \times 10^{-5}$), while rainfall exhibited a very strong positive correlation ($R = 0.963$; $R^2 = 0.927$; $p = 0.000384$), with higher collections aligning with peak rainfall months. The study concluded that mosquito abundance is strongly shaped by rainfall and relative humidity.

Keywords: Mosquitoes, seasonal, temporal, Awka

1. Introduction

Mosquitoes present a major risk for human health worldwide. They are common, flying insects that live in most parts of the world with piercing and sucking mouthparts but only female feed on blood, and many species are vectors of parasite and viral diseases ^[1]. They are a diverse group of insects that belong to the phylum Arthropoda, class Insecta, order Diptera, and family Culicidae. In Nigeria, especially in Anambra State, several mosquito species have been documented in different regions, including *Anopheles gambiae*, *Anopheles nili*, *Anopheles funestus*, *Anopheles moucheti*, *Aedes aegypti*, *Aedes albopictus*, *Aedes africanus*, *Aedes circumluteolus*, *Aedes taylori*, *Coquillettia species*, *Culex tritaeniorhynchus*, *Culex annulirostris*, *Eretmapodite chrysogaster*, *Culex quinquefasciatus* ^[2]. The most important man-biting mosquitoes belong to the genera *Anopheles*, *Culex*, *Aedes*, *Mansonia*, *Haemagogus*, *Sabethes* and *Psorophora* ^[3].

Mosquitoes are widely distributed throughout the world, with different species having preference for peculiar breeding sites. Their distribution being largely dependent on climatic factors such as rainfall pattern, temperature, and relative humidity ^[4]. In warm and tropical regions, climatic factors have also been associated with relative mosquito abundance and transmission of mosquito borne infections ^[5]. It has been observed that rainfall generally brings new opportunistic mosquito breeding sites though rainfall can also destroy existing breeding sites by changing breeding pools into streams, impeding development of mosquito eggs or larvae or by simply flushing eggs or larvae out of the pools ^[1]. Environmental temperature between 16 °C and 36 °C favours survival of mosquito population which peaks at a temperature range of 28 °C to 32 °C but can decline rapidly at temperature above the range ^[1].

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Increase in temperature may facilitate larval development, enhance vector survivorship and reproductive fitness, as well as increase its blood feeding frequency and parasite sporogonic development rate in previously cooler areas. Relative humidity (RH) affects longevity, blood feeding behaviour, mating, dispersal and oviposition of mosquitoes^[5]. It has been noted that relative humidity (RH) is one of the vital factors affecting the survival of mosquitoes and RH between 50-55% is the most appropriate condition for peak abundance of mosquito species, although adult mosquitoes could still survive relative humidity range of 80-85%^[6].

An effective mosquito control intervention plan should be based on the knowledge of the vector's abundance, and how they respond to rainfall, temperature, and RH in an area^[6]. This study investigated the seasonal and temporal patterns of mosquito species distribution in Awka South Local Government Area (LGA) of Anambra State.

2. Materials and Methods

2.1 Study Area

The study was conducted in Awka South Local Government Area (Longitude 7004'E and Latitude 6010'N) of Anambra State, Nigeria. The area is in the tropical rainforest zone of Nigeria which experiences about eight months of wet season between March and October, followed by about four months of dry season between November and February. The temperature range is generally 27-30 °C between June and December but rises to 32-34 °C between January and April. The relative humidity is about 70% in the dry season, reaching 80% during the wet season while the annual rainfall ranges between 2000-3000 mm. According to City Population^[7], the projected population of Awka South in 2022 was about 270,300. Awka South LGA comprises nine communities of Amawbia, Awka, Ezinato Isiagu, Mbaukwu, Nibo, Nise, Okpuno and Umuawulu. The main language of the people is Igbo. Trading and farming over the years has become the major occupation of the people while some of them are transport workers and civil servants. In Awka South LGA, ongoing infrastructural development such as road and house construction have given rise to environmental changes which has created artificial breeding habitats for mosquito larvae, in addition to natural body of water that are suitable for mosquito breeding, hence the reason for this study.

2.2 Study Design

The study was a field longitudinal survey which involved collection and identification of indoor and outdoor biting and resting mosquito larvae; as well as larvae from different breeding habitats in the study area. The study was done for a period of one year (November, 2023 to October, 2024), cutting across two seasons; dry season (November-March) and wet seasons (April-September). Four towns; Amawbia, Awka, Nibo and Mbaukwu were randomly selected to represent urban and rural areas in the LGA. The selected communities were Amawbia and Awka (Urban) while Mbaukwu and Nibo are rural communities^[8]. House to house visit were used in mosquito collection.

2.3 Ethical Consideration, Advocacy Visit and Informed Consent

Ethical clearance was obtained from Ministry of health, Anambra State with ref number: MH/PRSD/523/Vol.1/144. Advocacy visits were paid at appropriate quarters including

the community leaders, heads of household and other inhabitants. Also, oral informed consents were obtained from them and the study intent and their significances were explained to them prior to the commencement of the study.

2.4 Mosquito Collection

2.4.1 Selection of Houses for Mosquito Collection

This was done using multistage sampling method. The community was estimated to contain approximately 514 households. An average of 15 houses were randomly selected from each stratum using the household lists. One room was selected in each household for collection of indoor biting and resting adult mosquitoes using pyrethroid insecticide knockdown collection (PKC).

2.5 Collection of Indoor Adult Mosquitoes

Adult mosquitoes that bite and rest indoors were sampled using pyrethrum spray catch method^[9] from living rooms where people slept the previous night. Windows and doors were shut to prevent escape of mosquitoes. White sheets were spread from wall to wall with sufficient overlaps at their joints to avoid escape of fallen mosquitoes. The floor surfaces as well as the beds and any other area were completely covered. No space was left between the walls and all the surfaces were covered to prevent loss of any mosquito. A pyrethroid-based insecticide aerosol (Baygon) was sprayed in the rooms. At 20 minutes interval after spraying, the white cloth sheets earlier laid on the floor was folded to ensure that no knocked down mosquito escaped. The folded sheets were taken outside the rooms and spread out to collect the knocked-down mosquitoes, with a pair of entomological forceps, into a damped petri dish.

2.6 Collection of Outdoor Mosquitoes Species

Outdoor man-biting mosquitoes were collected using human-bait collection (HBC)^[9]. The collections were done quarter-hourly for three nights from 4.00 pm-8.00 pm (local time). The volunteer collectors were humans who were already vaccinated for yellow fever. They exposed their legs and hands for mosquito landing. Mosquitoes alighting on them was collected using test tube vials. Each vial was quickly covered with a ball of cotton wool to avoid escape of the mosquito. The time of collection of each mosquito were properly recorded. The locations used for the human bait mosquito collection was randomly selected. They included; under trees, stair case, verandas and near livestock sheds.

2.7 Identification of the Mosquitoes

All mosquitoes collected were properly labelled and sent to the Laboratory Unit of the Department of Parasitology and Entomology, Nnamdi Azikiwe University for identification. The mosquitoes were identified using the gross morphological features of the species earlier described^[10].

2.8 Collection of meteorological data

The monthly temperature, relative humidity and rainfall data were obtained from Nigeria Meteorological Agency (NIMET) office in Awka, Anambra State. Also, average monthly data of these the climatic factors were obtained for wet and dry seasons during the study period.

2.9 Data Analysis

Data collected were analysed using the statistical package for

social sciences (SPSS) version 2.10. Analysis of variance (ANOVA) was used to check for statistically significant differences in mosquito population across the time period, simple linear regression was used to check for association between climatic factors and mosquito species abundance. Shannon-Wiener diversity index (H) was calculated for all mosquito species as: where n_i is the abundance and N , the total number of individuals in the species ^[11]. Also, Simpson's dominance index (C) which evaluated the prevalence of each mosquito species and measures the probability of picking two organisms at random. Line graphs were used to show the responses mosquito abundance to temperature, relative

humidity and rainfall.

3. Results

A total of 616 adult mosquitoes comprising seven species were collected. *Culex quinquefasciatus* 240(38.9%) was the highest mosquitoes collected while *Culex tigripes* 4(0.6%) was the least (Table 1). The peak mosquito activity was highest in September 189(30.7% and October 122(19.8%) and least in January 4(0.6%). The distribution of mosquito species in the study area was statistically significant ($P=0.000694$; $p<0.05$).

Table 1: Monthly Percentage Distribution of Mosquito Species Collected Indoors and Outdoors in the study area

Months	<i>Culex quinquefasciatus</i> %	<i>Aedes aegypti</i> %	<i>Aedes albopictus</i> %	<i>Anopheles gambiae</i> %	<i>Anopheles funestus</i> %	<i>Mansonia africana</i> %	<i>Culex tigripes</i> %	Total%
Nov	8(1.3)	2(0.3)	2(0.3)	2(0.3)	2(0.3)	0	0	16(2.6)
Dec	5(0.8)	0	2(0.3)	2(0.3)	0	0	0	9(1.5)
Jan	4(0.6)	0	0	0	0	0	0	4(0.6)
Feb	6(0.9)	3(0.5)	0	1(0.2)	0	0	0	10(1.6)
Mar	7(1.1)	2(0.3)	2(0.3)	3(0.5)	0	0	0	14(2.3)
Apr	14(2.3)	5(0.8)	3(0.5)	2(0.3)	0	0	0	24(3.9)
May	18(2.9)	10(1.6)	3(0.5)	5(0.8)	0	3(0.5)	0	39(6.3)
June	18(2.9)	11(1.8)	7(1.1)	7(1.1)	1(0.2)	3(0.5)	0	47(7.6)
July	24(3.9)	17(2.8)	8(1.3)	7(1.1)	3(0.5)	3(0.5)	0	62(10.0)
August	31(5.0)	18(2.9)	14(2.3)	9(1.5)	5(0.8)	6(0.9)	0	83(13.5)
Sept	60(9.7)	39(6.3)	38(6.2)	26(4.2)	9(1.5)	17(2.8)	0	189(30.7)
Oct.	45(7.3)	24(3.9)	23(3.7)	11(1.8)	4(0.6)	11(1.8)	4(0.6)	122(19.8)
Total	240(38.9)	131(21.2)	102(16.6)	75(12.2)	24(3.9)	43(6.9)	4(0.6)	616(100)

$F=4.46895$ $P=0.000694$ $f\text{-crit}=2.231192$

The seasonal variation of indoor biting adult mosquitoes in the four communities of Awka South L.G.A in different months of the year was statistically significant ($P=0.004957$; $p<0.05$). Indoor biting mosquitoes were higher in the wet season 309(91.1%) than in the dry season 30(8.8%) being highest in September 105(30.9%) and least in January 2(6.6%) [Table 2]. The number of outdoor biting adult

mosquitoes were also higher in wet months 257(92.7%) than the dry season 22(7.9%) being higher in September 84(32.7%) and least in January 2(9.1%) [Table 3]. The seasonal variation of outdoor biting adult mosquitoes in the study area was not statistically significant ($P=1.37E-05$; $p>0.05$).

Table 2: Seasonal Variation of Indoor Biting Mosquitoes Species

Season	Months	<i>Culex quinquefasciatus</i>	<i>Aedes aegypti</i>	<i>Aedes albopictu</i>	<i>An. gambiae</i>	<i>An. funestus</i>	<i>Mansonia africana</i>	Total (%)
Dry	Nov	5 (45.5)	2 (18.2)	0	2 (18.2)	1 (9.1)	0	11(36.6)
	Dec	3 (60)	0	0	2 (40)	0	0	5(16.6)
	Jan	2 (100)	0	0	0	0	0	2 (6.6)
	Feb	3 (60)	1 (20)	0	1 (20)	0	0	5 (16.6)
	Mar	4 (44.4)	0	1 (11.1)	3 (33.3)	1 (11.1)	0	9 (30.0)
	Subtotal	17 (56.6)	3 (10)	1 (3.3)	7 (23.3)	2 (6.6)	0	30 (8.8)
Wet	April	8 (72.7)	0	1(9.1)	2 (18.8)	0	0	11 (3.2)
	May	10 (45.4)	3 (13.6)	1(4.5)	5 (22.7)	0	3 (13.6)	22 (6.4)
	June	9 (33.3)	5 (18.5)	3 (11.1)	6 (22.2)	1 (3.7)	3 (11.1)	27 (7.9)
	July	13 (39.4)	6 (18.2)	4(12.1)	4 (12.1)	3 (9.1)	3 (9.1)	33 (9.7)
	August	17 (35.4)	10(20.8)	8(16.7)	6(12.5)	3(6.3)	4(8.3)	48(14.2)
	Sept	32 (30.5)	15(14.3)	19 (18.1)	21(19.8)	6(5.5)	12(11.4)	105(30.9)
	Oct	22 (34.9)	8(12.7)	11(17.5)	9(14.3)	4(6.3)	9(14.2)	63(18.5)
	Subtotal	111(35.9)	47(13.9)	47(13.9)	53(17.2)	17(5.5)	34(11.0)	309(91.1)
	Grand Total	128(37.7)	50(14.7)	48(14.1)	60(17.7)	19(5.6)	34(10.0)	339

$F=3.725585$ $P=0.004957$

Table 3: Seasonal Variation of Outdoor Biting Mosquitoes

Season	Months	<i>Culex quinquefasciatus</i> (%)	<i>Aedes aegypti</i> (%)	<i>Aedes albopictus</i> (%)	<i>An. Gambiae</i> (%)	<i>An. Funestus</i> (%)	<i>Mansonia Africana</i> (%)	<i>Culex tigripes</i> (%)	Total (%)
Dry	Nov	3(100)	0	0	0	0	0	0	3(13.6)
	Dec	2(50)	0	2(50)	0	0	0	0	4(18.1)
	Jan	2(100)	0	0	0	0	0	0	2(9.1)
	Feb	3(60)	2(40)	0	0	0	0	0	5(22.7)
	Mar	3(50)	2(33.3)	1(16.6)	0	0	0	0	6(27.3)
	Subtotal	13(59.1)	4(18.1)	3(13.6)	0	0	0	0	22(7.9)
Wet	April	6(46.2)	5(38.5)	2(15.4)	0	0	0	0	13(5.1)
	May	8(47.1)	7(41.2)	2(11.8)	0	0	0	0	17(6.6)
	June	9(45)	6(30)	4(20)	1(5)	0	0	0	20(7.7)
	July	11(37.9)	11(37.9)	4(13.8)	3(10.3)	0	0	0	29(11.3)
	August	14(40)	8(22.9)	6(17.1)	3(8.6)	2(5.7)	2(5.7)	0	35(13.6)
	Sept	28(33.3)	24(28.6)	19(22.6)	5(5.9)	3(3.6)	5(5.9)	0	84(32.7)
	Oct	23(38.9)	16(27.1)	12(20.3)	2(3.4)	0	2(3.4)	4(6.8)	59(22.9)
	Subtotal	99(38.5)	77(29.9)	49(19.1)	14(8.9)	5(1.9)	9(3.5)	4(1.5)	257(92.7)
	Grand total	112(40.4)	81(29.2)	52(18.8)	14(5.1)	5(1.8)	9(3.2)	4(1.4)	277(100)

F=6.514222 P=1.37E-05

The overall diversity index (H) while the overall dominance index (C) of mosquito species collected during the study period was 1.6536 and 0.2295, respectively. *Culex quinquefasciatus* recorded the highest values for both

diversity (0.3676) and dominance (0.1217) while *Culex tigripes* had the least. The diversity index and dominance indices of mosquito species collected were statistically significant ($p=0.00804$) [Table 4].

Table 4: Index of Species Diversity and Dominance for All Mosquito Species

Species	Shannon-Wiener diversity index (H)	Simpson's dominance index (C)
<i>Culex quinquefasciatus</i>	0.3676	0.1217
<i>Aedes aegypti</i>	0.3412	0.0556
<i>Aedes albopictus</i>	0.3092	0.0346
<i>Anopheles gambiae</i>	0.248	0.0136
<i>Anopheles funestus</i>	0.1014	0.0009
<i>Mansonia Africana</i>	0.151	0.0027
<i>Culex tigripes</i>	0.0676	0.0002
Total	1.586	0.2293

Table 5 below shows the abundance of different mosquito species in relation to the climatic factors (temperature °C; relative humidity%; and rainfall mm). From the table it was observed, using linear regression analysis that rainfall showed the strongest and most significant positive influence on almost all mosquito species collected, with correlation coefficients ranging from $R = 0.75$ to 0.88 and coefficients of determination (R^2) between 0.57 and 0.78 . Relative humidity also revealed a moderate positive relationship with mosquito abundance, significantly affecting species such as *Culex*

quinquefasciatus, *Aedes aegypti*, and *Anopheles funestus* ($R = 0.57-0.66$, $p<0.05$). Conversely, temperature exhibited weak and mostly negative correlations with all species, indicating minimal influence on mosquito species abundance in the study area. Among the species of mosquitoes encountered, *Culex quinquefasciatus*, *Aedes aegypti*, and *Anopheles gambiae* revealed the strongest positive response to increasing rainfall and humidity, while *Culex tigripes* displayed no significant relationship with any climatic factor due to its very low abundance.

Table 5: Monthly Percentage of Mosquito species Abundance and Climatic Factors (Temperature, Relative Humidity, and Rainfall)

Months	Temperature (°C)	Relative Humidity (%)	Rainfall (mm)	<i>Culex quinquefasciatus</i> %	<i>Aedes aegypti</i> %	<i>Aedes albopictus</i> %	<i>Anopheles gambiae</i> %	<i>Anopheles funestus</i> %	<i>Mansonia Africana</i> %	<i>Culex tigripes</i> %	Total%
Nov	26.8	80	64	8(1.3)	2(0.3)	2(0.3)	2(0.3)	2(0.3)	0	0	16(2.6)
Dec	26.1	74	19	5(0.8)	0	2(0.3)	2(0.3)	0	0	0	9(1.5)
Jan	26	68	6	4(0.6)	0	0	0	0	0	0	4(0.6)
Feb	27.5	66	10	6(0.9)	3(0.5)	0	1(0.2)	0	0	0	10(1.6)
Mar	28.2	70	32	7(1.1)	2(0.3)	2(0.3)	3(0.5)	0	0	0	14(2.3)
Apr	27.8	81	102	14(2.3)	5(0.8)	3(0.5)	2(0.3)	0	0	0	24(3.9)
May	27.4	84	172	18(2.9)	10(1.6)	3(0.5)	5(0.8)	0	3(0.5)	0	39(6.3)
June	26.9	87	181	18(2.9)	11(1.8)	7(1.1)	7(1.1)	1(0.2)	3(0.5)	0	47(7.6)
July	26.5	90	221	24(3.9)	17(2.8)	8(1.3)	7(1.1)	3(0.5)	3(0.5)	0	62(10.0)
August	26.7	88	226	31(5.0)	18(2.9)	14(2.3)	9(1.5)	5(0.8)	6(0.9)	0	83(13.5)
Sept	26.4	86	257	60(9.7)	39(6.3)	38(6.2)	26(4.2)	9(1.5)	17(2.8)	0	189(30.7)
Oct	27.2	83	243	45(7.3)	24(3.9)	23(3.7)	11(1.8)	4(0.6)	11(1.8)	4(0.6)	122(19.8)
Total				240(38.9)	131(21.2)	102(16.6)	75(12.2)	24(3.9)	43(6.9)	4(0.6)	616(100)

Figure 1-3 presents a line graph illustrating the relationship between the overall mosquito abundance (%) with

temperature, rainfall and relative humidity in the study area. The regression analysis yielded a very weak positive

correlation ($R = 0.143$; R^2 of 0.020) in temperature; indicating that only 2.0% of the variation in mosquito abundance is explained by temperature.

However, mosquito abundance showed a strong positive correlation with relative humidity ($R = 0.915$; $R^2=0.838$) and

rainfall ($R = 0.963$; $R^2 = 0.927$) indicating that 83.8% of the variation in mosquito abundance can be explained by changes in relative humidity while 92.7% of the variation can be explained by rainfall. The results suggest that mosquito abundance increased steadily with rising relative humidity and rainfall patterns.

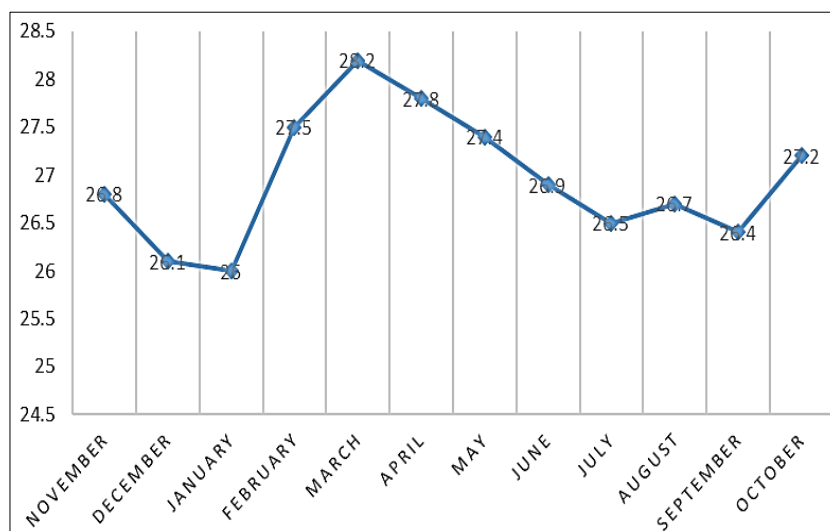


Fig 1: Line Graph Showing Relationship Between Mosquito Abundance and Temperature ($P=0.658$; $p>0.05$)

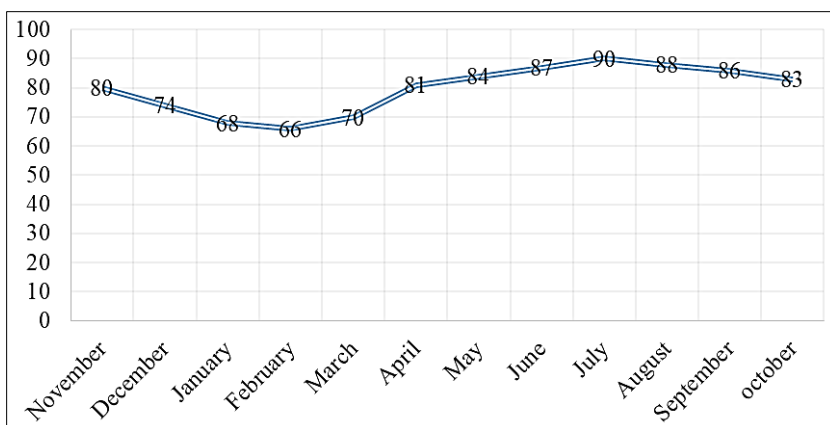


Fig 2: Line Graph Showing Relationship Between Mosquito Abundance and Relative Humidity. ($P = 2.98 \times 10^{-5}$; $p<0.05$),

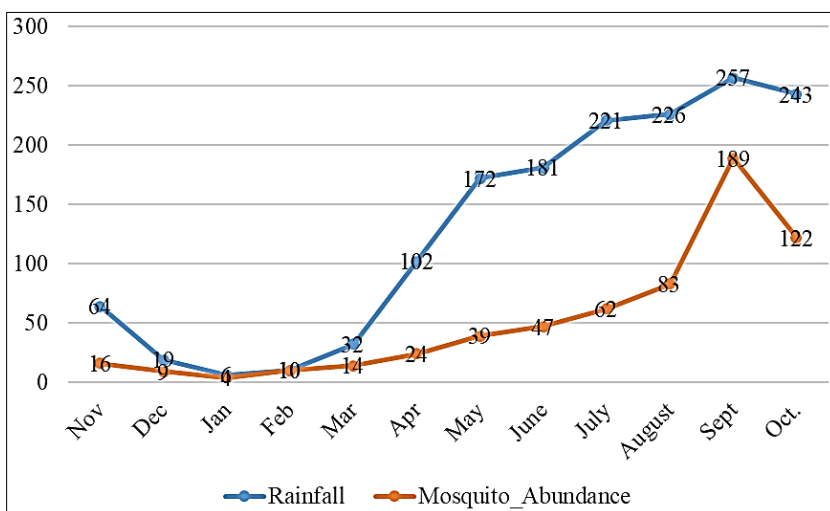


Fig 3: Line Graph Showing Relationship Between Mosquito Abundance and Rainfall ($P=0.000384$; $p<0.05$)

4. Discussion

The findings of the study revealed that mosquito abundance is largely dependent on climatic factors such as rainfall pattern, temperature, and relative humidity. Seven mosquito species were encountered in this study. They include; *Culex quinquefasciatus*, *Aedes aegypti*, *Aedes albopictus*, *Anopheles gambiae*, *Anopheles funestus*, *Mansonia africana*, and *Culex tigripes*. Similar results have been reported by other studies in southeastern Nigeria [12] [13] [13] [14] [15]. The monthly and seasonal variation of mosquito genera indicated a clear pattern of higher abundance during the wet season (April to October) for both indoor and outdoor biting mosquitoes; which coincides with peak rainfall and humidity, conditions highly favourable for mosquito breeding. *Culex* and *Aedes* species were the dominant genera across all months. These observations are consistent with earlier studies in Nigeria by [17] in Alulu-Nike Community Enugu State, who reported more indoor and outdoor biting adult mosquitoes in wet months than in the dry months.

Seasonally, *Culex quinquefasciatus* was abundant in the dry season and wet season indicating adaptive ecological preferences among the genera. Conversely, findings from [1] reported sigmoid curve with the peak being the late rainy season, early rainy season and dry season. The marked seasonality suggests that mosquito-borne disease transmission may peak during the wet season than dry season, when vector populations are at their highest. However, the seasonal variation of indoor biting adult mosquitoes in the four communities of Awka South L.G.A and in different months of the year was statistically significant ($p < 0.05$); while that of outdoor adult mosquitoes was not statistically significant ($p > 0.05$).

Among individual species, *Culex quinquefasciatus* recorded the highest values for both diversity and dominance, followed by *Aedes aegypti* and *Aedes albopictus*. Species with the least diversity and dominance values included *Culex tigripes* and *Aedes simpsoni*. There was significant difference between diversity index and dominance indices ($p = 0.00804$). This aligns with the study of Irikannu *et al.*, (2023) in community of Southeast Nigeria, who reported *Culex quinquefasciatus* as having the highest Shannon-Wiener diversity value (0.107) and the highest Simpson's dominance index (0.495). Generally, *C. quinquefasciatus* is the most predominant and most frequently encountered mosquito species in the present study. It has also been reported to be a vector filariasis in Nigeria [18] [19].

The influence of climatic factors specifically temperature, relative humidity, and rainfall on mosquito abundance was clearly evident throughout the study period. Analysis showed that temperature exhibited a negative correlation with both indoor and outdoor mosquito abundance, with lower mosquito populations recorded during warmer months. However, regression analysis revealed that the relationship between temperature and mosquito abundance was not statistically significant ($P = 0.66$), indicating that temperature alone was not a major driver of mosquito density in Awka South. This observation aligns with the findings of Umeanaeto *et al.*, (2019), which suggested that non-climatic factors, such as human behaviour and breeding site availability, may moderate the effect of temperature in urban environments.

In contrast, relative humidity showed a strong positive and statistically significant correlation with mosquito abundance ($R^2 = 0.84$, $p < 0.001$), underscoring its role in enhancing

mosquito survival, especially for adult stages. Humidity values ranged from 66% to 90%, with peaks observed during the wet season months (April-October), which coincided with elevated mosquito counts. These results corroborate previous reports by [20], which established strong links between relative humidity, mosquito longevity, and indoor resting behaviour.

Similarly, rainfall had the strongest positive association with mosquito abundance ($R^2 = 0.93$; $p < 0.001$). Abundance rose sharply following months of consistent rainfall, with a noticeable peak in September, after heavy rains in August. This pattern highlights the lag effect of rainfall, where breeding sites fill and mature over time, supporting increased larval development. However, mosquito abundance slightly declined during months of excessive rainfall, possibly due to flooding and washout of immature stages, as observed by [21] in Ibadan. The combined effects of humidity and rainfall indicate that mosquito populations in Awka South are largely driven by wet season dynamics, as also supported by [20] in Ondo State.

5. Conclusion

It was observed from the study that *Culex quinquefasciatus* was the most dominant species, followed by *Aedes aegypti*, *Aedes albopictus*, and *Anopheles gambiae*, with a clear increase in abundance during the rainy season. Strong positive correlations were established between mosquito abundance and environmental variables such as relative humidity, rainfall. These factors significantly influenced adult mosquito distributions. Mosquito control strategies that will take advantage of precise timing, based on how these climatic factors influence the mosquito distribution is recommended.

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