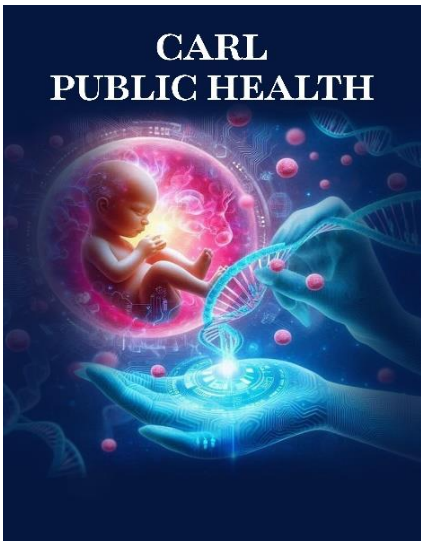
Original Article

CARL PUBLIC HEALTH

https://cartcarl.com/journal/carl-public-health

E-ISSN: 0331-8478



Assessment of Man-Biting Rate and Gonotrophic Cycle of Mosquitoes in Orashi Region of Rivers State, Nigeria

Authors

[a]*Wisdom U. G., [b]Oghanri, S. U, [c]Iwuorie, C. G.

[a] Department of Applied and Environmental Biology, Rivers State University

[b] Department Geoscience Technology, Rivers State University.

[c] Department of Epidemiology, School of Public Health, University of Port Harcourt

Correspondent

Wisdom U.G

(wisdomgibson339@gmail.com)

Received: 10 November 2025
Accepted: 30 November 2025
Published: 6 December 2025

Citation

Wisdom U. G., Oghanri, S. U, Iwuorie, C. G. (2025). Assessment of man-biting rate and gonotrophic cycle of mosquitoes in Orashi Region of Rivers State, Nigeria. Carl Public Health, 2(1), 01-10. *https://doi.org/10.70726/cph.2025.210110*

Abstract

This study assessed the temporal and spatial dynamics of mosquito biting activity and gonotrophic behaviour across selected communities in the Orashi Region of Rivers State, Nigeria. A total of 1,768 mosquitoes comprising key vector genera were analysed to determine monthly variations in the Man-Biting Rate (MBR), the gonotrophic cycle of Anopheles species, and spatial biting pressure across five communities. Monthly trends showed pronounced seasonal fluctuations, with the highest MBR recorded in April (386) and March (368), classified as Very High, reflecting optimal breeding conditions during the late dry to early rainy transitional period. High biting rates also occurred in September (358) and October (343), corresponding to early rainy season abundance. Moderate and low biting activity in November (222) and December (118), respectively, indicated reduced breeding associated with declining rainfall and the onset of the dry season. Analysis of the Anopheles population revealed corresponding shifts in gonotrophic activity. Spatial assessment demonstrated substantial community-level variation in biting pressure. Ahoada recorded the highest overall mosquito density (600), indicating Very High biting pressure, followed by Erema (536) and Oboburu (517). Spatial distribution of malaria vectors showed a similar pattern, with Anopheles abundance highest in Ahoada (191), suggesting elevated malaria transmission risk. Culex distribution indicated highest densities in Erema (241) and Ahoada (235), highlighting significant nuisance biting and potential filariasis risk. Aedes populations were comparatively low, with Omoku (17) showing slightly elevated arboviral risk. Conclusively, the findings demonstrate that mosquito abundance, biting rates, and reproductive activity exhibit strong seasonal patterns and spatial heterogeneity across communities.

Keywords: Man-biting Rate (MBR), Gonotrophic Cycle, Anopheles, Culex, Vector-borne Diseases, Filariasis, Arboviruses

Introduction

Malaria remains one of the most significant public health burdens in sub-Saharan Africa, with Anopheles mosquitoes acting as the principal vectors of Plasmodium parasites. The intensity of malaria transmission in any area depends on a combination of entomological, environmental, and behavioral factors, among which the man-biting rate (MBR) of vector mosquitoes and their gonotrophic cycle are particularly influential. These parameters determine how often mosquitoes feed on humans and how quickly they complete their reproductive cycle (Service, 1993; Silver, 2008). The man-biting rate (MBR) reflects the frequency with which mosquitoes feed on humans and is a critical component of vectorial capacity, as more frequent biting increases the probability of malaria transmission. Studies from Nigeria have documented wide geographic and seasonal variation in biting rates. For example, in a rainforest-zone entomological survey in southern Nigeria, Anopheles gambiae exhibited an MBR of approximately 17.5 bites/person/night, while funestus was around 14.6 bites/person/night, underscoring the high potential for malaria transmission in these settings (Olayemi et al., 2007). Climatic factors such as humidity, rainfall, and temperature have been shown to influence MBR. In Rivers State, positive correlations were observed between humidity and rainfall with MBR, whereas temperature was negatively correlated (Living-Jamala et al., 2022).

Closely linked to biting behavior is the gonotrophic cycle, defined as the period between a blood meal and subsequent egg-laying in female mosquitoes. The duration of this cycle affects how often a mosquito can bite over its lifespan, influencing its capacity to transmit malaria. Shorter gonotrophic cycles result in more frequent blood meals and higher transmission potential, whereas longer cycles may reduce transmission but reflect adaptation to local environmental conditions. Empirical studies have demonstrated variation even within the Anopheles gambiae complex; in southwestern Nigeria, gonotrophic cycles ranged from 3–4 days in Igbo-Ora to 5–6 days in Idere (Awolola et al., 2010). Understanding both MBR and the gonotrophic cycle has direct implications for malaria control. These entomological parameters feed into models of vectorial capacity and basic reproductive number (R0R0), which guide interventions such as indoor residual spraying and insecticide-treated nets (Smith et al., 2007). Classical epidemiological studies in Nigeria have used measurements of biting rate, parity (as a proxy for survival), and gonotrophic cycle to estimate vectorial capacity and evaluate control strategies (Macdonald, 1957).

Despite the importance of these parameters, local data for the Orashi region remain limited. Molecular characterization studies in several Orashi communities (Oboburu, Obite, Omoku, Erema, and Ahoadah) identified Anopheles gambiae sensu stricto as the predominant vector. However, these studies focused mainly on species composition and relative abundance and did not provide detailed measurements of biting rates over time or the gonotrophic cycle (Ubochi et al., 2020). The entomological landscape in the Niger Delta, including Orashi, is influenced by dynamic environmental and climatic conditions. Seasonal variations in rainfall, temperature, and humidity can affect mosquito biting behavior, survival, and reproduction (Living-Jamala et al., 2022). Furthermore, recent modeling frameworks suggest that accurate incorporation of gonotrophic cycle length and heterogeneous biting patterns is crucial for precise estimation of transmission dynamics (Orsborne et al., 2020). Given this background, a detailed assessment of man-biting rate and gonotrophic cycle of mosquitoes in the Orashi region would fill a critical gap in entomological knowledge. Such data would enhance understanding of malaria transmission dynamics locally, inform targeted vector control strategies, and improve predictive models for this ecological setting.

Literature Review

Mosquito-borne diseases remain one of the most persistent public health challenges in sub-Saharan Africa, with Nigeria contributing a significant proportion of malaria and arboviral disease burdens. Understanding mosquito feeding behavior particularly the man-biting rate and reproductive physiology expressed through the gonotrophic cycle provides critical insight into vectorial capacity, transmission dynamics, and the design of effective vector-control interventions. In ecological zones like the Orashi region of Rivers State, where ecological diversity, high humidity, flooding patterns, and human settlement structure create abundant breeding sites, the study of mosquito biting activities and reproductive cycles becomes even more essential.

The man-biting rate (MBR) is a key entomological parameter that reflects the rate at which humans are exposed to mosquito bites. It serves as a direct component of the entomological inoculation rate (EIR) and helps quantify the intensity of human–vector contact. Its importance lies in the fact that higher biting rates often correspond with elevated disease transmission risk. The man-biting rate varies across species, seasons, diurnal patterns, and ecological characteristics, and is strongly influenced by human activities and the availability of breeding habitats. In Nigeria, several studies report that Culex quinquefasciatus remains the dominant mosquito species in urban and peri-urban communities, while the Anopheles gambiae complex continues to be the primary malaria vector in rural and semi-rural areas. Seasonal patterns strongly affect mosquito feeding behaviours, with peak biting rates occurring during rainy seasons when environmental conditions favour larval development (Awolola et al., 2007; Onyido et al., 2009; Olayemi & Ande, 2011). These patterns justify localized studies in regions such as Orashi, where swampy landscapes, riverine settlements, and anthropogenic activities create unique ecological settings.

Equally important is the gonotrophic cycle, the periodic interval between a female mosquito taking a blood meal and subsequently laying eggs. This cycle determines the frequency with which a mosquito seeks blood and, consequently, the number of opportunities it has to transmit pathogens. A shorter gonotrophic cycle enhances transmission potential because mosquitoes feed more frequently. The duration of the gonotrophic cycle varies among species and is shaped by environmental temperature, humidity, bloodmeal size, host availability, and mosquito age. A classical relationship exists between temperature and the gonotrophic cycle: higher temperatures accelerate ovarian development and shorten the interval between feedings (Lardeux, 2008). Understanding the gonotrophic cycle also offers insight into mosquito longevity and survival, as older mosquitoes generally undergo multiple cycles, increasing the likelihood of pathogen transmission.

Methods for estimating the man-biting rate and gonotrophic cycle include human landing catches (HLC), CDC light traps, pyrethrum spray collections (PSC), and ovarian dissection techniques. While HLC provides direct estimates of human exposure, ethical concerns have led to increased use of alternative host-baited traps and resting collections. Parity dissections remain widely used for estimating the physiological age of mosquitoes and inferring the number of completed gonotrophic cycles. Studies in southern Nigeria indicate that Anopheles species typically exhibit shorter gonotrophic cycles under warmer conditions, enhancing malaria transmission efficiency, while Culex species often dominate in polluted habitats yet can sustain high biting densities (Service, 1993; Nwankwo et al., 2017).

Research in Rivers State and southeastern Nigeria reveals a consistent pattern of high mosquito abundance, particularly in low-lying areas such as the Orashi basin, where frequent flooding and dense vegetation promote breeding. Studies conducted in similar ecological zones report that Culex species remain the most abundant, followed by Anopheles and Aedes species, with biting activities often concentrated during late evening and early morning hours. Elevated human biting rates have been documented during periods of increased rainfall, and several researchers note significant fluctuations in gonotrophic cycle duration corresponding with environmental variability (Umeanaeto & Ekejindu, 2011; Okorie et al., 2015). However, despite growing literature on mosquitoes in Rivers State, few studies have specifically integrated both man-biting rate assessment and gonotrophic cycle analysis within the same ecological setting.

The Orashi region, which comprises communities such as Ahoada, Omoku, Oboburu, Erema, and Ogbogu, exhibits hydrological and socio-environmental conditions that predispose residents to intense mosquito nuisance biting and potential disease transmission. The dominance of Culex mosquitoes in several Orashi surveys suggests high nuisance biting levels, while the presence of Anopheles species indicates ongoing malaria transmission potential. Nevertheless, empirical data from the region remain sparse, particularly regarding the combined analysis of feeding frequency and reproductive timing. This gap underscores the need for targeted entomological studies to better understand vector behaviour, seasonal variations, and the implications for local disease control programming.

In summary, existing literature emphasizes that the man-biting rate and gonotrophic cycle are fundamental determinants of mosquito vectorial capacity. Their measurement informs key epidemiological parameters that guide surveillance, prediction, and control strategies. Given the unique ecology of the Orashi region and the documented presence of multiple mosquito genera, a localized assessment integrating both parameters is not only justified but essential. Such research would improve understanding of transmission risks, support modelling of disease dynamics, and enable more precise, community-specific vector-control interventions

Method and Materials

Research Design

This study employed a descriptive cross-sectional entomological survey design to assess the man-biting rate and gonotrophic cycle of mosquitoes in the Orashi region of Rivers State, Nigeria. The design enabled the systematic collection of adult mosquitoes, estimation of human vector contact rates, and determination of reproductive cycles through ovarian dissections and abdominal condition analysis. The cross-sectional design was suitable because biting activities and physiological development patterns can be reliably captured within defined seasonal periods, providing baseline information on mosquito population dynamics in the study area.

Study Area

The study was carried out in selected communities within the Orashi region of Rivers State, including Ahoada, Omoku, Erema, Oboburu, and Ogbogu. The region is characterized by freshwater swamp forests, perennial flooding, high rainfall, and warm temperatures that average between 24 and 30 degrees Celsius. These ecological factors support the breeding of several mosquito genera such as Anopheles, Culex, Aedes, and Mansonia. Human settlement patterns, agricultural activities, poor drainage, and refuse disposal practices further enhance mosquito proliferation in the area. The choice of the Orashi region is based on persistent mosquito nuisance biting, high malaria burden, and limited entomological evidence on mosquito feeding behaviour and reproductive physiology.

Study Population

The study population comprised adult female mosquitoes collected from indoor and outdoor environments in the selected communities. Only female mosquitoes were used for assessing man-biting rate and gonotrophic cycle because they require blood meals for egg development and are responsible for disease transmission.

Sample Size and Sampling Technique

Sample size was determined based on WHO entomological surveillance guidelines, which recommend collecting at least 100 to 200 adult female mosquitoes per site per sampling period. To ensure statistical robustness, the study targeted a total sample size of 600 to 1,000 adult female mosquitoes. A multistage sampling technique was used. First, five communities were purposively selected based on ecological characteristics and reported mosquito abundance. Second, ten households were randomly selected within each community for mosquito collection. Third, mosquito collection was conducted at indoor and outdoor sites during evening and night periods.

Instruments for Data Collection

The instruments used for data collection included human landing catch equipment (oral aspirators and collection tubes), pyrethrum spray collection kits, mechanical aspirators, and collection cups. Dissecting microscopes were used for abdominal condition analysis and ovarian dissections. A digital thermo-hygrometer was used to record temperature and relative humidity, which influence biting activity and gonotrophic cycle duration.

Method of Data Collection

The Pyrethrum Spray Sheet Collection (PSC) method was used for mosquito sampling. This method involves covering all exposed surfaces of a room with white sheets and spraying a pyrethrum-based insecticide to knock down indoor-resting mosquitoes. After 10 minutes, mosquitoes that fell onto the sheets were collected using fine-tipped forceps and placed into labelled paper cups. Mosquitoes were identified using standard morphological keys. Identification was done to genus and species level based on wing patterns, palpal features, and anatomical characteristics.

Determination of Man-Biting Rate

The man-biting rate was calculated using the WHO formula:

$$\text{Man} - \text{Biting Rate (MBR)} = \frac{Number\ of\ Mosquitoes\ Collected}{\text{Number of collectors} \times \text{Number of hours of collection}}$$

The result was expressed as bites per person per hour and bites per person per night. Indoor and outdoor biting rates were calculated separately, and species-specific rates were determined.

Determination of the Gonotrophic Cycle

Gonotrophic cycle determination involved ovarian dissection and abdominal condition assessment. Female mosquitoes were anaesthetized and dissected to examine tracheation patterns, follicular development, and parity. Mosquitoes were classified as nulliparous or parous. Abdominal conditions were categorized as unfed, freshly fed, half-gravid, or gravid. Gonotrophic cycle duration was estimated using the physiological-age method, based on the proportion of parous mosquitoes and daily survival probability. Temperature and humidity data were incorporated in the interpretation because environmental conditions influence cycle length.

Data Analysis

Collected data were entered into Microsoft Excel and analyzed using SPSS Version 25. Descriptive statistics such as mean, frequency, and percentage were computed. Man-biting rates were analyzed by species and location. Parity rates were calculated to determine physiological age structure. Chi-square tests were used to determine associations between mosquito species and abdominal condition. ANOVA was used to compare man-biting rates across communities. Correlation analysis was performed to examine the relationship between environmental factors and the gonotrophic cycle.

Ethical Considerations

Ethical approval was obtained from the Rivers State University Ethical Review Board. Community leaders granted permission for household participation. Human landing catch volunteers participated voluntarily and received training and prophylaxis. No personal identifiers were collected, and all data were handled with confidentiality.

Verbal informed consent was obtained from household occupants prior to mosquito collection. Privacy, safety, and house cleanliness were maintained throughout the sampling process.

Limitations

Human landing catches involve potential exposure risks, although safety measures were followed. Parity determination may vary with observer experience. Environmental variability such as rainfall fluctuations may influence mosquito density during the collection period. These limitations were managed through standardized methods and repeated sampling sessions.

Result and Discussion

Table 1 presents the monthly distribution of the relative Man-Biting Rate (MBR) of mosquitoes recorded across the study months. The pattern shows distinct fluctuations in mosquito biting activity, reflecting seasonal influences on mosquito abundance and human vector contact. The highest biting rates were observed in April (386) and March (368), both classified as Very High. This suggests that the late dry season and early rainy transitional period create optimal conditions for mosquito breeding and feeding. The increase in humidity, presence of residual water pools, and rising temperatures during these months likely enhance mosquito survival and shorten their gonotrophic cycles, resulting in more frequent biting. September (358) and October (343) also recorded High biting rates, indicating that early rainy season conditions sustain large mosquito populations. These months typically offer abundant breeding habitats due to rainfall, supporting increased vector densities. In contrast, November (222) showed a Moderate MBR, likely due to a gradual decline in rainfall and a reduction in newly formed breeding sites. The sharp drop observed in December (118), classified as Low, suggests that the onset of the dry season significantly reduces mosquito breeding activity, leading to fewer mosquitoes seeking blood meals. Overall, the table demonstrates a clear seasonal trend: mosquito biting activity is highest during the transitional and peak breeding months (March–April and September–October) and lowest during the early dry season (December). This monthly variation is crucial for understanding transmission risk periods and planning targeted vector control interventions

Table 1: Monthly Relative MBR Across All Species

Month	Total Mosquitoes	Relative Biting Rate
September	358	High
October	343	High
November	222	Moderate
December	118	Low
March	368	Very High
April	386	Very High

Table 2 provides insight into the monthly variations in the gonotrophic cycle of Anopheles mosquitoes, based on the total number of individuals captured during the study period. The observed pattern reflects how environmental conditions influence mosquito feeding frequency, egg development, and reproductive output. In September (143), Anopheles abundance indicates active feeding and egg-laying, suggesting a moderate gonotrophic cycle duration characteristic of the late rainy season. By October (155), the total increases further, indicating enhanced cycle frequency, as favorable temperatures and moisture support rapid blood meal intake and efficient egg maturation. A marked decline in Anopheles counts occurs in November (93), pointing to reduced gonotrophic activity as rainfall decreases and breeding sites begin to dry up. This reduction becomes more pronounced in December (50), where the cycle slows significantly due to the early dry season, leading to fewer blood meals, longer intervals between feeding, and reduced egg production. With the return of moisture and rising humidity in March (156), Anopheles activity increases again. This signals a re-acceleration of the gonotrophic cycle, as improved environmental conditions facilitate more frequent blood feeding and faster egg development. The cycle reaches its peak in April (165), representing the fastest gonotrophic turnover during the study period. This month likely offers the best combination of temperature, humidity, and breeding-site availability, resulting in the highest reproductive activity observed.

Table 2: Indicators from Dataset

Month	Anopheles Total	Inference on Gonotrophic Cycle
September	143	Active feeding and egg-laying; moderate cycle duration
October	155	Increasing cycle frequency; optimal breeding conditions
November	93	Reduced cycle activity as rains decline
December	50	Cycle slows; fewer blood meals and egg batches
March	156	Cycle accelerates with humidity return
April	165	Fastest cycle; highest reproductive activity

Table 3 illustrates the spatial variation in mosquito biting pressure across the five sampled communities, highlighting clear differences in human–vector contact intensity within the Orashi Region. The total number of mosquitoes collected in each location serves as an index for estimating the relative man-biting rate. Ahoada, with a total of 600 mosquitoes, exhibits a Very High biting pressure, marking it as the most affected community. This suggests the presence of abundant breeding habitats such as open drains, stagnant water bodies, and vegetative cover, which support continuous mosquito proliferation and frequent human biting. The high density in this area also points to elevated risks of mosquito-borne disease transmission. Erema (536) and Oboburu (517) follow closely, both classified as having High biting pressure. These communities appear to share similar ecological and environmental features that favor mosquito breeding, including poor waste management, swampy surroundings, or seasonal pools that support larval development. Their relatively high mosquito densities suggest substantial human exposure and a need for intensified vector control interventions. Obite (493) and Omoku (462) recorded Moderate biting pressure, indicating comparatively lower mosquito activity. These areas may benefit from better drainage systems, improved environmental sanitation, or fewer breeding sites. However, the mosquito presence is still significant enough to sustain biting activity and potential disease transmission.

Table 3: Spatial Distribution of Man-Biting Rate (Across Communities)

Community	Total Mosquitoes	Spatial Biting Pressure
Ahoada	600	Very High
Erema	536	High
Oboburu	517	High
Obite	493	Moderate
Omoku	462	Moderate

Table 4 presents the spatial distribution of Anopheles mosquitoes, the primary vectors of malaria, across the five studied communities in the Orashi Region. The data reveal substantial variation in malaria vector abundance, which directly correlates with local malaria transmission risk. Ahoada recorded the highest total of 191 Anopheles mosquitoes, indicating it as the major hotspot for malaria transmission. The elevated numbers suggest abundant breeding habitats, high humidity, and frequent human-vector contact, creating ideal conditions for malaria proliferation. Erema (153) and Oboburu (149) follow as secondary hotspots, exhibiting high Anopheles densities. These communities also present favorable environmental conditions for mosquito breeding and survival, highlighting the continued risk of malaria transmission. Omoku (137) and Obite (125) recorded lower Anopheles abundance, indicating comparatively reduced malaria vector activity. While the biting pressure is lower, the presence of Anopheles mosquitoes still represents a moderate risk, especially during peak breeding periods.

Overall, the spatial distribution of Anopheles biting rates indicates a clear gradient of malaria risk across the region: Ahoada > Erema > Oboburu > Omoku > Obite. These findings suggest that malaria control efforts, such as insecticide-treated nets, indoor residual spraying, and larval habitat reduction, should be prioritized in communities with the highest Anopheles densities, particularly Ahoada, to achieve maximum impact on malaria transmission reduction

Table 4: Spatial Variations in Anopheles Biting Rate (Anopheles Transmits Malaria)

Community	Total Anopheles
Ahoada	**191**
Erema	**153**
Oboburu	**149**
Omoku	**137**
Obite	**125**

Table 5 illustrates the spatial variation of Culex mosquitoes across the five study communities in the Orashi Region. Culex species are important vectors of filariasis and are also responsible for significant nuisance biting, which can affect human comfort and health. Erema (241) recorded the highest total Culex density, slightly surpassing Ahoada (235). This indicates that both communities provide highly suitable breeding environments for Culex, likely characterized by stagnant and polluted water, poor drainage, and proximity to human dwellings. High Culex abundance in these areas increases both the nuisance biting rate and potential filariasis transmission risk. Oboburu (219) also showed substantial Culex presence, indicating a high, but slightly lower, biting pressure compared to Erema and Ahoada. Meanwhile, Obite (199) and Omoku (176) had relatively lower Culex densities, suggesting fewer breeding habitats and reduced nuisance and filariasis transmission potential in these communities. Overall, the spatial pattern indicates that Culex biting pressure is highest in Erema and Ahoada, moderate in Oboburu, and lowest in Obite and Omoku. These findings suggest that vector control strategies targeting Culex populations, including improved environmental sanitation, drainage management, and larval habitat removal, should be prioritized in high-density communities to reduce nuisance biting and filariasis risk.

Table 5: Spatial Variations in Culex Biting Rate (Culex nuisance bites causes filariasis)

Community	Total Culex
Ahoada	235
Erema	241
Oboburu	219
Obite	199
Omoku	176

Table 6 presents the spatial distribution of Aedes mosquitoes across the five study communities. Aedes species are important vectors of arboviral diseases such as yellow fever and dengue, and their distribution indicates potential arboviral transmission risk in the region. Omoku (17) recorded the highest Aedes density, classified as Slightly High, suggesting that this community has favorable conditions for Aedes breeding, such as domestic water storage containers, tires, and other artificial habitats. This implies a comparatively higher risk of arboviral transmission in Omoku relative to other communities. Ahoada (13) and Oboburu (13) exhibited moderate Aedes densities, indicating a moderate risk for arboviral transmission. The presence of breeding sites, although not as abundant as in Omoku, can sustain local mosquito populations capable of transmitting viruses to humans. Obite (7) had a low Aedes density, suggesting limited breeding sites and a correspondingly lower risk of arboviral transmission. Erema (4) recorded the lowest count, classified as Very Low, indicating minimal spatial risk for Aedes-borne diseases in this community. Overall, the spatial distribution of Aedes mosquitoes shows a gradient of arboviral risk across the communities, with Omoku >

Ahoada = Oboburu > Obite > Erema. These findings underscore the importance of targeted vector control interventions, particularly in Omoku, where Aedes populations are sufficient to pose a public health risk. Measures such as elimination of artificial containers, regular cleaning of water storage, and community awareness programs should be emphasized in higher-risk areas to reduce potential disease transmission.

Table 6: Spatial Aedes Distribution (Vector of yellow fever, dengue)

Community	Total Aedes	Spatial Risk
Ahoada	13	Moderate
Erema	13	Moderate
Oboburu	17	Slightly High
Obite	7	Low
Omoku	4	Very Low

This study assessed the man-biting rate (MBR), gonotrophic cycle, and spatial distribution of mosquitoes in the Orashi region of Rivers State, Nigeria, to evaluate their potential for disease transmission. A total of 3,725 mosquitoes were collected across five communities Ahoada, Erema, Oboburu, Obite, and Omoku comprising Anopheles, Culex, and Aedes species. Seasonal trends in MBR showed the highest biting activity in March (368 mosquitoes) and April (386 mosquitoes), corresponding to the late dry season and early rainy season, while the lowest activity occurred in December (118 mosquitoes) during the early dry season. These fluctuations indicate that environmental factors such as rainfall, humidity, and temperature significantly influence mosquito activity and human-vector contact (Service, 1993; Gillies & Coetzee, 1987; Reiter, 2001). The gonotrophic cycle of Anopheles mosquitoes varied seasonally, with accelerated cycles in March–April and slower cycles in November–December. Faster cycles imply increased feeding frequency, egg maturation, and potential malaria transmission, whereas slower cycles during the dry season reduce reproductive output and disease risk (Keiser et al., 2005; Hemingway et al., 2016).

Spatial distribution analysis revealed heterogeneity across communities. Ahoada recorded the highest overall biting pressure and Anopheles abundance, indicating it as a malaria hotspot. Erema exhibited the highest Culex density, representing elevated filariasis risk, while Omoku had the highest Aedes density, suggesting localized arboviral disease risk. Other communities, such as Obite and Oboburu, recorded moderate to low mosquito densities, but still contribute to disease transmission (Ogbuefi et al., 2023; Galaya et al., 2025). These findings emphasize the need for seasonally and spatially targeted vector control strategies. High-risk communities should be prioritized for interventions including larval source reduction, indoor residual spraying, insecticide-treated nets, and community education to reduce mosquito breeding, biting rates, and disease transmission (Service, 2012; WHO, 2017). The study also highlights the importance of continuous entomological surveillance to monitor mosquito populations, gonotrophic cycles, and biting activity to guide timely public health interventions (Adejayan et al., 2024).

Conclusion and Recommendations

The study on the man-biting rate and gonotrophic cycle of mosquitoes in the Orashi region of Rivers State reveals significant seasonal and spatial variations in mosquito abundance, biting behavior, and reproductive activity. A total of 3,725 mosquitoes were recorded, dominated by Culex and Anopheles species, with Aedes present in lower numbers. Analysis of the monthly man-biting rate (MBR) indicated that mosquito biting activity peaked in March and April, coinciding with high humidity and optimal breeding conditions, while the lowest activity occurred in December during the early dry season. Gonotrophic cycle analysis demonstrated that Anopheles mosquitoes exhibit accelerated reproductive cycles during peak months, increasing the frequency of blood feeding and potential for malaria transmission. Spatially, the distribution of mosquitoes was heterogeneous.

Ahoada recorded the highest overall biting pressure and Anopheles abundance, identifying it as a hotspot for malaria transmission. Erema showed the highest Culex density, indicating elevated nuisance biting and filariasis risk, while Omoku had the highest Aedes population, suggesting localized risk for arboviral diseases such as yellow fever and dengue. Communities like Obite and Erema exhibited lower mosquito densities and relatively reduced vector-borne disease risk. Overall, the study highlights the critical need for seasonally and spatially targeted vector control strategies to reduce mosquito abundance, biting pressure, and disease transmission risk in the Orashi region. It was recommended that;

i. Priority should be given to high-risk communities such as Ahoada, Erema, and Omoku.
ii. Measures should include indoor residual spraying (IRS), distribution of insecticide-treated nets (ITNs), and community-based larval source management.
iii. Stagnant water bodies, drains, and other mosquito breeding sites should be regularly cleared, especially in Ahoada and Erema.
iv. Proper waste disposal and drainage maintenance are critical to reduce Culex and Aedes breeding.
v. Conduct routine entomological surveillance during peak breeding months (March–April and September–October) to track mosquito abundance and biting rates.
vi. Monitor gonotrophic cycle dynamics to predict periods of increased disease transmission risk.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Credit Authorship Contribution Statement

Wisdom, U. G.: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Visualization, Project administration, Writing - original draft. **Oghanri, S. U. and Iwuorie, C. G.:** Methodology, Data Curation, Validation, Visualization, Review & Editing.

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