# Effects of Rainfall and Temperature on the Occurrence of Malaria and Typhoid Fever in Awka South, Anambra State

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## ABSTRACT

This study examined the effect of rainfall and temperature on the occurrence of malaria and typhoid in Awka South LGA, Anambra State. Records of rainfall and temperature were obtained from Nigeria Meteorological Agency (NMets) while the records of malaria and typhoid cases were obtained from Chukwuemeka Odimegwu Ojukwu Teaching Hospital Amaku Awka from 2015 to 2024. Time series analysis was used to analyze the trends of each of the data collected. Pearson Product Moment Correlation analysis was used to analyze the relationship between the occurrence of the diseases and the climatic parameters. The seasonal occurrence of the diseases was analyzed by dividing the year into cold dry season, hot dry season and rainy season. The correlation analysis indicated that malaria and typhoid are influenced differently by the various climate factors. Rainfall showed a significant positive relationship ($r=0.423$, $p<0.001$) with malaria and typhoid ($r= 0.398$, $p<0.001$) while temperature showed a significant negative relationship with malaria ($r = - 0.551$, $p<0.001$) and typhoid ($r=-0.522$, $p<0.001$). The result of seasonality analysis of the occurrence of malaria and typhoid showed a seasonal pattern in disease occurrence. It was recommended that should come up with enlightenment programs should be viii conducted to educate people on the effect of climate change on the occurrence of diseases; to also provide safe and adequate drinking water for the masses; and provide free mosquito nets for the residents of the area. The people on the other hand should improve on their sanitation in their environment

**Keywords:** Malaria, Typhoid, Rainfall, Temperature, Trend, Awka

## INTRODUCTION

Malaria and typhoid fever are significant contributors to morbidity and mortality, placing a heavy burden on healthcare systems, stifling economic productivity, and impeding social development (World Health Organization, WHO 2023). Malaria and typhoid fever remain formidable public health challenges in tropical and subtropical regions, particularly in sub-Saharan Africa. Nigeria bears the world's highest malaria burden, accounting for nearly 27 percent of the global malaria cases and 31 percent of malaria-related deaths (WHO, 2023). Typhoid fever, caused by *Salmonella Typhi,* is also highly endemic in Nigeria due to inadequate sanitation and limited access to clean water, with an estimated incidence of 535 cases per 100,000 persons (Ikefuna & Iroezindu, 2020). The transmission dynamics of these diseases are profoundly influenced by climatic factors. Malaria, a vector-borne disease transmitted by the female Anopheles mosquito, is highly sensitive to variations in temperature and rainfall. Temperature affects the mosquito's life cycle, biting rate, and the development rate of the malaria parasite within the mosquito (the extrinsic incubation period) (Caminade et al., 2019). Rainfall, on the other hand, creates breeding sites for mosquitoes (static water bodies). However, both excess and deficit rainfall can impact mosquito abundance in complex ways (Akpan et al., 2018). Similarly, typhoid fever, a water-borne disease, exhibits strong seasonal patterns often linked to climatic conditions. Heavy rainfall can lead to the contamination of drinking water sources through sewage overflow and runoff, especially in areas with poor sanitation infrastructure (Bashir et al., 2021). Higher temperatures can also facilitate the proliferation of *S. Typhi* in contaminated water and food (Bandino et al., 2015).

Malaria and typhoid fevers represent a persistent and devastating dual burden on public health systems across Nigeria, particularly in rural and peri-urban communities with limited access to clean water and robust sanitation infrastructure. Nigeria accounts for the highest global burden of malaria, with an estimated 68 million cases and 194,000 deaths annually, primarily affecting children under five and pregnant women (World Health Organization, 2023). Concurrently, typhoid fever remains highly endemic, with systematic reviews indicating a high incidence in sub-Saharan Africa due to pervasive issues with water quality and sanitation. The co-occurrence of these diseases often leads to misdiagnosis and complicates clinical management, further straining already fragile healthcare systems. The transmission of both malaria and typhoid is intrinsically linked to environmental and climatic conditions. Recent estimates indicate that sub-Saharan Africa experiences a high incidence of typhoid, with invasive bacterial diseases such as typhoid contributing significantly to mortality in children under five years of age (Marks et al., 2022).

Human health is affected by natural environmental factors such as temperature and rainfall. Continuous research into the influence of meteorological parameters on infectious diseases is a veritable strategy for proffering sustainable solution to their morbidity; this is because climate affects infectious diseases more than most other disease categories especially in Africa, where the burden of infectious diseases is highest (Wilkinson, 2016).

Researchers have found a close link between local climate and the occurrence or severity of some diseases. Weather and climate can influence host defenses, vectors, pathogens and habitat. The importance of examining the role of weather on human health cannot be over emphasized. There is growing evidence that the earth's climate is changing is leading researchers to revisit the long standing relationship between climate and disease from a global perspective. Increased atmospheric and surface temperatures are already contributing to the world wide burden of disease and premature deaths, and are anticipated to influence the transmission dynamics and geographic distribution of malaria, dengue fever, tick-borne diseases and diarrhea diseases such as cholera (IPCC, 2013).

A growing body of empirical research across Africa—especially in Nigeria—has established strong correlations between climatic factors and the incidence of both malaria and typhoid. Temperature and rainfall remain two of the most studied variables due to their direct and indirect effects on disease transmission, pathogen survival, and human exposure. In Nigeria, Ayanlade et al. (2020) examined the spatiotemporal relationship between rainfall variability and malaria incidence in several states, including those in the southeastern region. Their findings revealed that increased rainfall, particularly during the wet season (April–October), significantly correlates with spikes in malaria cases. Similarly, Oresanya et al. (2018) indicated that moderate increases in temperature (25–30°C) provided optimal conditions for Anopheles mosquitoes and Plasmodium parasites, while extreme heat slightly suppressed mosquito survival. This aligns with findings by Mordecai et al. (2013) which proposed 25°C as the most efficient temperature for malaria transmission. In the context of typhoid, Eze et al. (2018) explored seasonal outbreaks in parts of southeastern Nigeria and linked them to poor sanitation, water contamination, and intensified rainfall. Their study recorded a higher prevalence of typhoid fever during the rainy season, attributing it to the overflow of latrines and contamination of boreholes and wells. Similarly, Okunlola et al. (2021) found strong links between temperature fluctuations and typhoid spread in urban centers of southwestern Nigeria, especially where water is stored during hot periods. Across other African countries, Thomson et al. (2017) analyzed climate-health data from East and West Africa and emphasized how climate variability—especially increasing rainfall extremes—contributed to malaria resurgence in highland and previously malaria-free regions. For typhoid, Dewan et al. (2013) in their multi-country analysis confirmed that rainfall intensity and poor drainage systems consistently predict higher typhoid incidence in African urban slums. Overall, these studies underline the vulnerability of African populations—especially in Nigeria—to climate-sensitive diseases. These studies offer context-specific insights that are essential for understanding the local epidemiology of these climate-sensitive diseases. In Awka, Okafor and Anyaorah (2019) examined the seasonal distribution of malaria cases and found that the highest incidence occurred during the peak of the rainy season (June–September). Their study highlighted that stagnant rainwater in poorly drained areas of Awka South created breeding habitats for

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Anopheles mosquitoes, especially in peri-urban zones with limited sanitation infrastructure. Similarly, Igbokwe et al. (2020) reported a positive correlation between temperature rise and increased malaria transmission in Anambra State. The study suggested that average temperatures between 27°C and 30°C, which are common in Awka during the dry-to-wet season transition, created optimal conditions for mosquito activity and parasite development. In the context of typhoid fever, Umeh and Ogbuagu (2018) investigated the seasonal occurrence of waterborne diseases in Awka and found typhoid prevalence to be higher during the rainy season. Beyond Anambra, studies in other southern Nigerian states support these findings. In Enugu, Mwankwo et al. (2017) found that both malaria and typhoid cases peaked during rainy periods, especially in low-income settlements with inadequate drainage system. These regional studies consistently point to the role of climatic conditions, combined with human environmental practices, in shaping disease patterns. The southern region's tropical climate—characterized by high humidity, seasonal rainfall, and warm temperatures—creates a suitable ecological niche for disease transmission.

In Awka South Local Government Area, these two diseases contribute significantly to morbidity and mortality, consistently ranking among the top causes of hospital admissions and outpatient visits. Despite the implementation of national and state-level intervention programs—including the distribution of insecticide-treated nets (ITNs), seasonal malaria chemoprevention (SMC), and efforts to improve water, sanitation, and hygiene (WASH), the prevalence of malaria and typhoid remains alarmingly high and subject to periodic surges. A critical barrier to their optimization is the lack of localized, evidence-based understanding of the environmental drivers of disease transmission in Awka South LGA. The Intergovernmental Panel on Climate Change (IPCC, 2022) has projected increased temperature variability and more intense, erratic rainfall patterns for West Africa. Without a clear understanding of the current climate-disease relationship in Awka South LGA, it is impossible to build predictive models to forecast how future climate scenarios might impact disease burden, thereby undermining long-term public health resilience and adaptation planning. Therefore, the core research problem addressed by this study is the absence of a definitive, empirical analysis of the effects of temperature and rainfall on the occurrence of malaria and typhoid fever in Awka South LGA. The aim of this study is to examine the effects of rainfall and temperature on the occurrences of Malaria and Typhoid in Awka South LGA Anambra State from 2015 to 2024.

## MATERIALS AND METHODS

### Study Area

Awka South Local Government Area is made up of nine towns, namely, Amawbia, Awka, Ezinato, Isiagu, Mbaukwu, Nibo, Nise, Okpuno and Umuawulu. The LGA is situated at approximately 6°10′N 7°04′E and covers an area of about 164.2 km². According to the 2006 census, Awka South LGA has a total population of 189,654 people. Awka South LGA area experiences a tropical wet and dry climate, typical of southern Nigeria with distinct wet and dry seasons. Rainy season usually begins around March/April and lasts until October with peak rainfall in June and September. Average annual rainfall ranges from 1,500 mm to 2,000 mm supporting lush vegetation and agriculture. Dry Season spanning from November to March features reduced rainfall, lower humidity, and the presence of the harmattan (a dry, dusty wind from the Sahara). The area generally experiences warm to hot temperatures year-round, ranging between 26°C and 32°C with March and April typically the hottest months. Humidity is high during the rainy season and moderate during the dry season. This climatic pattern plays a significant role in the health and livelihood of residents, influencing the spread of climate-sensitive diseases such as malaria and typhoid fever.

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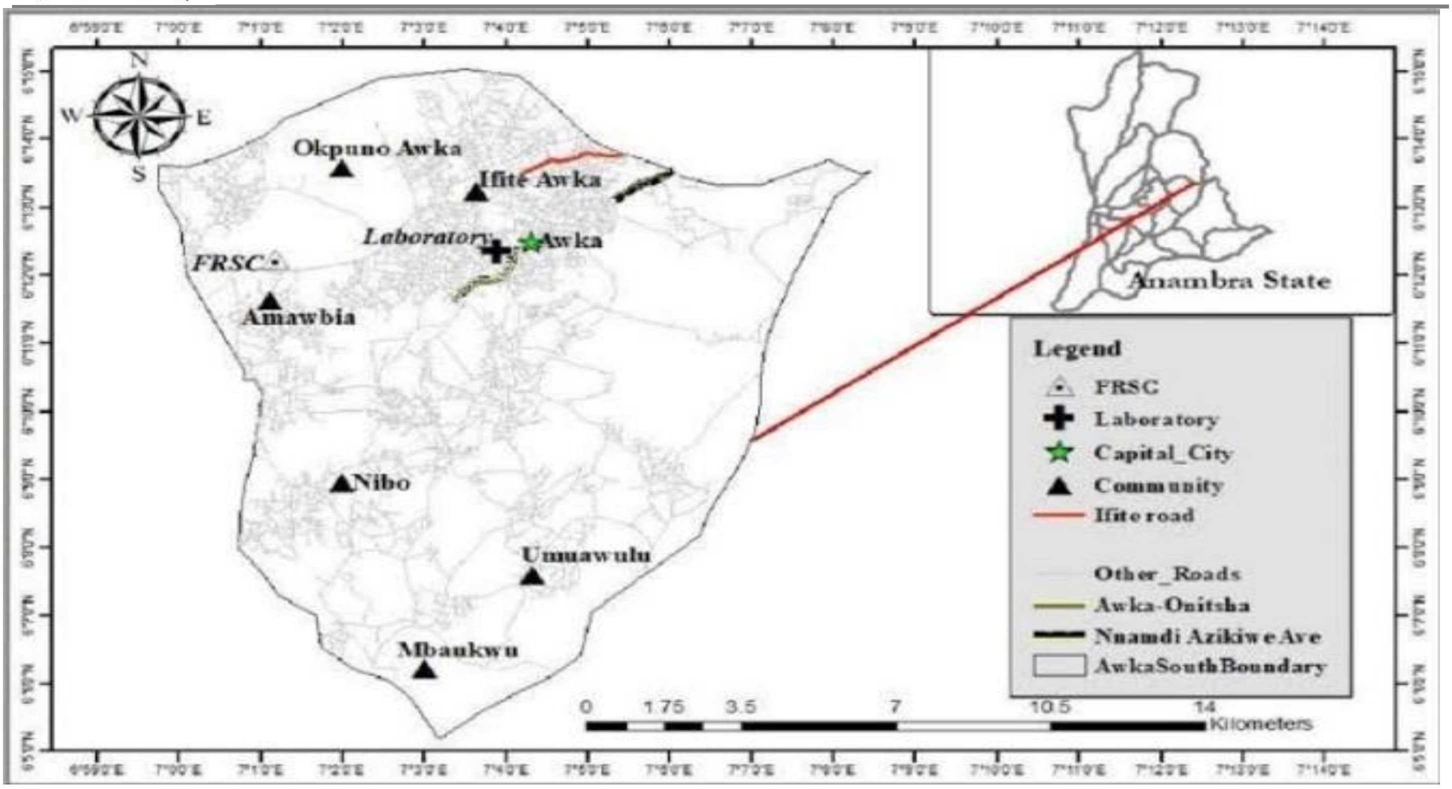


Figure.1: Map of Awka South Local Government Area.

## METHODOLOGY

This study adopts a descriptive and correlational research design to examine the relationship between climatic variables (temperature and rainfall) and the occurrence of malaria and typhoid in Awka South LGA, Anambra State. The design allows for quantitative analysis of secondary data and supports the identification of patterns and trends over time.

### Data needs

This research requires both health and climatic data to examine the effects of temperature and rainfall on the occurrences of malaria and typhoid in Awka South LGA. Data for this study were collected from secondary sources. The health data include monthly records of confirmed malaria and typhoid cases, as well as any documented cases of co-infection from 2015 to 2024 was obtained from Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Amaku Awka. Meteorological data consisting of monthly average temperature (maximum and minimum) and monthly rainfall amount for the same time period was sourced from the Nigerian Meteorological Agency (NiMets).

### Method of Data Analysis

The collected data were analyzed using both descriptive and inferential statistical techniques. Time series and trend analysis of climatic and diseases occurrence from 2015-2024 was analyzed to determine the patterns of climatic variables and diseases occurrence while the Pearson’s correlation coefficient was used to examine the relationship between climatic variables and disease cases from 2015 to 2024.

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# RESULTS AND DISCUSSION

## Patterns of Rainfall and Temperature Distribution in Awka South Local Government Area

### Monthly Average Rainfall in Awka South from 2015-2024

Rainfall in Awka South is highly seasonal and varies from month to month. The distribution of monthly average rainfall in Awka South LGA from 2015 to 2024 is shown in figure 2. From the result rainfall distribution in Awka South Local Government Area fluctuates reflecting a very distinct seasonal pattern with rainfall almost absent in January (1.34 mm) and December (6.92 mm). rainfall rises slightly in February with average rainfall of about 30.84 mm, and then increases more noticeably in March. The wet season fully sets in from April with significant amounts and reaches an early maximum in June and July before experiencing a short-lived reduction of rainfall in August, known as the Little Dry Season (August Break). Rainfall intensifies again, peaking in September, which is the wettest month of the year. It then begins to decline steadily through October and November, returning to minimal levels by December. This distribution demonstrates the bimodal rainfall regime characteristic of southern Nigeria with two rainfall peaks separated by the August break and an extended dry season from November to February. The concentration of rainfall within six to seven months of the year has important implications for the spread of diseases in the study area. The heavy rainfall months (June– September) create stagnant pools and blocked drains that serve as breeding grounds for mosquitoes, which increases malaria transmission during this period. At the same time, intense rainfall can also lead to contamination of water sources, thereby raising the risk of typhoid fever, especially in communities that depend on surface water or shallow wells.

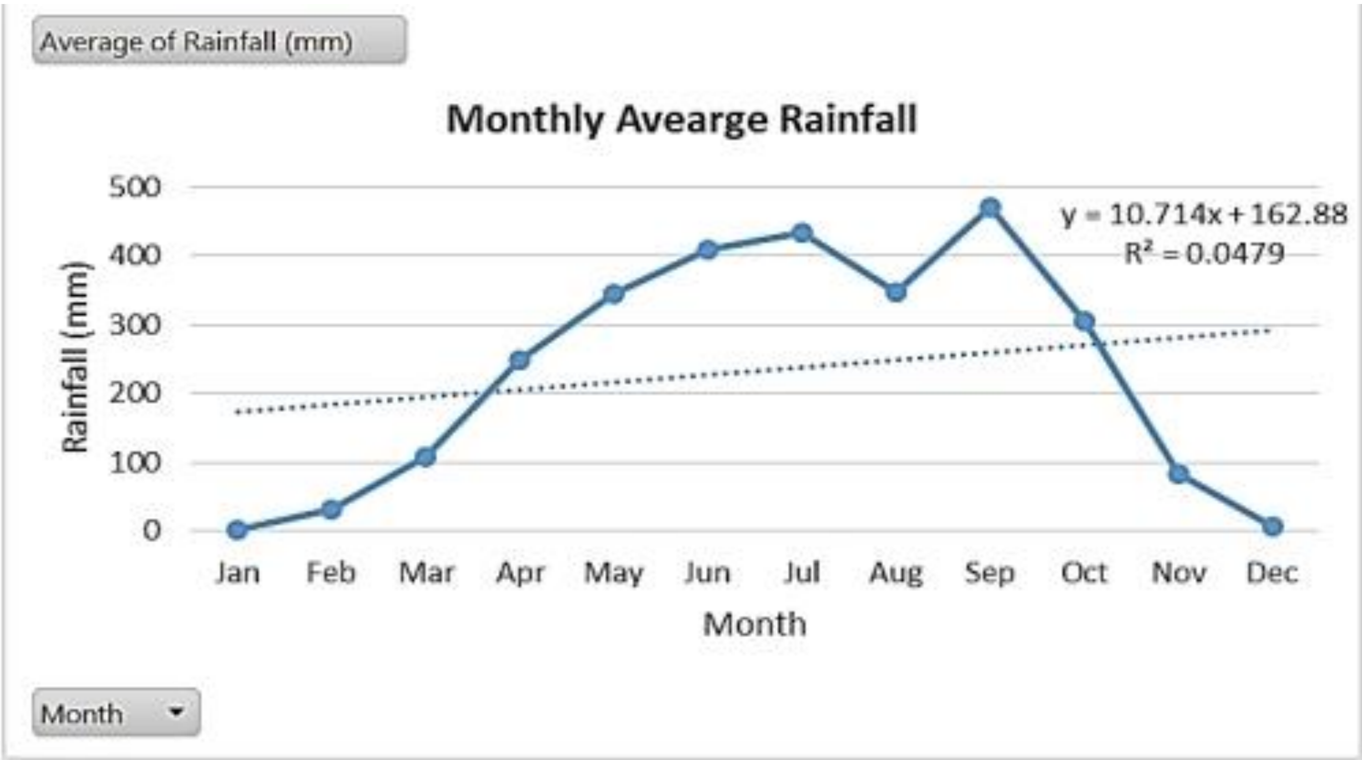


Figure 2: Average Monthly Rainfall (2015 – 2024).

The trend line equation (y = 10.714x + 162.88) and the associated $R^2$ value of 0.0479 are also displayed on the chart. The $R^2$ value indicates the strength of the statistical fit between the months and the rainfall values. The value suggests that there is very little long-term trend in the data. this indicates that rainfall follows its seasonal cycle consistently without showing a significant upward or downward shift over the years. This makes the figure

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useful for confirming that while rainfall is highly seasonal, its monthly averages remain relatively stable across the 2015–2024 period.

**Monthly average Temperature (2015 – 2024)**

The mean monthly temperature in Awka South Local Government Area over the ten-year period is presented in Figure 3, indicates that the warmest months are February and March coinciding with the late dry season. Temperatures then decline slightly with the onset of rains, reaching their lowest in July and August, when heavy cloud cover and persistent rainfall suppress daytime heating. A gradual increase follows in October and November before values stabilize again in December. The graph confirms that while temperature fluctuates across the year, the magnitude of change (about 3–4 °C) is far smaller than rainfall swings. Nevertheless, this small variation is ecologically important: high pre-rainfall temperatures create favorable breeding conditions for vectors such as mosquitoes, while lower temperatures during rainy months may slow down transmission cycles but do not drop enough to inhibit them completely.

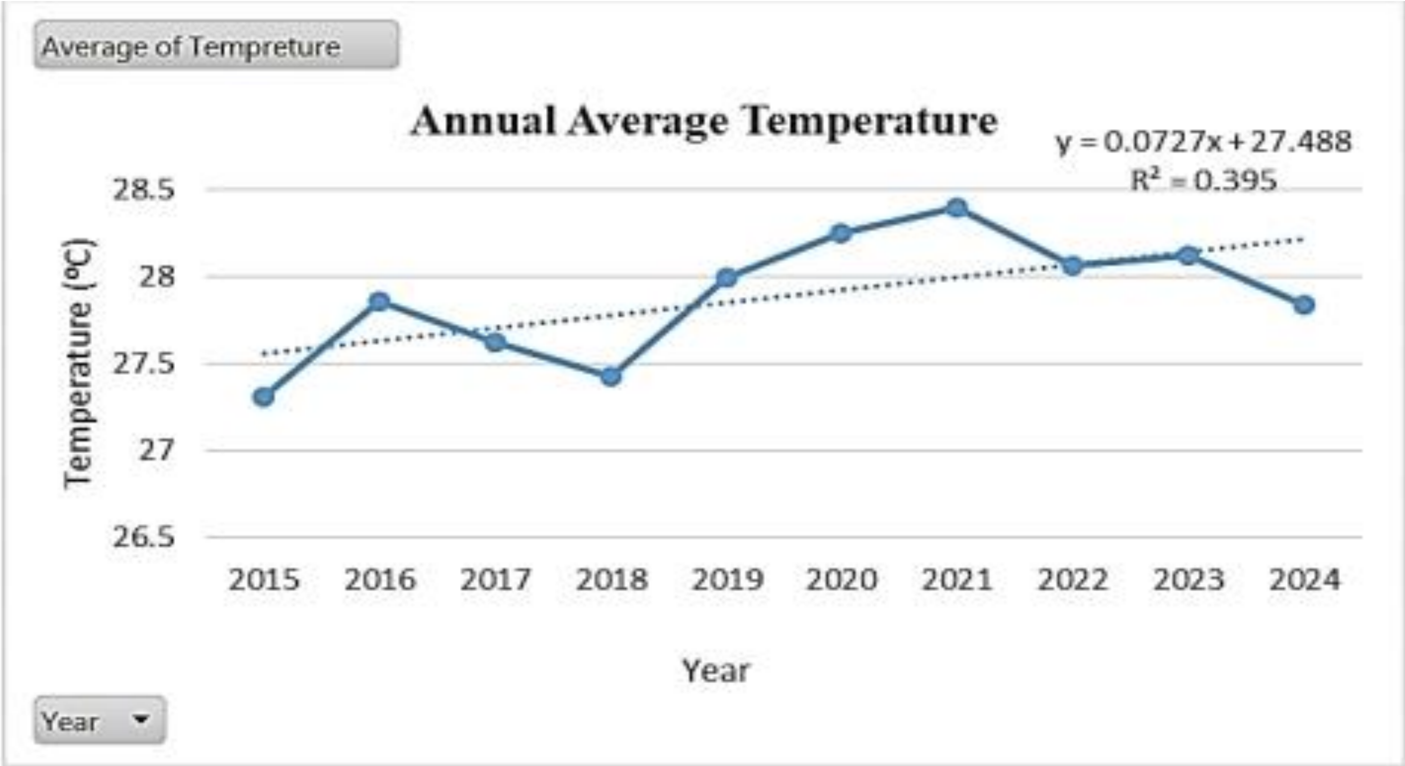


Figure 3: Monthly average Temperature (2015 – 2024)

**Patterns of distribution of cases of malaria and typhoid in the study area from 2015-2024.**

The annual recorded incidences of malaria and typhoid cases are presented in figure 4. From the graph, malaria consistently recorded much higher cases than typhoid throughout the study period. In total, malaria accounted for 9,430 cases compared to 638 cases of typhoid, representing more than 90% of the disease burden. This highlights the predominance of malaria as a public health concern in the study area. The yearly trend shows fluctuations in reported cases. For malaria, the highest cases were observed in 2018 and 2021 while the lowest occurred in 2020. Similarly, typhoid cases peaked in 2021 whereas the lowest value was recorded in 2020. The decline in 2020 for both diseases suggests possible disruptions in healthcare-seeking behavior or reporting, which could be linked to broader socio-economic or environmental conditions during that year-the Covid-19.

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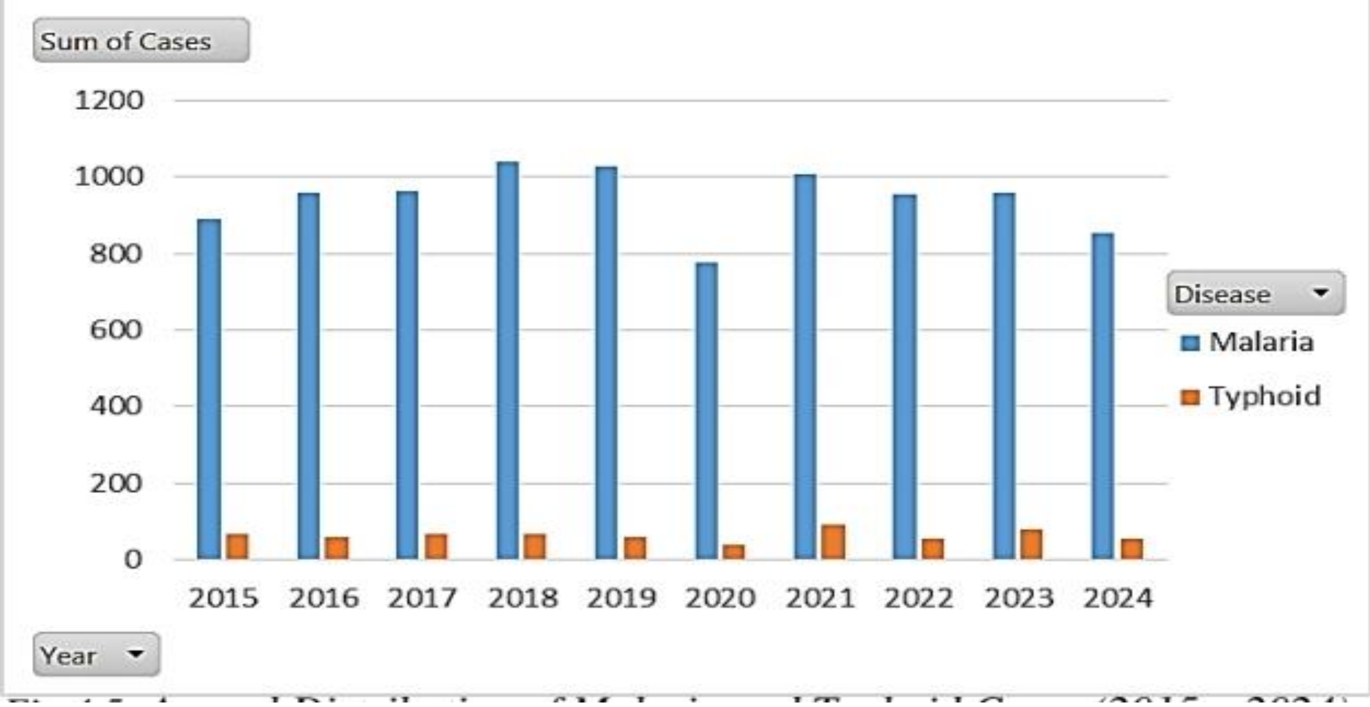


Figure 4: Annual Distribution of Malaria and Typhoid Cases (2015 – 2024)

**Relationship between the pattern of temperature and rainfall and the occurrence of malaria and typhoid.**

To achieve this objective a scatter plot with trend lines and $R^2$ values to validate and visualize relationships between climate variables and disease cases. Correlation Analysis was used to build a correlation matrix showing R-values, t-statistics, p-values, and interpretation of strength, direction, and significance.

**Combo Charts of Climatic Variables and Disease Cases**

The figure 5 illustrates the monthly relationship between rainfall and malaria and typhoid cases over a ten-year period. The result shows that rainfall and malaria cases distribution displays a seasonal pattern with clear peaks during the wet months (June–September) and troughs during the dry season (December–February). Even in years with relatively moderate rainfall (e.g., 2020), malaria cases remained elevated for some months after rainfall had subsided. This lag effect indicates that mosquito breeding continues in stagnant water that persists after the rains. In some years, malaria cases rise slightly later than rainfall, highlighting the time needed for mosquito breeding cycles and parasite incubation to contribute to disease. It is also evident that typhoid cases display seasonal pattern often rise during or shortly after months of heavy rainfall. Peaks are noticeable in several years such as 2016, 2018, 2020, and 2023, where rainfall levels were particularly high and typhoid cases also increased significantly. The pattern suggests that rainfall indirectly influences typhoid transmission.

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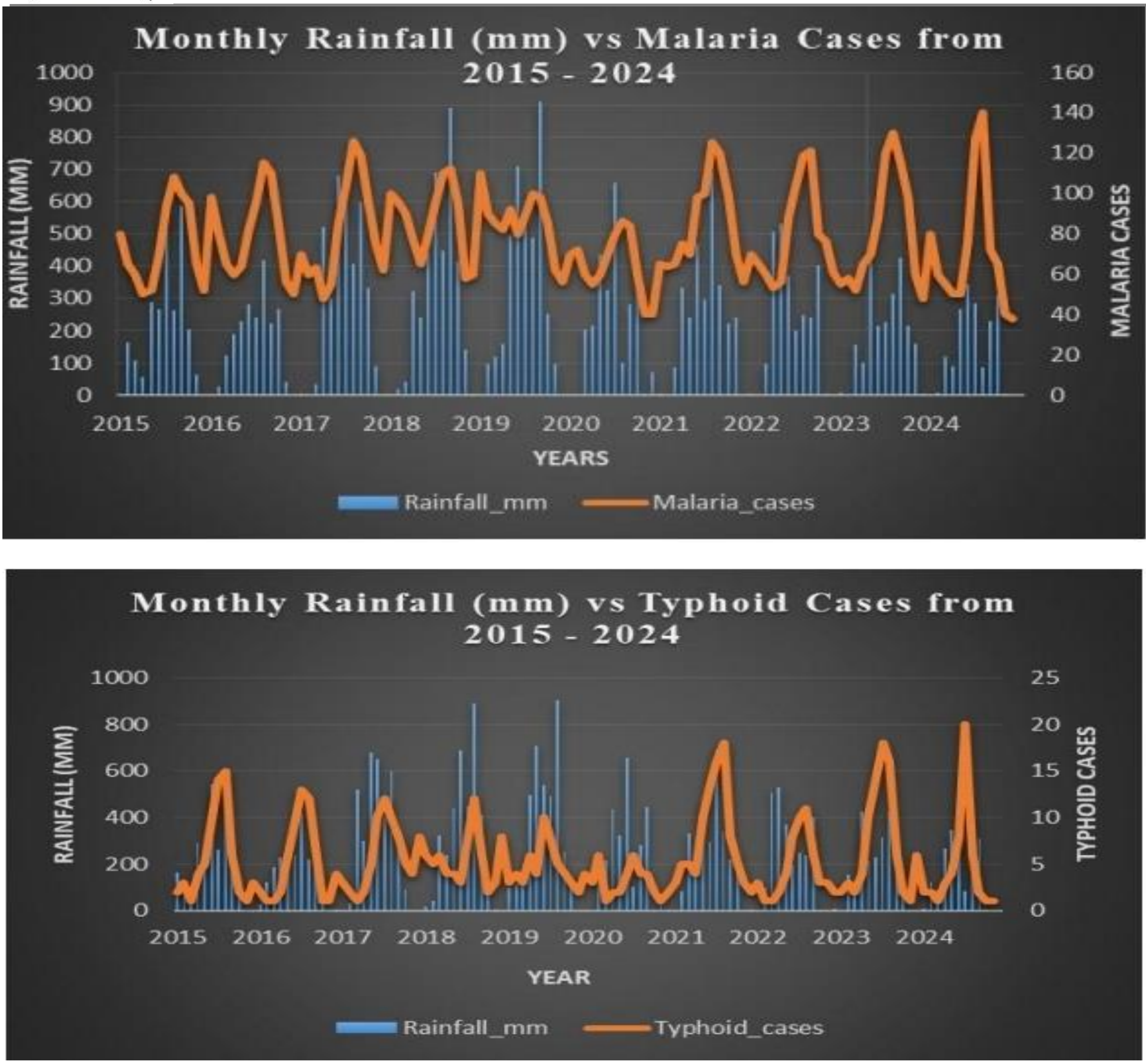


Figure.6. Monthly Rainfall (mm) vs Malaria and Rainfall Vs Typhoid Cases

Figure 7 illustrates the relationship between monthly temperature variations and reported malaria and typhoid cases across the ten-year period (2015–2024). The graph shows that malaria cases are not evenly distributed throughout the year but closely follow temperature cycles. One of the key observations is that malaria tends to increase when temperatures remain within the moderate tropical range (20–30°C), which favors mosquito survival and parasite development. Unlike rainfall, which provides breeding grounds through stagnant water, temperature primarily influences the speed of mosquito reproduction and the incubation rate of the malaria parasite inside the vector. This explains why even in months with less rainfall, malaria cases remain relatively high if the temperature is conducive. Interestingly, the chart reveals dips in malaria cases during extreme temperature fluctuations, especially when values approach the higher end of the spectrum (~30–32°C). Unlike malaria, which is directly tied to mosquito ecology, typhoid transmission is more closely linked to human behavior, sanitation, and water quality, though climate factors such as temperature still play an indirect role. The chart shows that typhoid cases often rise during warmer months, particularly when temperatures remain high and stable.

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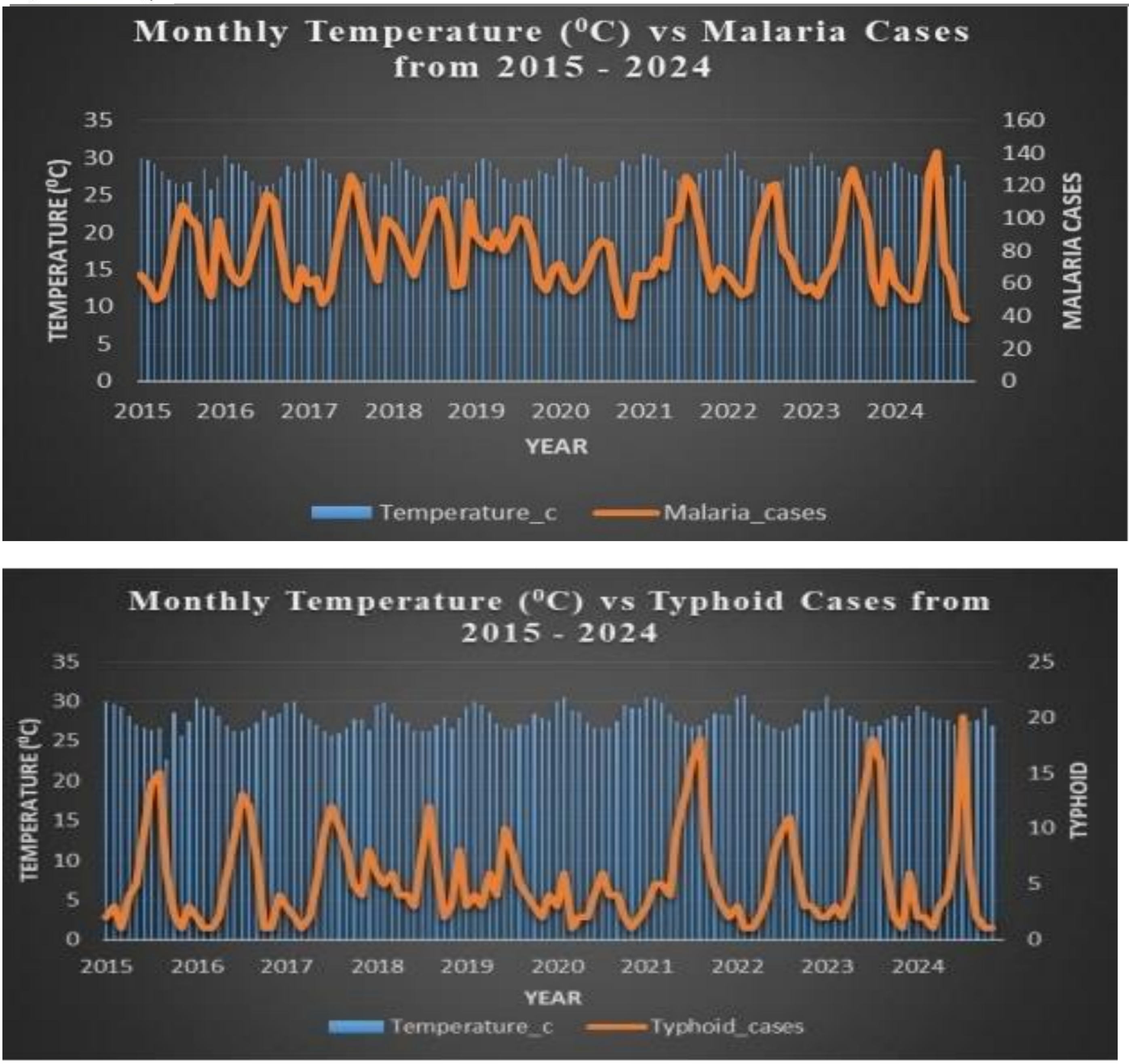


Figure 7: Monthly Temperature (°C) vs Malaria and Typhoid Cases from 2015–2024.

**Scatter Plots of Relationships**

Figure 8 shows the scatter plot of monthly rainfall (mm) against malaria cases from 2015 to 2024. The scatter points reveal a generally upward trend, as confirmed by the fitted regression line. The equation of the line is $y = 0.0454x + 68.019$, indicating that as rainfall increases, malaria cases also tend to rise. Specifically, for every additional 1 mm of rainfall, malaria cases increase by approximately 0.045 on average. The $R^2$ value of 0.1787 suggests that rainfall alone explains about 18% of the variation in malaria cases. While this is not a very strong explanatory power, it does indicate a meaningful relationship, implying that rainfall is one of several contributing factors influencing malaria prevalence. The positive slope further demonstrates that malaria incidence increases during months of higher rainfall, which aligns with the epidemiological understanding that rainfall creates breeding grounds for mosquitoes. The regression equation $y = 0.0079x + 3.4867$ indicates a slight positive relationship between rainfall and typhoid incidence. This suggests that for every additional 1 mm of rainfall, typhoid cases increase by about 0.008 on average. The $R^2$ value of 0.1584 means that rainfall explains roughly 16% of the variation in typhoid cases.

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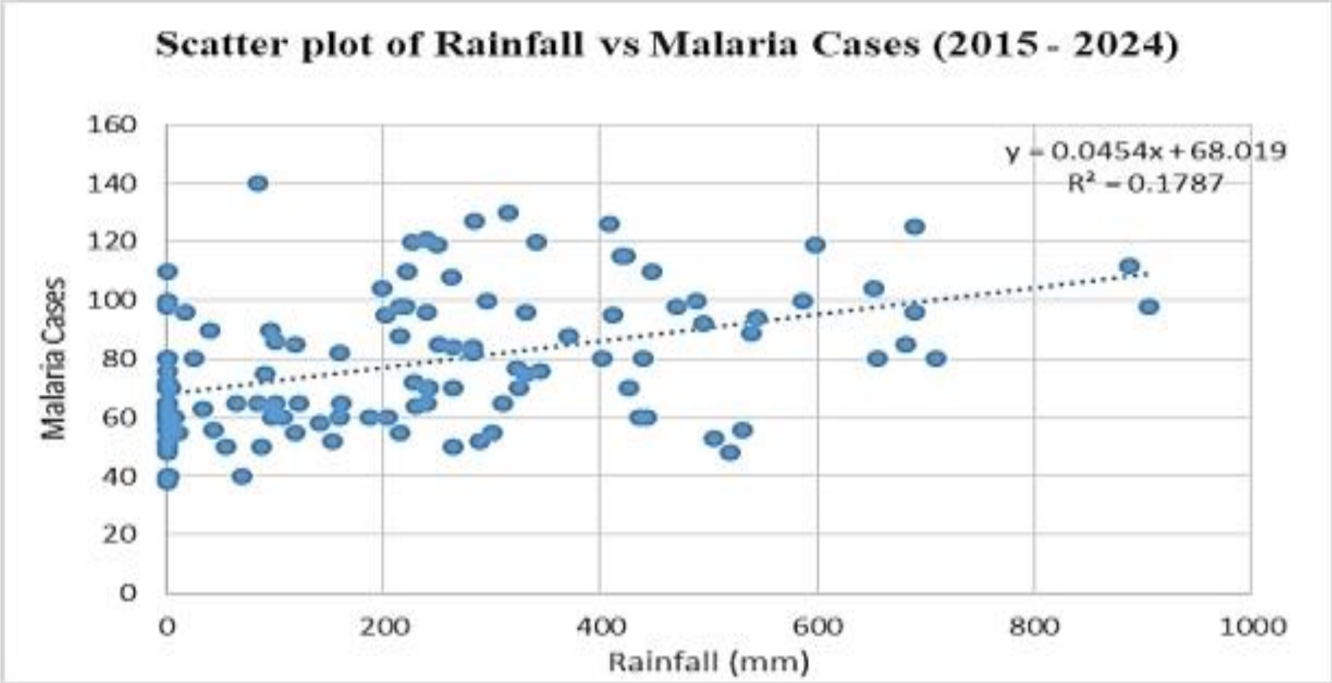


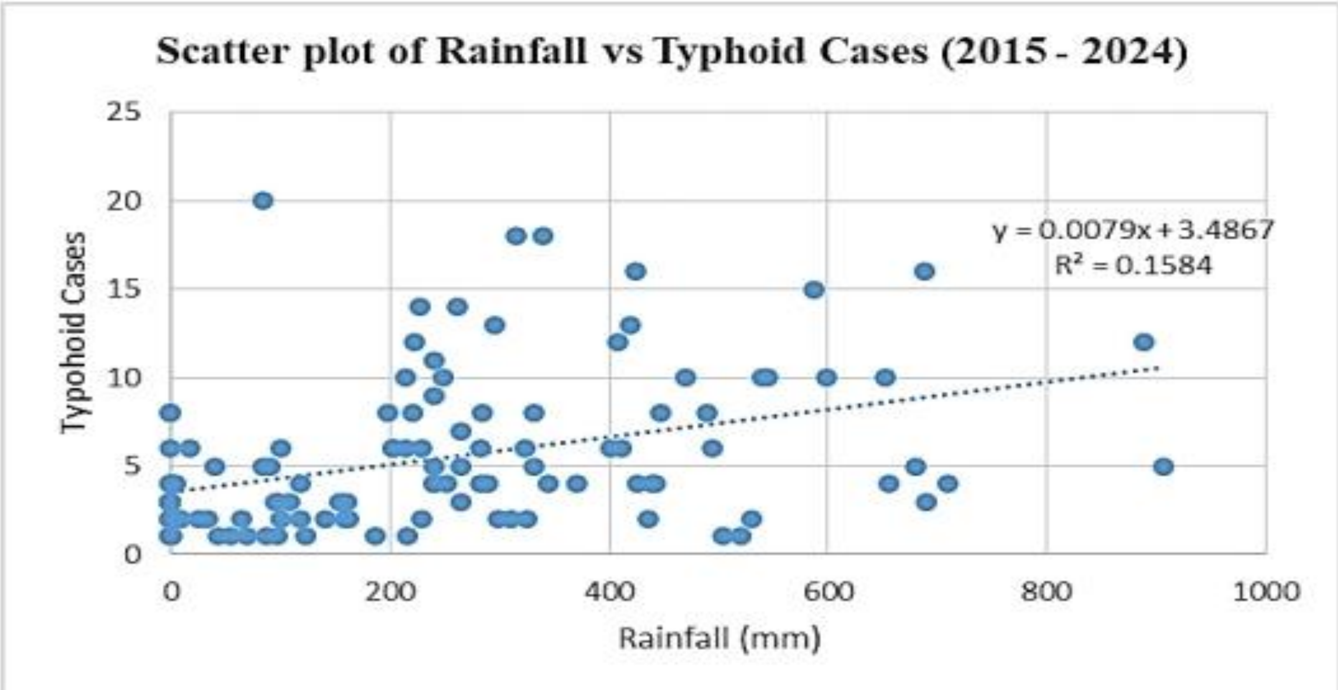


Figure. 8: Scatter plot of Rainfall vs Malaria and typhoid Cases (2015–2024

Figure 9 illustrates the scatter plot of monthly temperature (°C) against malaria and typhoid cases between 2015 and 2024. The regression line has a negative slope (–9.4975), which indicates an inverse relationship between temperature and malaria incidence. In practical terms, as temperature increases, the number of malaria cases tends to decline. The $R^2$ value of 0.3035 suggests that about 30% of the variation in malaria cases can be explained by temperature alone. Interestingly, most of the points are concentrated within the 26–30°C range, which reflects the general climatic condition of the region.

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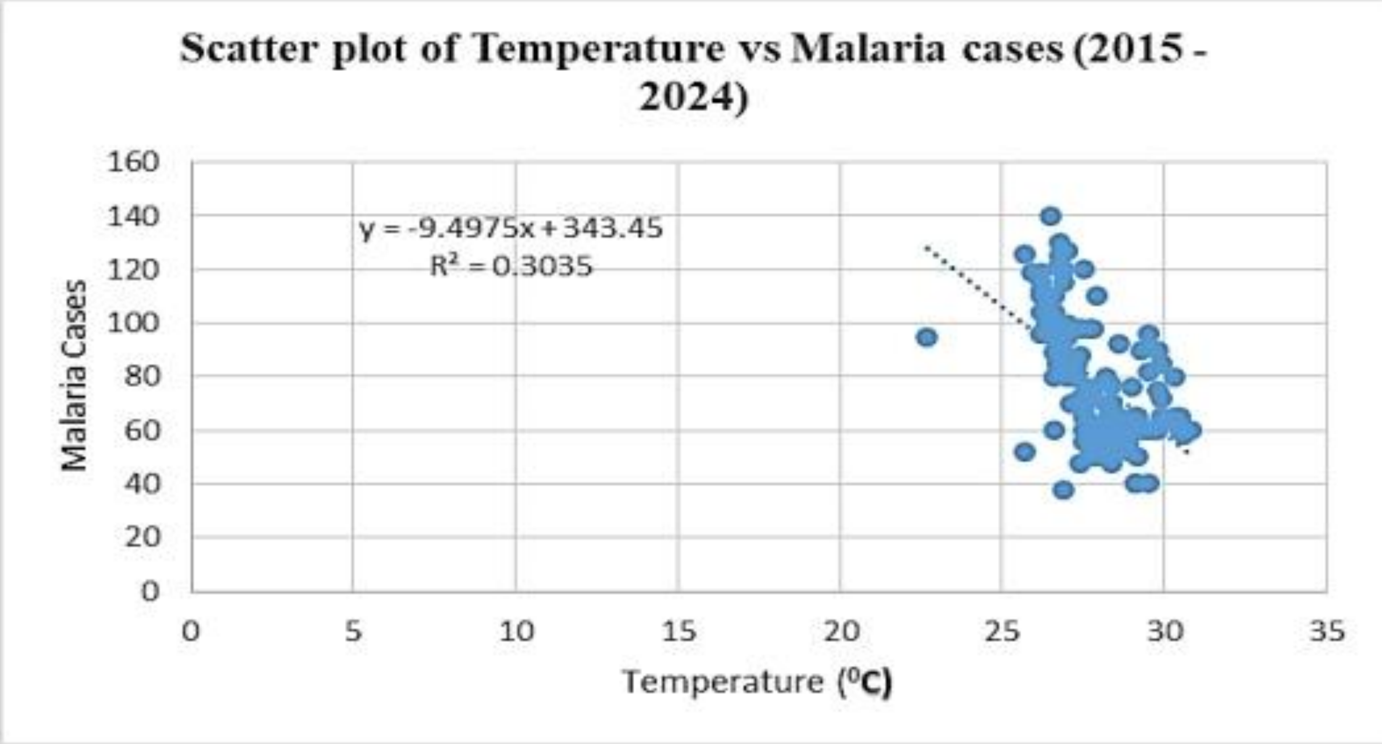


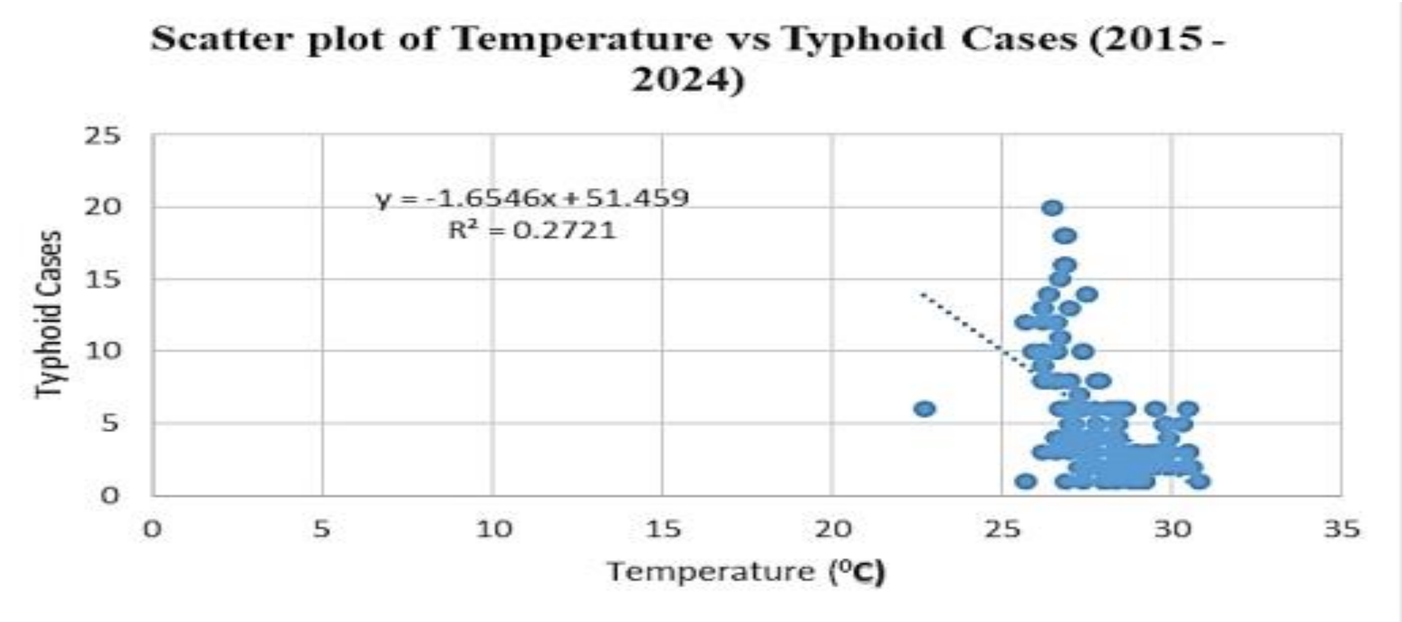


Figure 9: Scatter plot of tempearture vs Malaria and typhoid Cases (2015–2024

The downward trend highlights that malaria transmission appears to reduce during periods of higher temperature, possibly because extremely high heat can shorten mosquito lifespans or reduce breeding efficiency. On the other hand, moderate temperatures within the optimal mosquito survival range (around 25–28°C) may still support malaria prevalence. The regression equation ($y = -1.6546x + 51.459$) also indicates a negative relationship between temperature and typhoid incidence. The $R^2$ value of 0.2721 implies that about 27% of the variability in typhoid cases can be linked to temperature changes. While not extremely high, this level of explanatory power demonstrates that temperature plays a noticeable role in shaping typhoid patterns in the study area. There is clustering of typhoid cases within the 26–30°C range, suggesting that most outbreaks occurred under moderate temperatures. The downward slope confirms that cases decline as the climate shifts toward hotter extremes. This underlines that, although rainfall is the more critical climatic driver for typhoid, temperature also exerts a moderating effect on the occurrence of the disease.

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### Correlation Analysis

The statistical relationship between climatic variables (rainfall and temperature) and the prevalence of malaria and typhoid between 2015 and 2024 was examined using the Pearson correlation coefficient. The result is presented in table 2.

| variable pair | R | n | t | p(two-tailed) | Strength | Direction | Significant |
|---|---|---|---|---|---|---|---|
| Rainfall – Malaria | 0.423 | 120 | 5.066779 | P<0.001 | moderate | positive | Yes |
| Temperature – Malaria | -0.551 | 120 | -7.17063 | P<0.001 | strong | negative | Yes |
| Rainfall – Typhoid | 0.398 | 120 | 4.712406 | P<0.001 | moderate | positive | Yes |
| Temperature – Typhoid | -0.522 | 120 | -6.64207 | 9.99E-10 P<0.001 | strong | negative | Yes |

Table 2: Correlation between Climatic Variables and Disease Cases (2015–2024).

The results show a moderate positive correlation ($r = 0.423$) between rainfall and malaria as well as rainfall and typhoid ($r = 0.398$) which are statistically significant ($p < 0.001$) and This means that as rainfall increases, malaria and typhoid cases tend to rise. The moderate strength suggests rainfall is an important driver of malaria and typhoid transmission, most likely through the creation of mosquito breeding habitats such as stagnant pools and flooded areas. However, because the correlation is not extremely strong, it also highlights that other factors such as temperature, sanitation, and public health interventions play additional roles in determining malaria outcomes. Temperature shows a strong negative correlation with malaria and typhoid respectively ($r = -0.551$ and $-0.522$), with high statistical significance ($p < 0.001$). This result indicates that malaria risk in the study area is more pronounced during moderate temperature conditions but diminishes when temperatures rise toward extreme values. This indicates that as temperature rises, typhoid incidence tends to decline. One explanation is that higher temperatures may reduce bacterial survival rates in the environment or accelerate the breakdown of pathogens in water and food sources. Taken together, these correlations highlight a consistent pattern as rainfall tends to increase the risk of both malaria and typhoid, whereas higher temperatures act as a limiting factor for both diseases. These findings align with existing studies in tropical regions, which emphasize the combined effects of rainfall and temperature on disease ecology.

### Seasonality of malaria and typhoid in the study area.

### Monthly Seasonality of Malaria

Figure 10 presents the monthly variation in malaria incidence between 2015 and 2024. The graph clearly depicts a trough during the months of March to May, where malaria cases remain consistently low, and a sharp upward trajectory beginning in June. The tallest bar in August visually emphasizes that this month accounts for the highest malaria burden within the year, with over 115 average cases. The visual also makes the cyclical nature of malaria more apparent: a sharp rise during the midyear rainy season, sustained high levels through September, and then a noticeable decline into the dry months of November and December. The graph shows that malaria occurrence is not evenly distributed across the year but follows a distinct seasonal pattern tied to rainfall and mosquito activity.

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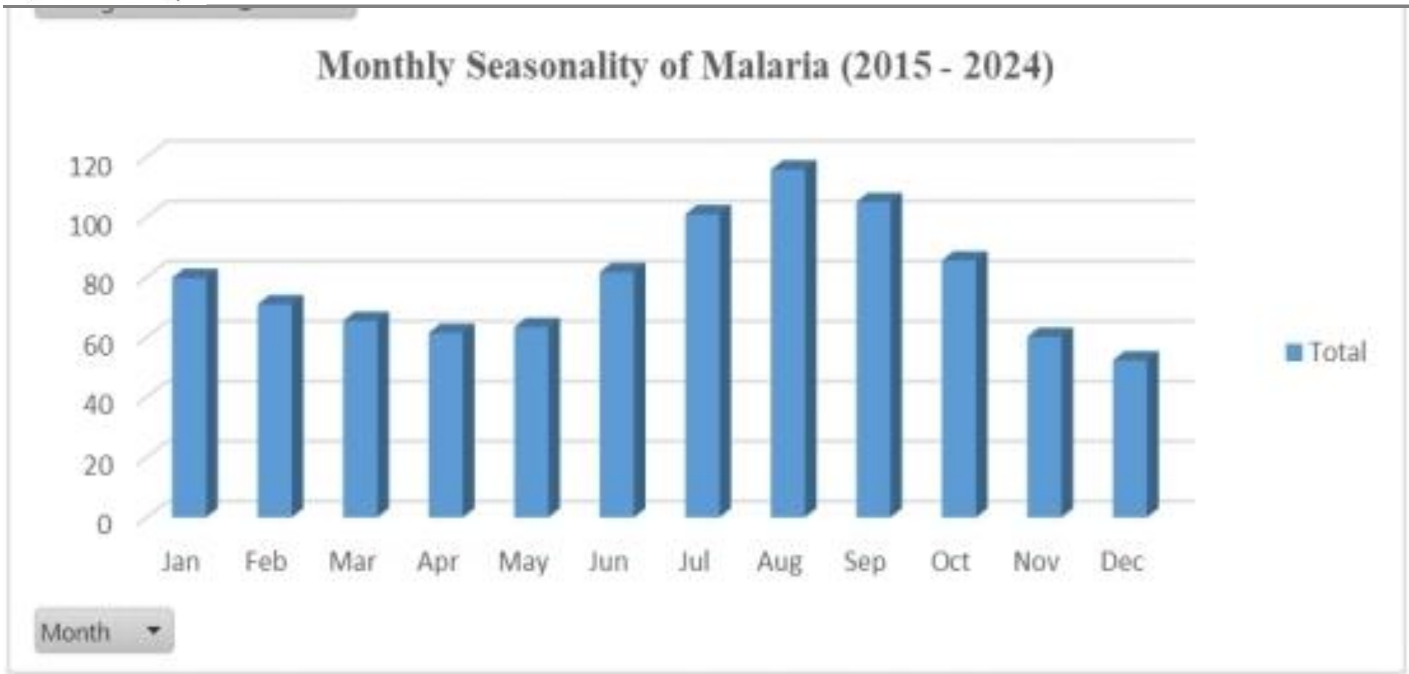


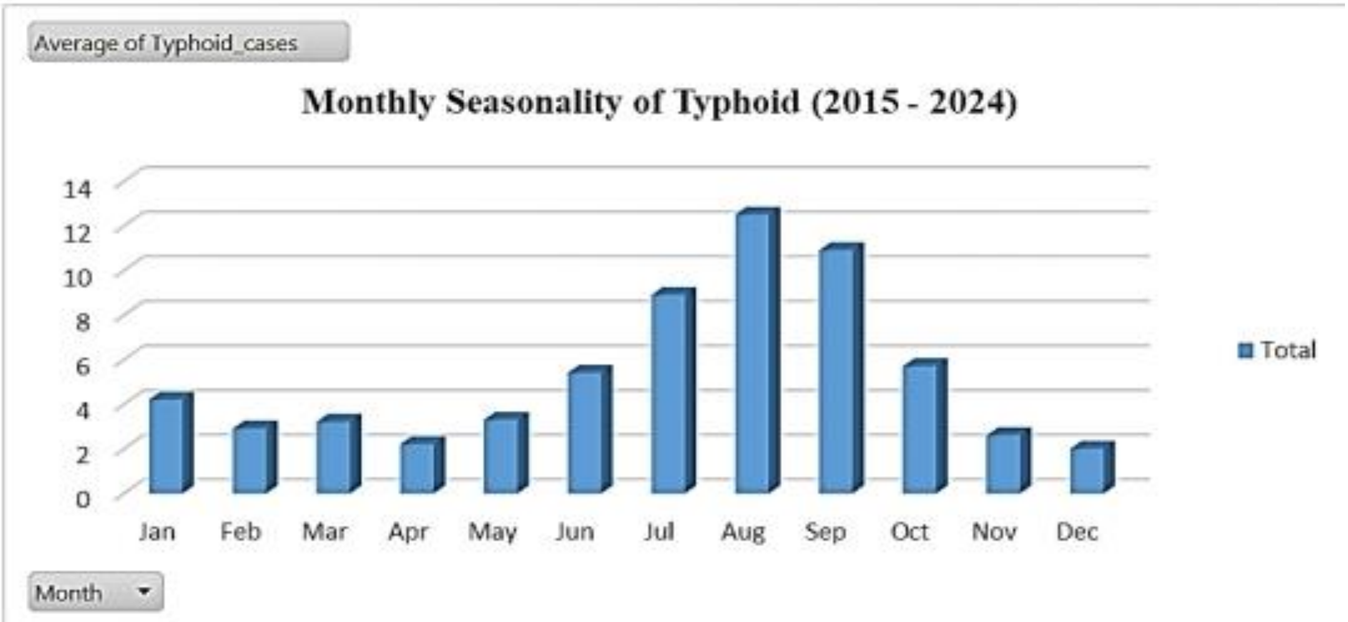


Figure 10: Monthly Seasonality of Malaria and Typhoid (2015–2024).

The graph of typhoid infection illustrates the same seasonal pattern but provides a more vivid depiction of the peaks and troughs in typhoid incidence. The bar chart shows a clear upward slope beginning in June, reaching a sharp peak in August, and then gradually declining from September onwards. The visual emphasizes the stark contrast between the wet and dry seasons: the rainy months (June–September) are marked by elevated cases, while the dry months (November–April) are characterized by much lower incidence. What is particularly evident in the chart is the sharp spike in August, where typhoid incidence more than doubles compared to June. This visual representation makes the seasonal impact of rainfall on typhoid transmission more obvious and highlights the seasonal risk.

## DISCUSSION

The findings of this study demonstrate clear evidence that climate variability exerts a significant influence on the distribution and seasonality of malaria and typhoid in Awka South. The analysis of rainfall and temperature

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patterns over the ten-year period (2015–2024) confirmed that the study area follows the bimodal rainfall regime typical of southern Nigeria, with distinct wet and dry seasons. These climatic rhythms provided a useful context for interpreting disease patterns, as both malaria and typhoid incidence closely aligned with the annual cycle of rainfall and, to a lesser degree, temperature variability. Malaria occurrence revealed strong seasonality, with cases rising the rainy season and reaching their highest values in August and September. This pattern corresponded with the heaviest rainfall months, underscoring the role of surface water accumulation in mosquito breeding. By contrast, malaria incidence dropped sharply during the dry months of November to February, when rainfall was negligible and mosquito habitats diminished. These findings align with earlier research that has linked malaria seasonality in tropical climates to rainfall intensity and persistence. Typhoid fever displayed a somewhat similar seasonal trend, but with sharper fluctuations and more extreme peaks. This seasonal surge is attributable to rainfall-induced contamination of water supplies, as heavy downpours often flush fecal matter and other pollutants into wells, streams, and household water storage systems. The statistical analyses strengthened these descriptive patterns by providing empirical evidence of climatic influence on disease occurrence. Correlation results showed a moderate positive relationship between rainfall and both malaria and typhoid, meaning that higher rainfall generally translated into more cases. Conversely, temperature displayed a strong negative correlation with both diseases, indicating that rising temperatures tended to suppress incidence. Regression models further confirmed these findings: rainfall was a significant positive predictor, while temperature exerted a significant negative effect on disease prevalence. Together, rainfall and temperature explained about one-third of the variation in malaria and typhoid cases, suggesting that while climate plays a critical role, other factors such as sanitation infrastructure, healthcare access, and individual protective behaviors also influence disease outcomes. The results confirmed that rainfall and temperature jointly have significant effects on both malaria and typhoid incidence. The models' explanatory power ($R^2$ values of 33.6% for malaria and 30.2% for typhoid) highlights that climate is a substantial, though not exclusive, determinant of disease patterns in the study area. Overall, the findings underscore the close relationship between climate variability and disease epidemiology in Awka South. The results highlight the importance of climate-informed health policies and seasonal preparedness strategies, ensuring that interventions are aligned with the periods of greatest risk.

## CONCLUSION

The study concludes that malaria and typhoid remain endemic in Awka South LGA and are strongly linked to climatic variability. Rainfall provides breeding grounds for mosquitoes and fosters water contamination, thereby increasing malaria and typhoid risks. Temperature, on the other hand, plays a dual role: moderate warmth supports malaria transmission, while excessively high temperatures reduce vector survival and pathogen viability. Therefore, climate plays a central role in shaping disease ecology in the study area, necessitating continuous monitoring and targeted interventions. Based on the findings, the researcher recommended strengthening disease surveillance in public health authorities and integrate climatic monitoring with disease surveillance to develop predictive models for malaria and typhoid outbreaks. The government should also engage vector control programs through the distribution of insecticide-treated nets, indoor residual spraying, and community clean-up campaigns should be intensified during the rainy season when malaria risk is highest. Since typhoid is strongly linked to water contamination, efforts should be made to improve potable water supply, sewage management, and household hygiene practices, particularly during the wet season through Water, Sanitation, and Hygiene (WASH) interventions.

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