How to Cite:
Arunagiri, S., Vasudevan, B., Prasad, S. S., & Srihamdathwani, S. (2022). Retrospective study on dengue transmission: Influence of climatic factors and spatial prevalence in Chennai during 2016-2017. *International Journal of Health Sciences*, *6*(S2), 9891–9901. https://doi.org/10.53730/ijhs.v6nS2.7576

Retrospective study on dengue transmission: Influence of climatic factors and spatial prevalence in Chennai during 2016-2017

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***Abstract*---**Weather variables, mainly temperature and humidity, influence vectors, viruses, human biology, ecology and consequently the intensity and distribution of vector-borne diseases . The climatic factors connected with Dengue fever happening in Chennai were investigated. The factors accountable for Dengue fever have been recognized and mapped to dengue cases in Chennai city. This work studies the association between yearly climate patterns between 2016 and 2017 and the spread of Dengue fever in Chennai. Monthly rainfall and temperature is taken as the factors of study. The study develops a statistical analysis to quantitatively assess the relationship between climate and Dengue fever. The correlation technique was used to fit the statistical model. The Inverse Distance Weighted (IDW) interpolation and Geographic Information System (GIS) techniques were used in mapping the spatial diffusion of Dengue fever risk zones. The results show that there is a significant correlation between Dengue fever and climate factors for the majority of the study area. Statistical analysis was conducted for comparison of model outputs and predictions.

***Keywords*---**dengue, climate, temperature, geographic information system, statistical analysis.

Introduction

Aedes species mosquito is the vector behind spread of dengue viruses . Almost half of the world's population, about 4 billion people, live in areas with a risk of dengue. Dengue has caused severe illness in areas with risk. Urbanization, globalization, environment, human behaviour, and lack of control of vectors have contributed to the global distribution of dengue has increased due to urbanization, globalization , human activities and lack of health facilities.. The population dynamics of the vectors are sensitive to environmental conditions, such as humidity, precipitation, and temperature. Understanding the drivers of dengue was vital in controlling and preventing the disease's spread. Climate change is likely to expand the geographical distribution of several vector-borne human infectious diseases. The risk of dengue transmission is increased by warming climates, as the growth and development of mosquitoes are significantly influenced by temperature and humidity. The study has focused on quantifying the influence of weather variability on dengue incidence.

Study Area

Chennai is located on the southeast coast of India and in the northeast corner of Tamil Nadu. The Latitudinal and Longitudinal extension. of Chennai is 13.04 degrees north and 80.17 degrees east. The city has 15 zones. The average elevation of the city is 6 metres (20 ft.), its highest point being 60 m (200 ft.). Chennai on the Bay of Bengal in southeastern India is the capital of the state of Tamil Nadu. The total population of Chennai is 11.2 million. Chennai is one of India's major ports and the commercial hub of South India and thus it became a metropolitan city and emerged as the fourth-largest city in the country. Chennai is a coastal city with the second largest beach in the world.

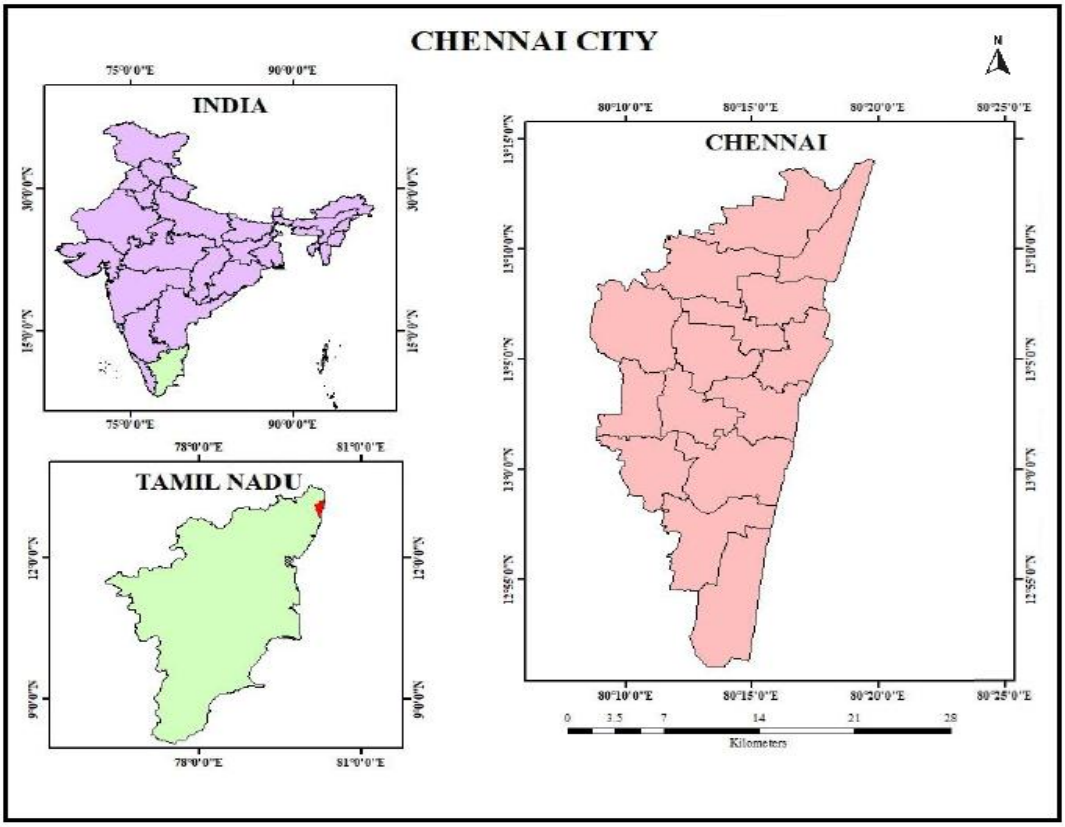

Figure 1. Study Area Map (Chennai City)

Aim

The main aim is to study the correlation between dengue cases and climatic factors for study area during the period of 2016 – 2017.

Objective

The objectives of the study analysis are:

- Determining the dengue cases for Chennai city in a Choropleth map 2016-2017.
- Preparing a rainfall variability map using the rainfall data.
- Analyzing the correlations between dengue cases and climatic factors.
- Predicting the reason for the increase of dengue cases in Chennai city

Materials and Methods

Geospatial techniques and statistical techniques have been used to show the spatial diffusion of dengue in Chennai City. The study also includes the use of spatial components like the rainfall and other climate data in modelling the climate-related spread of dengue. SPSS has been used for analyzing the data and

GIS Software for preparing maps of occurrence and spread with locations is used for modelling the spread of dengue.

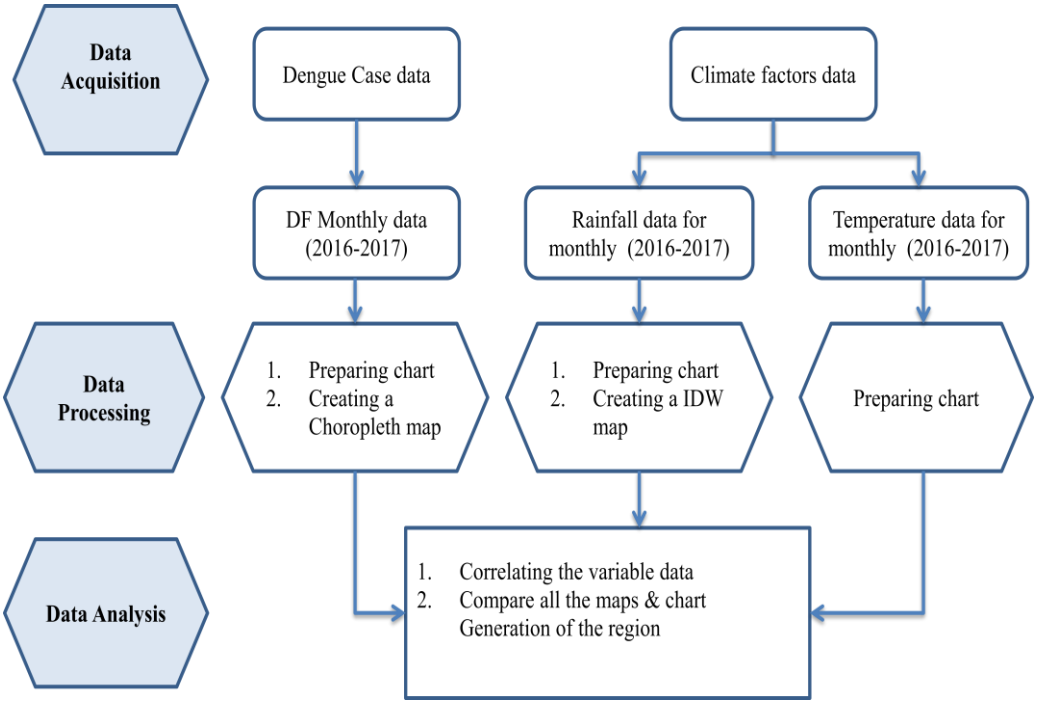

Figure 2. Methodology chart

Dengue case

In 2016, the total number of dengue cases was 2,151. The zones of Manali, Thiruvotriyur, and Alandur have shown low dengue cases. The three zones that show a very large number of cases in Chennai are Adyar, Kodambakkam, and Tenampet. In 2017, the total number of dengue cases in Chennai was 8,487. Above 1,000 dengue cases were in the zones of Kodambakkam and Teynampet because of the population density. The five zones, categorized with less than 400 cases, are Manali, Thiruvottriyur, Alandur, Perungudi, and Sholinganallur.

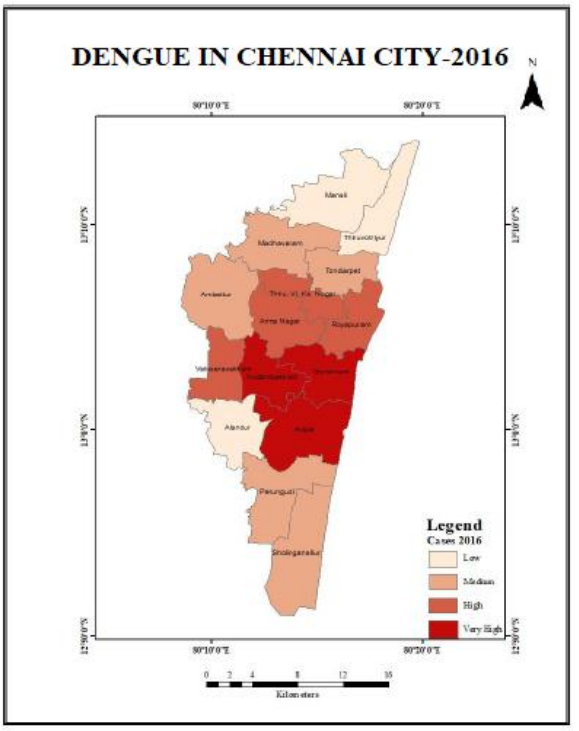

Figure3. Dengue in Chennai city (2016)

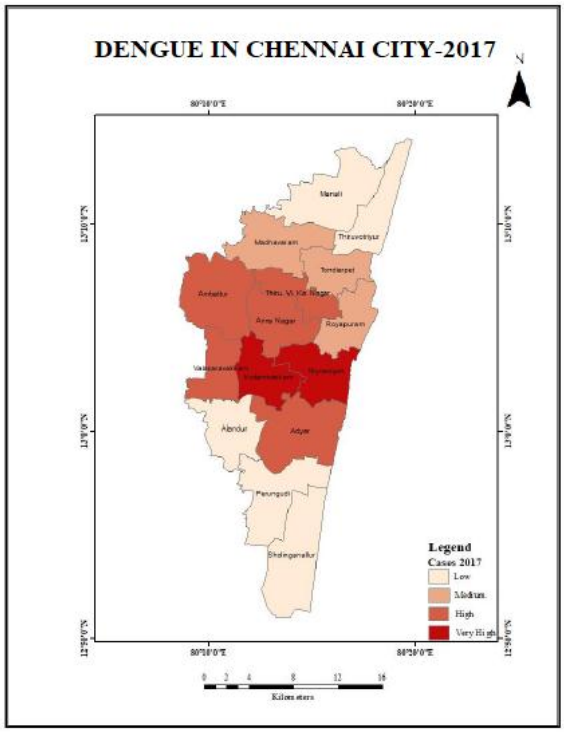

Figure 4. Dengue in Chennai city (2017)

Comparing the annual dengue cases of 2016 and 2017, the cases have increased in the year 2017. In October there were more cases in both years. Second maximum values of dengue cases in September as well as 2016 and 2017. The graph compares and describes the dengue cases in Chennai city.

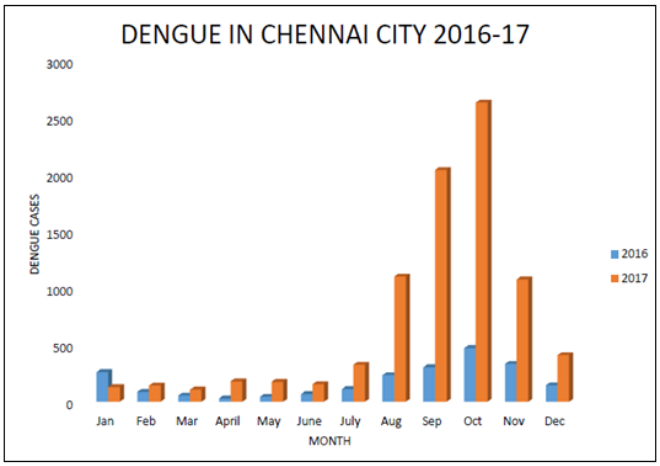

Figure 5. Dengue in Chennai city 2016-2017

Rainfall Data

Using the rainfall data for 2016 to analysis the Inverse distance weighting (IDW) for the study area. Nungambakkam and Meenambakka have a high rainfall in these two stations the values are above 70 mm in this year. Map of the rainfall variability shows the values of each station and easily understandable. The Rainfall variability of 2017 shows the values and a visual view of rainfall data In 2017, annual values of rainfall data have three stations (Ennore, Nungambakkam, Meenambakkam) are in high values of above 100 mm. Only one station of Madhavaram is below on 100 mm.

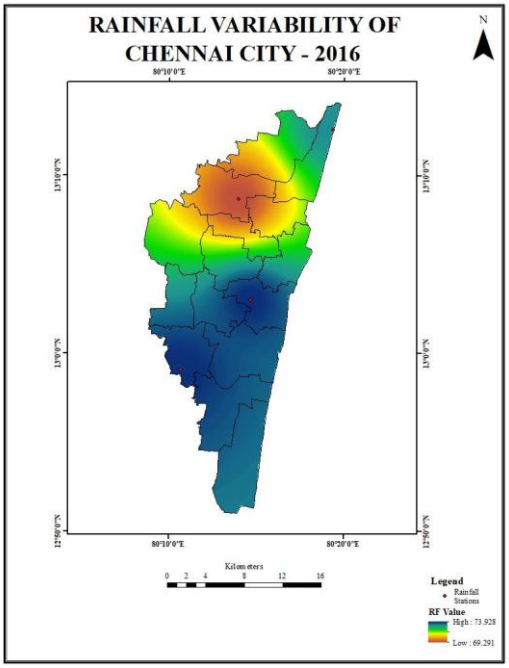

Figure 6. Dengue in Chennai city (2017)

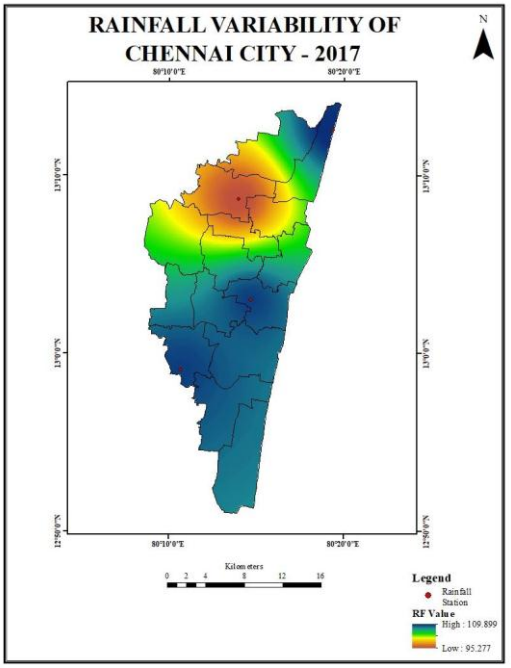

Figure 7. Dengue in Chennai city (2017)

In 2016, the four rainfall stations recorded nearly equal amounts of rainfall in Chennai. Very high rainfall is received in Nungambakkam and Meenambakkam. The low rainfall received is in Madhavaram. Comparing the rainfall data for two years, the year 2017 has crossed 100 mm, in three stations. Madhavaram station has received below 100 mm of rainfall.

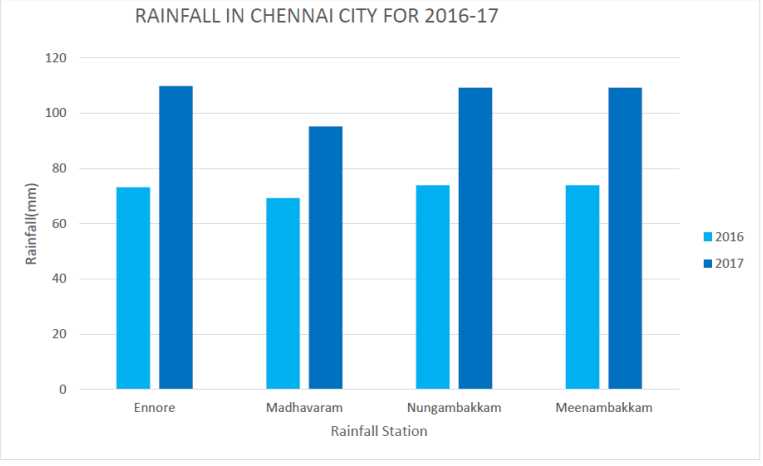

Figure 8. Rainfall in Chennai city 2016-2017

Temperature

The temperature of Chennai city has an average for both the years 2016 and 2017. In the graph, there is no major change in temperature recorded over the

months. In Chennai, the months of April, May, and June have a high temperature of above 30 °C every year.

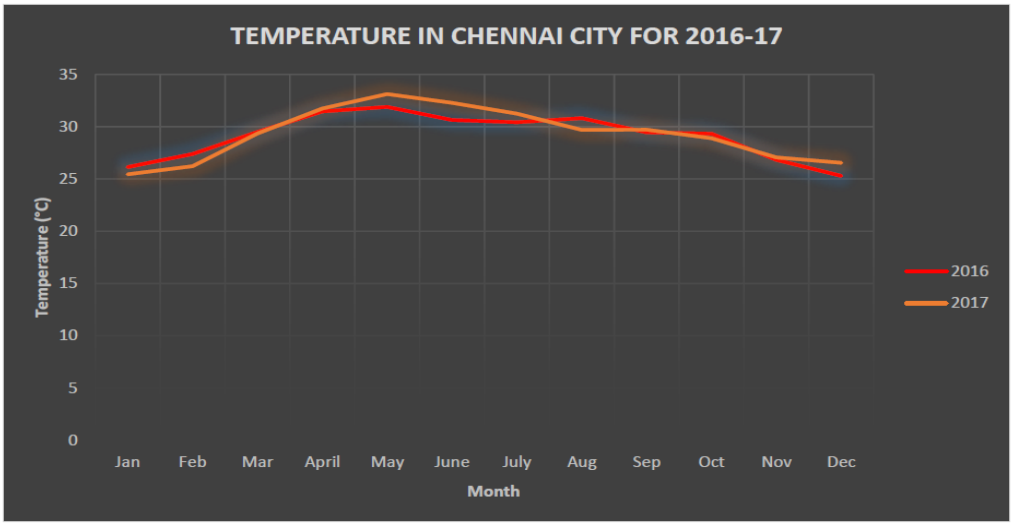

Figure 9 Temperature in Chennai city for 2016-2017

Correlational Analysis

It is one of the statistical analyses using SPSS statistical software. For this analysis, to correlate the three variables (Dengue cases data, rainfall data, and temperature data). All these data are from the months of 2016 and 2017. In the relationship between the three data or variables, in the year 2016, the correlation coefficient (r) is negative.

Correlations

		Dengue	Rainfall(mm)	Temperature
Dengue	Pearson Correlation	1	-.160	-.341
	Sig. (2-tailed)		.619	.277
	N	12	12	12
Rainfall(mm)	Pearson Correlation	-.160	1	.349
	Sig. (2-tailed)	.619		.266
	N	12	12	12
Temperature	Pearson Correlation	-.341	.349	1
	Sig. (2-tailed)	.277	.266	
	N	12	12	12

In 2017, the correlation coefficient (r) is a positive value of relationships between Dengue cases and rainfall variables. There are negative values of relationships between Dengue cases and Temperature.

Correlations

		Dengue	Rainfall (mm)	Temperature
Dengue	Pearson Correlation	1	.743**	-.077
	Sig. (2-tailed)		.006	.811
	N	12	12	12
Rainfall (mm)	Pearson Correlation	.743**	1	.019
	Sig. (2-tailed)	.006		.952
	N	12	12	12
Temperature	Pearson Correlation	-.077	.019	1
	Sig. (2-tailed)	.811	.952	
	N	12	12	12

Results and Discussions

This study, to find the relationship between dengue and climate factors for the reason for the increasing cases these two years. For this study, we also analyze the choropleth map, IDW (Inverse distance weighting), and graphs. In 2017, dengue cases are more than 60% of cases. They increased by more than 40% in 2016. But, the temperature has not changed between the years 2016 and 2017. It may increase by 1 or 2 degrees Celsius in 2017. The final, result of the study is for correlated variables (dengue and rainfall) the year 2016 the values of correlation are -0.160 and for the correlated variables, dengue cases and temperatures, for the year 2016 is 0.341 of correlation values. In 2017, for the correlated variables, dengue and rainfall, the relationship is 0.743 and for the other correlated variables (dengue and temperature) the year, 2017 is -0.077 correlation values.

Conclusion

In Chennai city, the years 2016 and 2017 have shown a rapid increase in the number of dengue cases. This study searches for the reason for the larger cases in Chennai. Using correlation analysis for finding the relationship between dengue and climate factors. The final result of the study is the value of correlation has no impact on these three variables (Dengue, Rainfall, and Temperature) in 2016. In 2017, there is a relationship between dengue and rainfall. It has an impact on the increase of dengue cases and also no relationship between dengue and temperature. It may be the reason for transmission of person to person, spread by mosquitoes, Aedes mosquitoes breeding containers (wastewater containers). Aedes mosquitoes choose to breed in tires, barrels, plastic drums and jerry cans. But there are various other indoor and outdoor breeding sites.

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