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ASSOCIATION OF DENGUE INFECTION AND SEASONAL CLIMATE VARIABILITY IN NORTH INDIAN POPULATION OF KANPUR REGION: A SINGLE CENTER HOSPITAL-BASED STUDY FROM 2015 TO 2019.

Microbiology

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ABSTRACT

Climatic variations and geographical locations have drawn the global interest towards the incidence of the dengue infection and its outbreak. The objective of the present study was to determine the climatic contributors in the spread of the dengue incidences in the Kanpur region of the Uttar Pradesh during the period of 2015 to 2019. Climatic data was collected from the record of meteorological information. Spearman correlation was calculated for both rainfall and temperature with outbreak of dengue cases. It was found that temperature has not significant effect in the spread of the dengue cases (Spearman r = -0.1977; p = 0.13), while the rainfall has significant relationship in the significant increase of dengue cases in the study region (Spearman r = 0.3197; p =0.0128). Taking into consideration, the result of the present study, dengue management program should be implemented considering the climatic and geographical variability.

KEYWORDS

Dengue; climatic variability; rainfall; temperature; outbreak

INTRODUCTION

Dengue is among the most prevalent mosquito -borne arboviruses, human viral disease that is transmitted between humans by the *Aedes aegypti* and to a lesser extent by *Aedes albopictus*. World Health Organization (WHO) estimated that in the year 2016 the number of dengue cases increased to3.34 million (1, 2). In a recently published study, it was found that each year 390 million dengue infection cases were reported globally and another report emphasized that 3.9 billion people belongs to 128 countries are at risk of developing dengue infection with 70% of disease burden in Asia (3, 4). The number of dengue cases is increasing to new places that resulted in explosive outbreak. Dengue can be grouped into subclinical disease to the extent of severe flu like symptoms, organ failure, severe bleeding along with plasma leakage. Dengue is caused by the four closely related serotypes of Flaviviridae family virus namely DENV-1, DENV-2, DENV-3 and DENV-4. Dengue has significant impact on the human health and economy of the countries. WHO reported that between the year 2000 and 2015 the mortality associated with dengue increased from 960 to 4032 respectively.

Dengue is widely spread disease of the tropics that is affected by the rainfall, temperature, unplanned rapid urbanization and relative humidity. Climatic factors are among the most determinant of this vector-borne disease. Few studies published in past showed that there are positive correlation between temperature and transmission of DENV (5-6). In another study, published in past warmer temperature lead to the higher development and survival rate of Aedes that in turn associated with increased cases of dengue infection (7). However, there is limited information about the association between rainfall and dengue infection. Although, rainfall has been thought in past published literature that it has been a positive predictor for occurrence of dengue infection (8).In another controversial study, it was shown that excess rainfall may contribute in the flushing of eggs, larvae and pupae that further negatively correlated with the incidences of the dengue infection.

A rapid increase in incidences of the dengue infection has been erupting in the region of North India especially in Kanpur region of the Uttar Pradesh. Kanpur's climatic condition is presented by the hot summer and dryness except the south west monsoon season (which lasts till the end of October) (10). The climate belongs to the tropical nature with temperature variation from 20^{0}C to 48^{0}C with total rainfall variation from 450 mm to 750 mm (10). In one of the previously published report it was found that Kanpur recorded an average annual rainfall of 441 mm with an average of 40 rainy days (10). The relative humidity of the Kanpur region varies from 15% to 85% due to adjacent river Ganga basin which favors the outbreak of the dengue infection in this area (10).

The present study aims to predict the annual number of dengue infected cases in the Kanpur region and finding its association with temperature and rainfall, predicting the role of climatic variations with the increase episodes of dengue infections in the Kanpur region of Uttar Pradesh.

METHODS

Study area

Kanpur extended at 26° 26' North and 80° 19" East coordinates and is among the largest city of the Uttar Pradesh and is also known as the industrial capital of the state. It is located at the banks of the river Ganga with population of around 2.9 million according to the 2011 census of the Government of India. It was formerly known as the Manchester of the country with biggest industrial hub related to leather, wool, cotton etc. The study was conducted at Department of Microbiology, GSVM Medical College Kanpur. The Institutional Ethics Committee of GSVM Medical College Kanpur approved the present study. The informed consent from every patient were obtained before using the data into the present study.

Data

The dengue confirmed cases by the Department of Microbiology, GSVM Medical College Kanpur between the years 2015 to 2019 were recruited in the present study. The official confirmation of the affected subject was performed through laboratory test of NS1 antigen and IgM serological assays. The average number of dengue confirmed cases were defined as the total number of confirmed dengue infected cases in each year. Daily maximum and minimum temperature (^{0}C) along with rainfall (mm) and relative humidity (%) were recorded from the Kanpur's meteorological data from the year 2015 to 2019 were collected from the official website source of whether atlas_kanpur (11).

STATISTICALANALYSIS

The maximum, minimum temperature, relative humidity and rainfall were included in the predictor variables list while the dengue confirmed cases was variable response. To the assess the correlation

between the dengue confirmed cases and climatic variation, the Spearman correlation was used. The statistical analysis were performed using SPSS Statistics software version 21.

RESULTS

During the 5 years period a cumulative of 10183 confirmed dengue cases have been reported between the period of 2015 to 2019. Yearly distribution of the positive confirmed dengue cases showed a "Z" pattern with major outbreak at a time interval of 2 years (Figure 1). Increased seasonal pattern of dengue confirmed cases was observed with significant increment in the month of September and October of each year with declination in the month of December (Figure 2). The dengue confirmed cases reached the longest peak following the temporal trends of temperature and rainfall (Figure 3).Spearman correlation showed that the temperature had no significant effect on dengue cases (Spearman r = -0.1977; p = 0.13), while the rainfall was significantly correlated with the dengue cases in Kanpur region of Uttar Pradesh (Spearman r = 0.3197; p = 0.0128).

DISCUSSION

In the present study, incidences of dengue in the Kanpur region of the Uttar Pradesh and climatic determinants like temperature and rainfall were identified. Highest peak of dengue infected cases persist in each year during the period of 2015 to 2019 followed by the rainfall and temperature. The results of the present study showed that there is "Z" pattern in the outbreak of the dengue cases. It was also observed that the outbreak of the dengue cases occurred after every two subsequent years. In figure 2, it was found that most of the dengue confirmed cases outbreak occurred in the month of September and October in Kanpur region. The results of the present study also in agreement of the previously published single center hospital based study, that showed reported that maximum number of dengue cases in the month of September and October of each year in Delhi region (12). Similar pattern of the outbreak were obtained in the preset study, as the maximum number of cases were observed in the month of September and October. This is attributed due to post-monsoon collection of rainwater that increased the possibility and availability of *Aedes* mosquito breeding sites.

The correlation analysis and regression analysis showed that rainfall have positive and significant association with number of cases of dengue infections, while temperature doesn't have any role with the confirmed cases of dengue infection in the study region. In previously published study, the rainfall has been found to link with the dengue incidences that contributes in increase in vector population (13). In another study conducted in Jinjang (Malaysia), it was found that rainfall has strong association with the transmission of A. aegypti (14). These results are in complete agreement with the result of the present study. In another recently published study, the Susceptible-Exposed-Infected-Recovered model was implemented in the area of Thailand and also found that rainfall have strong association with the dengue fever (15). As the relationship between dengue incidences and climatic determinants varies with geographical location and countries, scientists and researchers should focus on the region wise detailed study of the dengue outbreak in their corresponding geographical niche.

CONCLUSION

This study determines the temperature and rainfall as prospective contributors for prevalence of dengue especially in the Kanpur district of the Uttar Pradesh. The study strongly support that rainfall have strong association with the dengue outbreak and clinicians should focus on the management of the dengue cases with special care during the rainy season, so that incidences of the dengue can be lowered considering the climatic variability.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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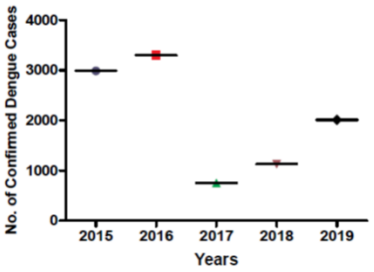

Figure 1: Yearly distribution of dengue cases in Kanpur, Uttar Pradesh from 2015 to 2019.

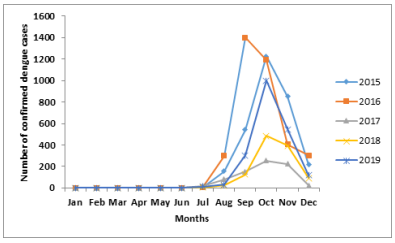

Figure 2: Dengue confirmed cases month wise from 2015 to 2019 in Kanpur district of Uttar Pradesh.

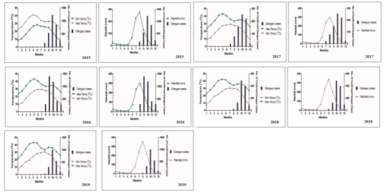

Figure 3: Temporal trend of monthly dengue cases against monthly climate factors (temperature and rainfall) from 2015 to 2019.

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