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Research Article

Trend-Analysis of Dengue Cases and its relation to Vector Density in Selected Areas of Delhi State

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A B S T R A C T

Background: Dengue is a mosquito borne tropical disease caused by Dengue virus. India contributes up-to 34% global cases of Dengue. India reported 111880 cases of Dengue in 2016. Delhi contributed 15.8% of total national cases in 2015 with major epidemic outbreaks in recent years. This disease has severe economic burden on the country and significantly reduces the quality of life of those affected by it.

Objective: The objective is to assess the burden of Dengue cases and Vector density in various areas of Delhi state.

Methods: Trends-charts plotted for all the areas under municipal corporation zones of Delhi with dengue cases, vector density and weather data. Priority-intervention areas were identified using Pearson-correlation from the zones. The trend was studied and interpreted.

Results: In 2016, Delhi reported a total of 4431 Dengue cases, out of which 2857 (58.24%) cases were reported originating in Delhi. Case reporting and Vector density trends were noted in various areas of Delhi. Three areas were identified as priority-intervention areas by obtaining maximum correlation between rainfall, vector density and cases.

Conclusion: Highest correlation of Vector density and Cases was observed in Civil lines area and between Rainfall and Cases in West and Najafgarh areas. There was also a gap between Vector density and Dengue cases during trends-charting in various areas of Delhi. This gap may be attributed to the IIP and EIP.

Keywords: Aedes, Cases, Dengue, Delhi, Municipal Corporation, NVBDCP, Trend-Analysis

Introduction

Dengue is a mosquito-borne viral infection causing severe flu-like illness. It has potential to escalate to severe dengue leading to death. The Aedes aegypti mosquito is the main vector that transmits the viruses that cause dengue. The viruses are passed on to humans through the bites of an

infective female Aedes mosquito, which mainly acquires the virus while feeding on the blood of an infected person[1]. Global estimates put incidence of dengue to be 390 million infections each year, out of which, clinical manifestation is seen in 96 million regardless of the severity of the disease. India alone contributed to up-to 34% of the cases in the same year.[2] In the year 2012, India had 50222 reported cases - the second highest in Southeast Asia region following Indonesia.[3] This number rose to 111880 in the year 2016[4]. Amongst all the states and union territories in India, Delhi state shared the highest burden of the disease with a total of 15867 (15.8%) out of 99913 cases in 2015.[5] Major epidemics were reported in Delhi in the years 1967, 1970, 1982, 1996, 2003 and 2006.[6-11] The economic burden of Dengue in India has been estimated to be 27.4 million US Dollar per year and this cost is up-to 4 times when treatment is sought under private sector[1,2] In this study, we attempt to assess the burden of Dengue cases and Vector density in various areas of Delhi state. As an early warning signal to mosquito breeding, we analyzed climatic data from the meteorology as a predictor of Dengue burden for a better picture of trends of Dengue in Delhi.

Delhi is divided in four Municipal Corporation (MCD) zones namely New Delhi Municipal Council (NDMC), East Delhi Municipal Corporation (DMC), North DMC and South DMC. These zones are further divided into 16 areas which report the cases from their regions to the respective MCD. The aim of this article is to assess the burden of Dengue cases and Vector density in various areas of Delhi state.

Methods

This study adopted a descriptive cross-sectional design using routinely collected surveillance data on dengue. Ethical clearance for the study was obtained from the Institutional Ethics Committee, Kasturba Medical College and Kasturba Hospital, Manipal University (IEC 757/2016). Duration of the study was from January 2017 to June 2017.

Study area was Delhi - National Capital Territory (NCT) spread over 1,484 square kilometers with 16.8 million population (Census 2011) comprising of 11 districts, 27 tehsils, 59 census towns and 300 villages. Five Municipal Corporations - the North Delhi, South Delhi and East Delhi Municipal Corporations, the New Delhi Municipal Council and Delhi Cantonment Board.

Data analysis was done using the dengue cases, vector density and weather data for the year 2016. These and vector density data was obtained from the Directorate of National Vector Borne Disease Control Programme (NVBDCP), Ministry of Health and Family Welfare and Indian Meteorological Department (IMD) supplied the meteorological data. The variables were Dengue cases weekly Municipal Corporation of Delhi (MCD) zonal data for Delhi with cases from other states, Vector density monthly MCD zonal data for Delhi with House, Container and Breteau and weather data including mean monthly data from IMD containing Min-Max temperature, relative humidity and total rainfall for Delhi (January-December 2016). Following standard definitions for vector density indices (larval) were used:[13]

House Index (HI): Percentage of houses infested with larvae and/ or pupae.

Container Index (CI): Percentage of water-holding containers infested with larvae or pupae.

Breteau Index (BI): Number of positive containers per 100 houses inspected.

The data was analyzed using MS Excel. Data was adjusted as per weekly and monthly reported data and trends-charts were plotted between Dengue cases and Vector density of various areas of Delhi. The missing data correction was done using Last observation carried forward and moving average imputation methods. Pearson correlation was performed between vector density and rainfall with new cases for each of the fifteen geographical zones where data was available.

Result

During the year 2016, Delhi reported a total of 4431 Dengue cases, out of which 2857 (58.24%) cases were reported from Delhi and 1844 (41.76%) cases were reported from outside Delhi (Figure 1). The first case was reported in Delhi Central under South DMC in the second week of April. The last groups of cases were reported in the third week of December from South and Central zones under South DMC. The peak in reported cases was observed during the months of August, September and October. Maximum cases were reported in the month of October (1958). In MCDs, maximum cases were reported by South DMC (1814) and minimum by NDMC (92). In Zones, maximum cases were reported by Central (204) and minimum by Delhi Cantt (13) and Northern railways (7).

Maximum vector density (BI) was reported in Narela (61.0) in the month of October. The maximum and minimum average vector density for the entire year was seen in NDMC (4.23) and President estate (0.36) respectively, both of which are under NDMC zone. The mean Vector density (BI) spiked in the months of July (11.2) and August (15.2) and remained lowest in the months of January to April and November - December. Average Vector density (BI) in Central was 3.074 (amongst lowest) but highest cases were reported and areas having highest Vector density (BI) did not report maximum number of cases. A gap between the Dengue cases and Vector density trend lines was noted in all the zones. Pearson correlation was done between 'Vector density vs. New Cases' and 'Rainfall vs. New Cases' for 15 zones of MCD.

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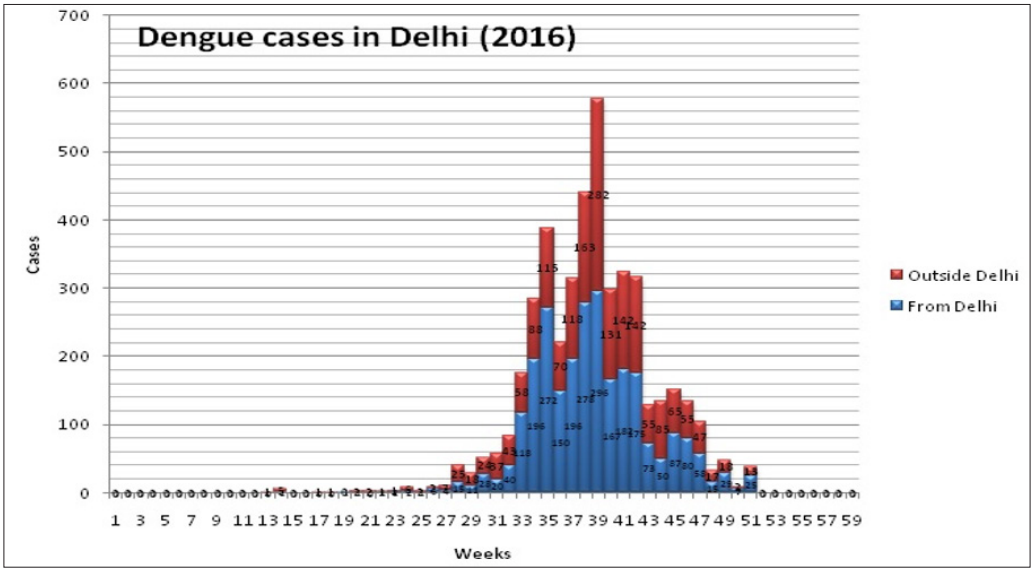

Figure 1.Dengue cases in Delhi (2016)

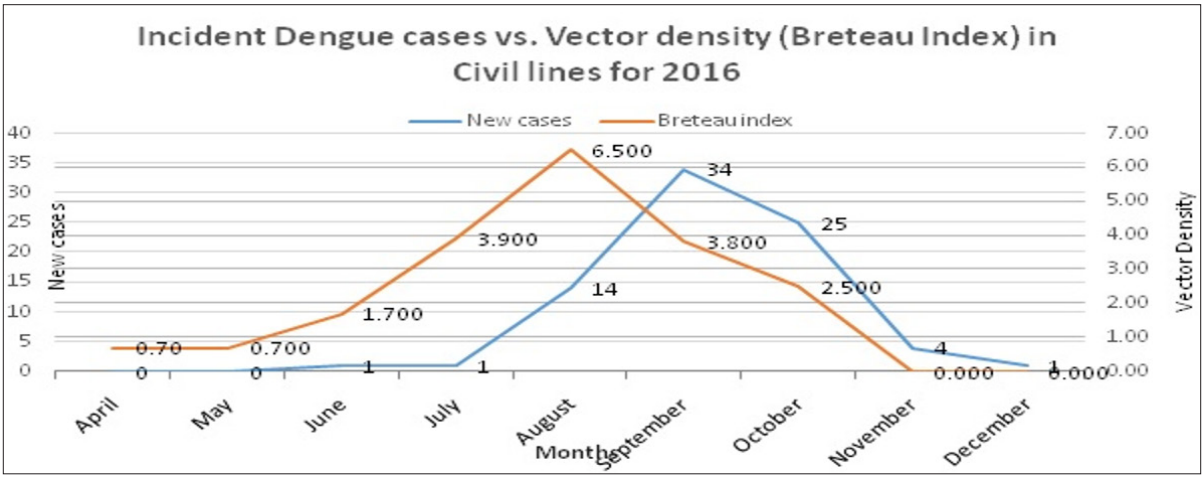

Figure 2.Incident Dengue cases vs. vector density (Breteau index) in Civil lines for 2016

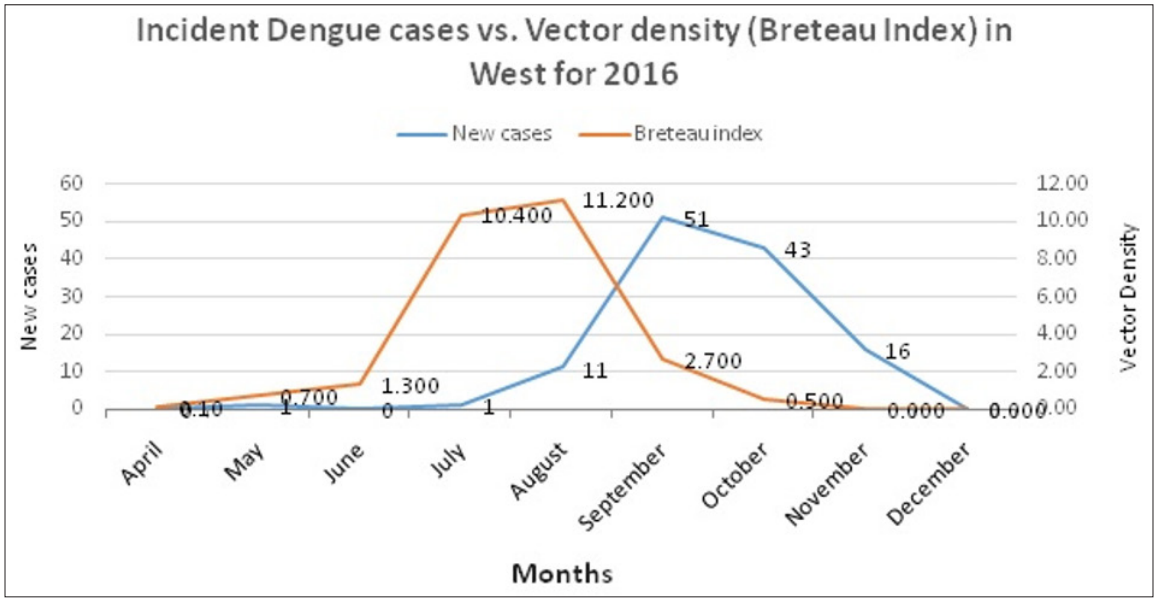

Figure 3.Incident Dengue cases vs. vector density (Breteau index) in West for 2016

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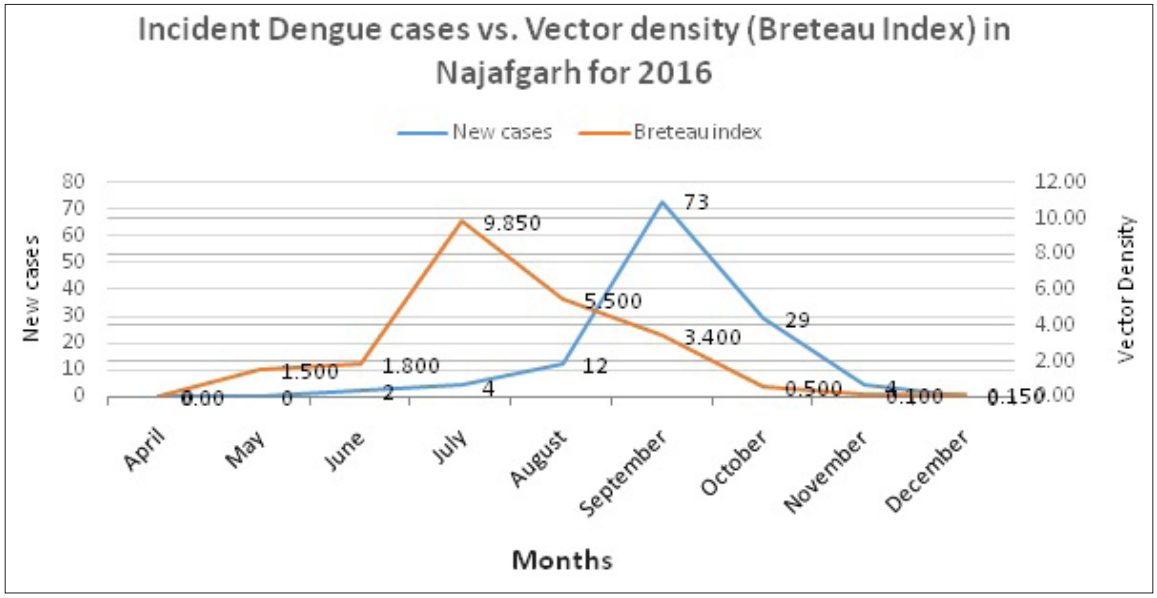

Figure 4.Incident Dengue cases vs. vector density (Breteau index) in Najafgarh for 2016

Highest correlation was obtained in 'Civil lines' (0.529), 'West' (0.872) and 'Najafgarh' (0.99) areas. Total cases of 'Civil lines' (78), 'West' (123) and 'Najafgarh' (124) were 325, which was 11.37% of reported cases from Delhi state in 2016.

Trends chart of Incident cases vs. Vector density in 'Civil lines' shows a peak of cases in the second week of September with Vector density highest during month of August (6.5) (48.1). The first case appeared in the third week of June and the last case in third week of December (Figure 2).

In 'West', a peak of cases in the second week of September with Vector density highest during month of August was seen (11.2). The first case appeared in the last week of May and the last cases (16) in the second week of November (Figure 3).

In 'Najafgarh', a peak of cases in the second week of September with Vector density highest during month of July was seen (9.8). The first case appeared in the last week of June and the last cases (4) in the second week of November (Figure 4).

Discussion

This study observed that maximum cases were reported during the months of August, September, October of 2016. The peak time of dengue cases was seen during the last week of September. After September, shortfall of dengue cases was noticed and the last case was seen in third week of December.

Gupta E et al. analyzed seasonality pattern of Dengue with outbreak data of 2003 to 2005 and noted that cases were maximum during September to November with peak time of occurrence of dengue cases during the second and third week of October. The cases tapered down in the month of November and disappeared in December.[14] Another study by Singh et al. showed maximum cases from September to November 2003 with peak in October 2003.[15]

The study reveals highest vector density (BI) in October in Narela (61.0) with minimum density from January to April and November to December.

No recent study was found from Delhi, relating vector density to number of cases of Dengue. Ansari M et al. noted that the highest vector density (BI) was present during the month of October in Andrews Ganj area (13.1). The vector density was minimum from January to March and November-December.[16]

A gap was noted between the Dengue cases and Vector density in all the zones where trends-charts were plotted. This might be due to the EIP and IIP.

In a meta-analysis done by Chan M et al. the EIP was found to be 15 days at 25°C and 6.5 days at 30°C. The IIP was at 5.9 days.[17] In another study done by Delatte H et al. in India demonstrated the minimal threshold of immature stages development at 10.4°C and its optimum at 29.7°C. The shortest periods for immature development were found at 30°C, within average of 8.8 days. The shortest gonotrophic cycle was noted at 30°C (mean 3.5 days).[18] The average maximum monthly temperature for the year 2016 in India was 32.4°C with peaking in the months of May and June with 40.1°C and 39.5°C respectively. Soon after these months, there was peak rainfall in the months of July and August with total rainfall of 292.5 mm and 122.7 mm respectively. The peak in the appearance of cases started to appear following these temperature and rainfall peaks in the months of August, September and October.

Amongst the high priority intervention areas found in

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the study, 'Najafgarh' has a total of six Delhi Government Dispensaries (DGDs) and one Primary Urban Health Centre (PUHC). 'West' has 28 DGDs and three PUHCs. 'Civil lines' has 15 DGDs and one PUHC.[19]

Conclusion

The relationship between Dengue cases and Vector density was studied. Maximum cases were reported in the months of August, September and October (1324) which constituted 46.34% of cases reported from Delhi and 29.8% of total cases. The mean Vector density (BI) spiked in the months of July (11.2) and August (15.2) and remained lowest in the months of January to April and November - December. Dengue cases followed the Vector density trends in all the areas of Delhi state.

These findings can be used to change the surveillance promptness and coverage for dengue in Delhi and also a more representative insect surveillance to support the same.

The weather data obtained from IMD was from just one observatory. This data did not capture the area variations within zones and areas of the state.

Conflict of Interest: None

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