Longitudinal studies on seasonal fluctuation of Aedes aegypti in Delhi, India due to climatic conditions

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Abstract

Unplanned urbanization and informal settlements create ideal breeding habitats for Aedes species. India’s rapid population growth and increased rural–urban movement has augmented the spread of dengue and resurgence of chikungunya. *Ae. Aegypti* is the vector of arboviruses answerable for significant sicknesses like dengue, dengue hemorrhagic fever and Chikungunya. The Studies on seasonal fluctuation of *Ae. Aegypti* were undertaken in Shahdara South, Rohini and Najafgarh. Month-wise House Index (HI), Container Index (CI) and Breteau Index (BI) of Shahdara, Rohini & Najafgarh were recorded during 2016 & 2018. The HI, CI and BI in Najafgarh (SDMC) varied from 0.0-5.39, 0.0-5.16& 0.0-9.07 respectively during 2016 and from 0.0-4.1, 0.0-9.6 and 0.0-4.3 respectively during 2018. The HI, CI and BI in Rohini (NDMC) varied from 0.0-3.1, 0.0-3.7 & 0.0-5.3 respectively during 2016 and from 0.0-4.1, 0.0-9.6 and 0.0-4.3 respectively during 2018. The HI, CI and BI in Shahdara (EDMC) varied from 0.05-4.9, 0.04-6.3 & 0.5-16.7 respectively during 2016 and from 0.0-2.6, 0.0-5.1 & 0.0-14.0 respectively during 2018.

Keywords: *Ae. Aegypti*, House Index (HI), Container Index (CI) and Breteau Index (BI)

Introduction

Mosquitoes transmit diseases of public health importance such as dengue, chikungunya, malaria, filariasis, zika, etc., thus presenting a threat to human health. For the last few years, annually more than one lakh cases of dengue infections occur in India resulting in substantial rates of mortality and morbidity [1]. At the same time, arbovirus transmission has become one of the major global public health issues in the past decades. Yellow fever virus, dengue virus (DENV), chikungunya virus (CHIKV) and zika virus (ZIKV) are transmitted by mosquitoes in tropical and sub-tropical regions [2]. Annually, about 390 million people worldwide are estimated to be affected by dengue virus (DENV), causing more illness and death than any other virus transmitted by arthropods [3]. Unplanned urbanization and informal settlements create ideal breeding habitats for Aedes. India’s rapid population growth and increased rural–urban movement has augmented the spread of dengue and resurgence of chikungunya [4]. The spread of vector borne sicknesses is controlled by complex segment, ecological and social elements. Worldwide travel and exchange, impromptu urbanization and natural difficulties, for example, environmental changes can effect on pathogen transmission season longer or progressively extreme or making sicknesses develop in nation where they were already obscure. One million or more lose their lives because of mosquito chomps each year with the greater part because of intestinal sickness. 2.5 billion Individuals are in danger of contracting dengue fever, a viral sickness broadly spread in tropical locales. Tropical zones are generally defenseless against parasitic disease and the danger of contracting arthropod borne diseases has expanded because of environmental change and strengthening globalization. *Ae. Aegypti* is the vector of arboviruses answerable for significant sicknesses like dengue, dengue hemorrhagic fever and Chikungunya. It is very much essential to study the correlation between prevalence of dengue vectors and different climatic parameters to guide the state as well as national program for developing an early warning system for outbreaks of dengue in Delhi NCR. Additional research studies are wanted in Delhi NCR for better understanding the seasonal prevalence of *Aedes* mosquitoes.

Keywords: *Ae. Aegypti*, House Index (HI), Container Index (CI) and Breteau Index (BI)
Climate changes have been reported to affect the biology and behavior of vectors allowing them to develop higher competence for dengue transmission. This supports the necessity of entomological surveillance to assess and predict the abundance of vectors and possibilities of occurrence of dengue.

Materials and methods
The immature stages of Aedes mosquito were collected with the help of ladle and pipette from Shahadara South, Rohini and Najafgarh. Localities throughout the year to know House, Container and Breteau indices. The material was brought to the laboratory for rearing and identification up to species level. The maximum House, Container and Breteau indices were recorded for August, 2018. The Studies on seasonal fluctuation of Ae. Aegypti were undertaken in Shahadara South, Rohini and Najafgarh. Month-wise HI, CI and BI of Shahdara, Rohini & Najafgarh were recorded during 2016 & 2018. Climatic data was taken from India Meteorological Department, Regional Meteorological Centre Lodhi Road Delhi to study Dengue transmission during 2016 (Table – 1) and 2018 (Table – 2).

Results
Seasonal Prevalence in Najafgarh (South Delhi Municipal Corporation) during 2016 and 2018 The HI, CI and BI in Najafgarh (SDMC) varied from 0.0-5.3, 0.0-5.16 & 0.0-9.07 respectively during 2016. The maximum House index was recorded in August, 2016 while the maximum CI and BI were recorded in July, 2016. The HI, CI and BI indices were minimum during the months of January, February and April, 2016 (Figure – 1). The HI, CI and BI in Najafgarh (SDMC) varied from 0.0-4.1, 0.0-9.6 and 0.0-4.3 respectively during 2018. The maximum HI, CI and BI indices were recorded for August, 2018. The HI, CI and BI indices were minimum during the months of January, March and November, 2018 (Figure – 2).

Seasonal Prevalence in Rohini (North Delhi Municipal Corporation) during 2016 and 2018 The HI, CI and BI in Rohini (NDMC) varied from 0.0-3.1, 0.0-3.7 & 0.0-5.3 respectively during 2016. The maximum HI, CI and BI index was recorded for August, 2016 while the maximum CI and BI indices were recorded for July, 2016 (Figure – 3). The HI, CI and BI were minimum during the months of January, February, April and November, 2016. The HI, CI and BI in Najafgarh (SDMC) varied from 0.0-4.1, 0.0-9.6 and 0.0-4.3 respectively during 2018. The maximum HI, CI and BI indices were recorded for August, 2018. The HI, CI and BI were minimum during the months of January, March and November, 2018 (Figure – 4).

Seasonal Prevalence in Shahdara (East Delhi Municipal Corporation) during 2016 and 2018 The HI, CI and BI in Shahadara (EDMC) varied from 0.0-5.9, 0.0-5.16 & 0.0-14.0 respectively during 2016. The maximum HI, CI and BI were recorded for August, 2016. The HI, CI and BI were minimum during the months of January, 2016 (Figure – 5). The HI, CI and BI in Shahadara (EDMC) varied from 0.0-2.6, 0.0-5.1 & 0.0-14.0 respectively during 2018. The maximum HI was recorded for September, 2018 while the maximum CI and BI indices were recorded for August, 2018. The HI, CI and BI were minimum during the months of January, February, April and November, 2018 (Figure – 6)
Fig 2: Seasonal Prevalence of *Ae. Aegypti* in Najafgarh during 2018

Fig 3: Seasonal Prevalence of *Ae. Aegypti* in Rohini during 2016

Fig 4: Seasonal Prevalence of *Ae. Aegypti* in Rohini during 2018
Fig 5: Seasonal Prevalence of *Ae. Aegypti* in Shahdara during 2016

Fig 6: Seasonal Prevalence of *Ae. Aegypti* in Shahdara during 2018

Table 1: Month wise dengue cases and meteorological data of Delhi during 2016

| Month    | Temperature (°C) | DTR (°C) | Rainfall (mm) | RH (%) | Dengue cases |
|----------|------------------|----------|---------------|--------|--------------|
|          | Max.             | Min.     |               |        |              |
| January  | 21.3             | 09.1     | 12.5          | 0      | 70.3         | 0             |
| February | 25.7             | 10.9     | 14.8          | 001.3  | 49.2         | 0             |
| March    | 31.5             | 17.3     | 14.2          | 32.0   | 44.9         | 2             |
| April    | 38.0             | 23.4     | 14.6          | 000.0  | 23.1         | 5             |
| May      | 40.1             | 26.8     | 13.3          | 024.3  | 36.4         | 6             |
| June     | 39.5             | 28.7     | 10.8          | 034.5  | 47.3         | 15            |
| July     | 34.5             | 27.2     | 7.2           | 292.5  | 74.5         | 91            |
| August   | 34.5             | 26.8     | 7.7           | 122.7  | 72.1         | 652           |
| September| 35.0             | 25.7     | 9.3           | 075.0  | 57.1         | 1362          |
| October  | 34.2             | 20.6     | 13.6          | 002.0  | 50.3         | 1517          |
| November | 29.2             | 12.8     | 16.4          | 000.0  | 52.4         | 655           |
| December | 4.2              | 09.5     | 14.7          | 000.0  | 64.1         | 126           |
Discussion
Our study on seasonal prevalence on *Ae. Aegypti* in Delhi and NCR revealed that larval indices of dengue vector were more in transmission season which is consistent with the studies done in Thailand [3]. Abiotic factors play vital role in the vector breeding and contribute to the increase in larval indices [6].

Our studies showed that the HI was 5.39,3.1 and 4.9 in Nazafgarh, Rohini and Shahadara respectively in August, 2016 which were lower than 10% in different areas which is consistent with the studies done in Malaysia [1] but different with the study done in Tauru Village of NCR in 1996 having 33.3% HI 21.0% CI and 40.0% BI respectively [8]. The gradual increase in number of cases from July 2016 to September 2016 was due to heavy rainfall which increased the number of potential containers during post monsoon season due to rain in preceding months.

Temperature and dengue cases were found correlated which is consistent with the studies done in Thailand [3] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of increasing of dengue cases from July 2016 to October 2016 [9,10] but DTR fluctuated inspite of 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