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STUDY ON LARVAL DENSITY OF AEDES MOSQUITOES IN NCR, DELHI DURING PRE AND POST MONSOON SEASON

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ABSTRACT

Aedes mosquito is a vector for transmitting many arboviruses. Since last few years, annually more than one lakh cases of dengue infections occur in India resulting in substantial rates of mortality and morbidity. Thus, the aim of this study was to determine the presence of Aedes larva during different seasons in areas where Dengue cases were high and to highlight the importance of vector control at regular intervals to ensure sustained control of mosquito breeding. Study was carried for two years i.e. June and September 2018 & June and October 2019 in areas of Noida and Ghaziabad. In pre monsoon season out of 245 houses 12 were positive for Aedes breeding and in post monsoon season out of 262 houses 36 were positive in Ghaziabad. In Noida out of 190 houses 17 were positive for Aedes breeding and in post monsoon season out of 185 houses 29 were positive All the indices were found above critical level during post monsoon season in both Noida and Ghaziabad during both years, which gives an early warning signal for preventing further transmission of the disease and also to prevent further outbreak situations by taking appropriate control measures on time.

Keywords: Aedes Aegypti, Breeding Habitat, Dengue, Vector Surveillance

1. INTRODUCTION

Arbovirus transmission has become one of the major global public health issues in the past decades. Dengue a Aedes borne infection is currently one of the most rapidly rising Arboviral disease found in tropical and subtropical regions and is commonly known to pose a significant threat to public health (Gubler, 1978). It is mainly transmitted by Aedes aegypti mosquito, sometimes also by Ae. albopictus (Gubler, 1998), (Whitehorn and Farrar, 2010). It is, also responsible for significant morbidity and mortality, especially in tropical countries (Sharma et al, 2000). India has reported more than one lakh cases of dengue infections every year resulting in substantial rates of mortality and morbidity (https://ncvbdc.mohfw.gov.in/). 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 (Garcia et al. 2018). Both Ae. aegypti and Ae. albopictus mosquitoes, the competent vectors of chikungunya and dengue virus, are widely

distributed, making these species an important factor in the worldwide burden of infectious disease. (Moyes et al. 2017) in Delhi. Ae. aegypti is the most prevalent dengue vector species, which prefers to breed in man-made containers. A recent report shows that Ae. albopictus and Ae. vittatus are also adapting to breed in man-made containers in the urban areas of Delhi in addition to their natural habitats of bamboo bushes and rock pits. Ae. albopictus was found in 9.52% of surveyed localities including the central urban part of Delhi. 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 (Sharma et al., 2014). This study was undertaken to understand the larval indices during pre and post monsoon season to ensure sustained control of mosquito breeding.

2. MATERIAL AND METHODS

The National capital territory of Delhi, located in northern India between the latitudes of 28°-24'-17" and 28°-53'-00" North and longitudes of 76°-50'-24" and 77°-20'-37" consists of 11 districts. Delhi shares borders with the States of Uttar Pradesh and Haryana. Delhi has an area of 1,483 sq. kms. Its maximum length is 51.90 kms and greatest width is 48.48 kms. The National capital territory of Delhi is surrounded on three sides by Haryana and to the east, across the river Yamuna by Uttar Pradesh. (https://delhi.gov.in/page/about-us)

Figure 1 Delhi District Map

Source mapsofindia.com

Prominent cities of NCR include Delhi, Ghaziabad, Faridabad, Gurugram, and Noida (Figure 1). The NCR is a rural-urban region, with a population of over 46,069,000 and an urbanization level of 62.6 %. Census, (2011)

Noida is located in Gautam Buddh Nagar district of Uttar Pradesh. As per the provisional data of 2011 census, Noida had a population of 642,381(Urban Agglomerations, (2011)). During summer, i.e. from March to June, the weather remains hot and the temperature ranges from a maximum of 48 °C to a minimum of 28 °C. Monsoon season prevails from mid-June to mid-September (Tyagi et al. 2015) As the Aedes mosquito commonly breeds during the summer, the water storage practice provides the places for the breeding of the mosquito in the indoor conditions as well as in outdoor conditions. The breeding sites of the Aedes mosquito like coolers, overhead tanks, plastic containers, flower pots, construction sites etc. are innumerable in the NCR of Delhi. The streets in some of the localities are narrow and provide the optimum temperature for the breeding of the mosquitoes mainly in the water containers and coolers. Localities have been selected based on the confirmed dengue cases reported during the last three years and on socioeconomic factors.

3. ENTOMOLOGICAL SURVEILLANCE

Entomological surveillance of Aedes mosquito has been standardized on different indices based on the simple determination of presence or absence of Aedes larvae either in each container or somewhat in each house. A house to

house survey of Aedes mosquito breeding habitats was carried out in NCR (Ghaziabad and Noida) June and September 2018 & June and October 2019. The study was conducted in the urban and peri-urban areas. Three localities were selected each from Ghaziabad and Noida. To study the level of infestation of areas larvae survey for Aedes larval breeding was carried out between 10 AM and 12 PM to assess the high-risk areas in the district prone to dengue/DHF outbreak. The tools used in the larval survey included a survey form, pipettes, plastic bottles, plastic bags, specimen vials with stoppers and a flashlight. After getting the consent from the head of the house, the premises of the house were meticulously searched for man-made as well as natural water collections which, were potential mosquito breeding habitats; including cooler, plastic storage, syntax tank, flower pot, earthen pot, steel container, bird pot, plastic unused, money plant, cement tank, unused cup, solid waste and all other containers containing any volume of water were inspected. Containers with live larvae or pupae were considered positive containers. Larvae and pupae were collected from containers using dipping and pipetting methods. The larval identification was done by using standard keys (Tyagi et al., 2015). Larval indices were calculated based on the following formulae:

$$\text{House index (HI)} = \frac{\text{No. of positive houses} \times 100}{\text{No. of houses inspected}}$$

$$\text{Container index (CI)} = \frac{\text{No. of containers positive} \times 100}{\text{No. of containers inspected}}$$

$$\text{Breteau index (BI)} = \frac{\text{No. of containers positive} \times 100}{\text{No of Houses inspected}}$$

The container preference for the breeding of Aedes larvae was also studied. The data were analysed using MS Excel sheet.

4. RESULTS AND DISCUSSION

An Aedes larval survey was carried out during pre and post monsoon season in different localities of Ghaziabad and Noida in June and September 2018 & June and October 2019. A total of 137 houses and 245 containers were surveyed in Pratap Vihar, Vijay Nagar and Indira Nagar areas of Ghaziabad during pre-monsoon season and 140 houses and 341 containers were surveyed during post monsoon season in the same localities. In the same year 74 houses and 121 containers were surveyed during pre-monsoon season in Khoda Village, Sector 71 and Tigri village of Noida and 81 houses and 191 containers were surveyed during post monsoon season in the same localities of Noida.

The HI, CI and BI in areas of Ghaziabad viz Pratap Vihar, Vijay Nagar and Indira Nagar in post monsoon season was high as compared to pre monsoon indices in the same area. (Table 1) Breteau index increased from 14.3 to 33.3 in Pratap Vihar, in vijay nagar it increased from 4.2 to 22.2 and in Indira Nagar from 5.6 to 18.2.

Table 1 Prevalence Indices of Aedes aegypti in Ghaziabad during 2018

Prevalence of *Aedes aegypti* in in Ghaziabad 2018							
S No	**Locality**	**Pre monsoon**			**Post monsoon**		
		HI	**CI**	**BI**	**HI**	**CI**	**BI**
1	Pratap vihar	11.4	6.4	14.3	23.8	14.6	33.3
2	Vijay nagar	4.2	1.9	4.2	14.8	9.9	22.2
3	Indira Nagar	3.7	4.8	5.6	13.6	8.2	18.2
	Total Prevalence	5.8	4.1	7.3	17.1	10.8	24.3

It was observed HI, CI & BI was high in all three localities of Ghaziabad viz Pratap Vihar, Vijay Nagar and Indira Nagar in post monsoon and pre monsoon season. (Figure 2)

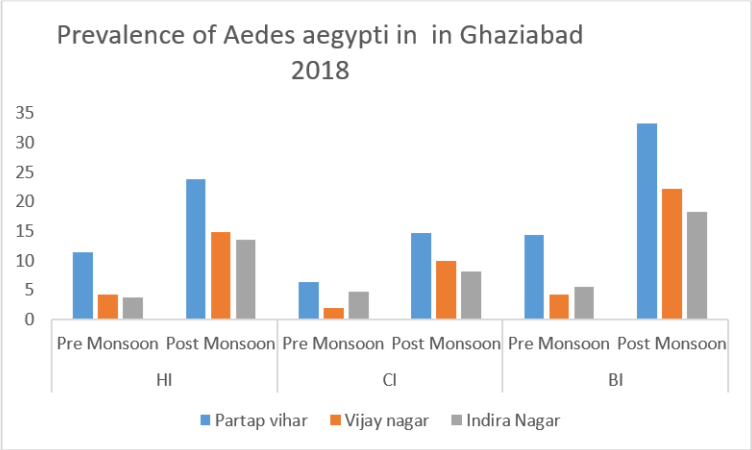

Figure 2 Prevalence of Aedes aegypti in Ghaziabad 2018

During 2018 HI, CI and BI in areas of Noida viz Khoda Village, Sector 71 and Tigri village in post monsoon season was high as compared to pre monsoon indices in the same area. (Table 2) Breteau index increased from 8.3 to 19.4 in Khoda Village, in Sector 71 it decreased from 16.7 to 13.6 and in Tigri village it increased from 6.3 to 17.9

Table 2 Prevalence Indices of Aedes aegypti in Noida during 2018

Prevalence of *Aedes aegypti* in Noida 2018							
S No	**Locality**	**Pre Monsoon**			**Post Monsoon**		
		HI	**CI**	**BI**	**HI**	**CI**	**BI**
1	Khoda Village	8.3	6.7	8.3	12.9	6.3	19.4
2	Sector 71	16.7	12	16.7	9.1	6	13.6
3	Tigri village	3.1	3	6.3	14.3	10.9	17.9
	Total Prevalence	8.1	5.8	9.5	21	12.6	29.6

It was observed that HI, CI and BI were on higher side during post monsoon season as compared to pre monsoon season in both Ghaziabad and Noida localities (Figure 3). However there is exception in Sector 71 where indices decreased probably because of vector control intervention.

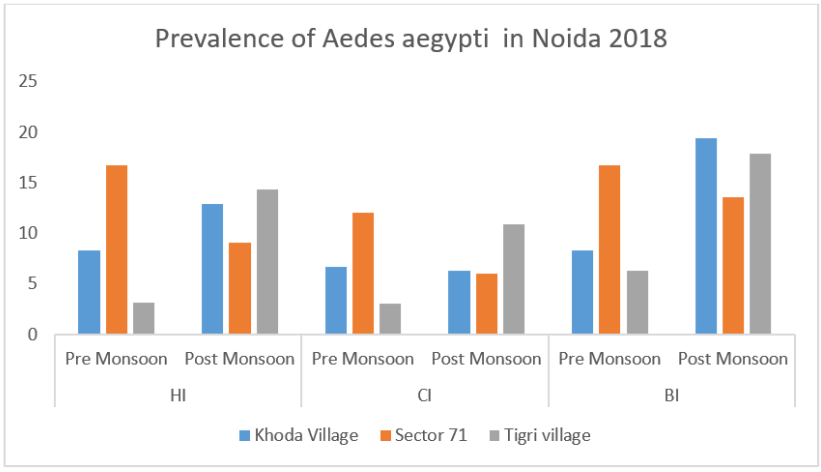

Figure 3 Prevalence of Aedes aegypti in Noida 2018

Similarly during 2019 a total of 108 houses and 142 containers were surveyed during pre-monsoon season in Pratap Vihar, Vijay Nagar and Indira Nagar areas of Ghaziabad and 122 houses and 245 containers were surveyed during post

monsoon season in the same localities. In the same year 116 houses and 167 containers were surveyed during pre-monsoon season in Khoda Village, Sector 71 and Tigri village of Noida and 104 houses and 129 containers were surveyed during post monsoon season in the same localities of Noida.

The HI, CI and BI in areas of Ghaziabad viz Pratap Vihar, Vijay Nagar and Indira Nagar in post monsoon season was high as compared to pre monsoon indices in the same area. (Table 3) Breteau index increased from 10 to 15 in Pratap Vihar, in vijay nagar it increased from 2.4 to 12.5 and in Indira Nagar from 5.6 to 9.5.

Table 3 Prevalence of Aedes aegypti in Ghaziabad 2019

Prevalence of *Aedes aegypti* in Ghaziabad 2019							
S No	**Locality**	**Pre Monsoon**			**Post Monsoon**		
		HI	**CI**	**BI**	**HI**	**CI**	**BI**
1	Partap vihar	6.7	7.3	10	10	9.3	15
2	Vijay nagar	2.4	2.1	2.4	7.5	5.6	12.5
3	Indira Nagar	2.8	3.8	5.6	11.9	4.3	9.5
	Total Prevalence	3.7	4.2	5.6	9.8	5.7	11.4

It was observed that HI, CI and BI were on higher side during post monsoon season as compared to pre monsoon season in all localities surveyed in Ghaziabad (Figure 4)

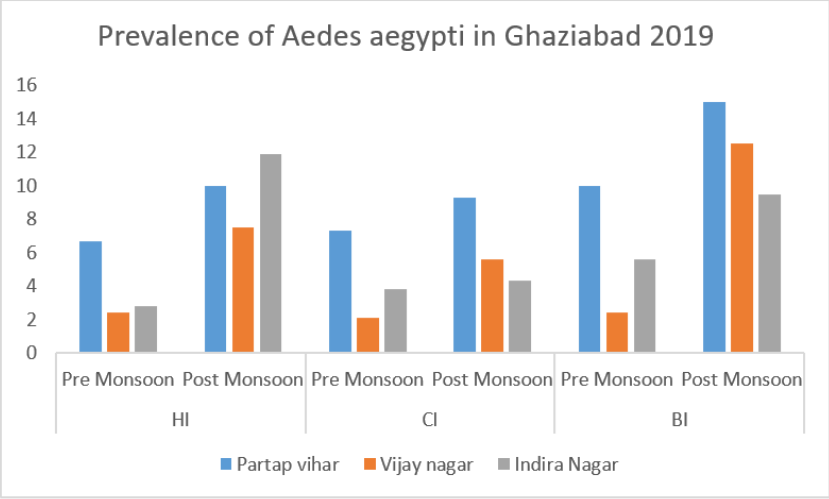

Figure 4 Prevalence of Aedes aegypti in Ghaziabad 2019

During 2019 HI, CI and BI in areas of Noida viz Khoda Village, Sector 71 and Tigri village in post monsoon season was high as compared to pre monsoon indices in the same area. (Fig 5) Brateau index increased from 4.8 to 16.6 in Khoda Village, in Sector 71 it increased from 2.9 to 17.5 and in Tigri village it decreased from 20 to 10.7

Table 4 Prevalence of Aedes aegypti in Noida 2019

Prevalence of *Aedes aegypti* in Noida 2019							
S No	**Locality**	**Pre Monsoon**			**Post Monsoon**		
		HI	**CI**	**BI**	**HI**	**CI**	**BI**
1	Khoda Village	4.8	3.6	4.8	11.1	12.2	16.6
2	Sector 71	2.9	2.1	2.9	12.5	15.2	17.5
3	Tigri village	20	12.7	20	10.7	8.8	10.7
	Total Prevalence	9.5	6.6	9.5	23.1	30.2	15.3

It was observed that HI, CI and BI were on higher side during post monsoon season as compared to pre monsoon season in Khoda Village, Sector 71 and Tigri village of Noida. (Figure 5) However because of timely vector control intervention in Tigri village, indices decreased remarkably.

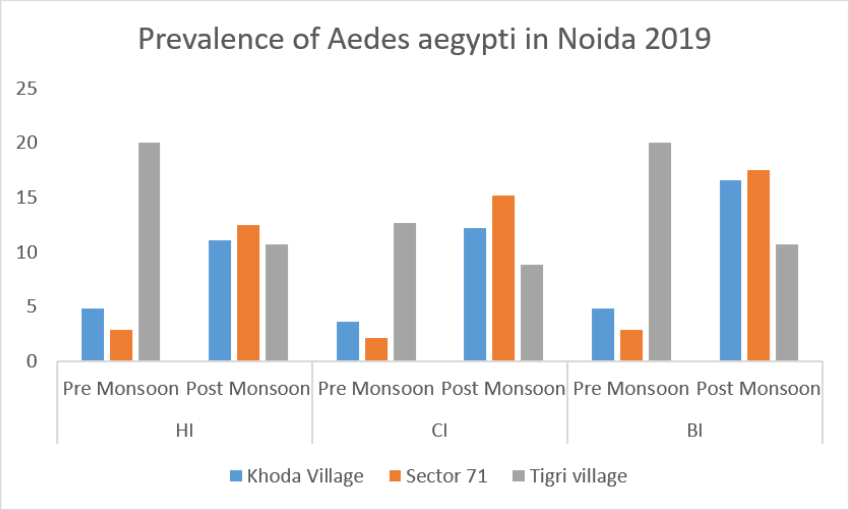

Figure 5 Prevalence of Aedes aegypti in Noida 2019

It was observed that HI, CI and BI were on higher side during post monsoon season as compared to pre monsoon season in both Ghaziabad and Noida localities with some exceptions.

All these indices were found above critical level during post monsoon season during both years, which gives an early warning signal for taking timely measures for preventing further transmission of the disease and also to prevent further outbreak situations.

Further, it was observed that potential breeding sites were found in bird pot, unused plastic, money plant, cement tank, unused cup, solid waste, etc. Aedes breeding was found in indoor, outdoor and peri-domestic areas.

Results of entomological indices calculated in the residential colonies of Ghaziabad and Noida shows a high risk of transmission of the disease due to the high House Index, Container Index and Breteau Index during post monsoon season. This also indicates that the vector control measures are not been carried out properly in these colonies. Studies done in three districts of Punjab, Pakistan revealed that the house index ranged from 12 to 18 % during pre-monsoon while it was from 14 and 29% due to the post-monsoon season in 2013. The container index ranged from 11.40 to 13.17% for the pre-monsoon and from 11.22 to 30.39% for the post-monsoon. Breteau index varied from 11 and 69% during both seasons and the premises index ranged from 24.40 to 44.32%. The entomological survey also revealed that in both seasons, the highest breeding potentiality was recorded in Lahore followed by Sheikhupura and Faisalabad Saleem et al. (2014).

Previous study which was conducted in different socio-economic groups of Delhi, India also suggests that Aedes larvae indices were higher in post monsoon season than pre-transmission season which is consistent with our study Vikram et al. (2015). The earlier study which was conducted in and around ports of Goa, India revealed high larval indices (Sharma et al., 2015). A similar study which was conducted in Tirunelveli, Tamil Nadu in 2012 larval indices were as HI, CI, BI, and PI varied from 5.00 - 43.33, 0.87-7.50, 5.00 - 63.33 and 00 - 200.00 respectively which were higher than our results respectively (Bhat & Krishnamoorthy, 2014). The earlier study which was conducted in Thiruvananthapuram district, India, the house index, container index and the Breteau index were 13.08, 13.28 and 16.57%, respectively Vijayakumar et al. (2014). Another study which was conducted in Dhaka, Bangladesh in 2000, the findings were consistent with our study (Ferdousi et al., 2015).

According to our study it was revealed that the main cause of mosquito breeding is the poor management of water storage in NCR. The area studied is vulnerable for transmission of vector and vector-borne diseases because of high larval indices. This situation necessitated the further strengthening of the vector based control method. These indices which were above the critical index, indicating an impending outbreak, if appropriate control measures are not taken well in time. The reason can be attributed to water storage practices, changes in lifestyle and socio-cultural behaviours among different communities.

5. CONCLUSION

The results of this study indicate that the current control measures are not sufficient to match the need. It is essential that control measures should be adopted during the pre-monsoon season when larval indices are low and efforts should be continued during the post monsoon season where the indices are the highest. To ensure sustained control of mosquito breeding survey of potential breeding places need to be conducted at regular intervals.

CONFLICT OF INTERESTS

None.

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