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Research Article

LARVAL DENSITY OF *AEDES* MOSQUITOES IN NCR DURING MONSOON SEASON

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ABSTRACT

Aedes mosquito is a vector for transmitting many arboviruses. Since the last few years, annually more than one lakh cases of dengue infections occur in India resulting in substantial rates of mortality and morbidity. Thus, this study was aimed to determine the presence of *Aedes* mosquito species to conduct larval surveys at regular intervals to ensure sustained control of mosquito breeding. Out of 269 houses, 55 houses were found positive for *Aedes* breeding and out of 342 containers searched, 65 containers were found positive. A survey was done at Gurgaon, Kadipur village showed higher larval indices HI, CI and BI (11.1%, 20.3 % and 25.4 resp.) than Vishwakarma Colony, Basai Road (HI-13.4, CI- 13.2 and BI- 14.9). In Noida, Bhangel Village has higher HI, CI and BI (29.7 %, 22.7% and 29.7%) than Salarpur Village (HI-26.2, CI-18.9 and BI-26.2). Our findings imply that both colonies of Noida show higher *Aedes* indices than the critical level, which makes the area vulnerable for transmission of vector and vector borne diseases and current control measures do not suffice to match the need. These indices were above the critical index, indicating an impending outbreak, if appropriate control measures are not taken on time.

Keywords: *Aedes aegypti, Aedes albopictus,* Breeding habitat, Dengue, Vector surveillance.

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 (Bharati & Saha, 2018). 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 (Kamgang *et al*., 2017). 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 virus, dengue virus, rift valley fever virus, yellow fever virus and zika virus and are both 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. *Ae.aegypti* is prevalent throughout India so the entire country is at risk for dengue transmission. Chikungunya is also spread by *Ae.aegypti* and *Ae.albopictus* and thus follows the same patterns of transmission and spread. 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

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undertaken to understand the larval indices during monsoon season to conduct larval surveys at regular intervals to ensure sustained control of mosquito breeding in two districts of NCR.

MATERIALS AND METHODS

Study area

Present entomological surveillance was undertaken in NCR from July 2019 to August 2019. The National Capital Region (NCR) is a central planning region centered upon the National Capital Territory in India. It encompasses the entire NCT of Delhi and several districts surrounding it from the states of Haryana, Uttar Pradesh and Rajasthan. (Urban Agglomerations, 2017). 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) Gurgaon, officially named Gurugram, is a city located in the northern Indian state of Haryana. It is situated near the Delhi-Haryana border, about 30 kilometers southwest of the national capital New Delhi and 268 km south of Chandigarh, the state capital (Agarwal *et al*., 2018). It is one of the major satellite cities of Delhi and is part of the National Capital Region of India. As of 2011, Gurgaon had a population of 876,900 Census, (2011). Under the Köppen climate classification, Gurgaon experiences a monsoon-influenced Composite climate. The average annual rainfall is approximately 714 millimetres (28.1 in). Info (2014) 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) in 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 breeding season of the *Aedes* mosquito is also during the summer, the water storage 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 providing the optimum temperature for the breeding of the mosquitoes mainly in the water containers and coolers. All localities were selected based on the confirmed dengue cases reported during the last three years and on socioeconomic factors.

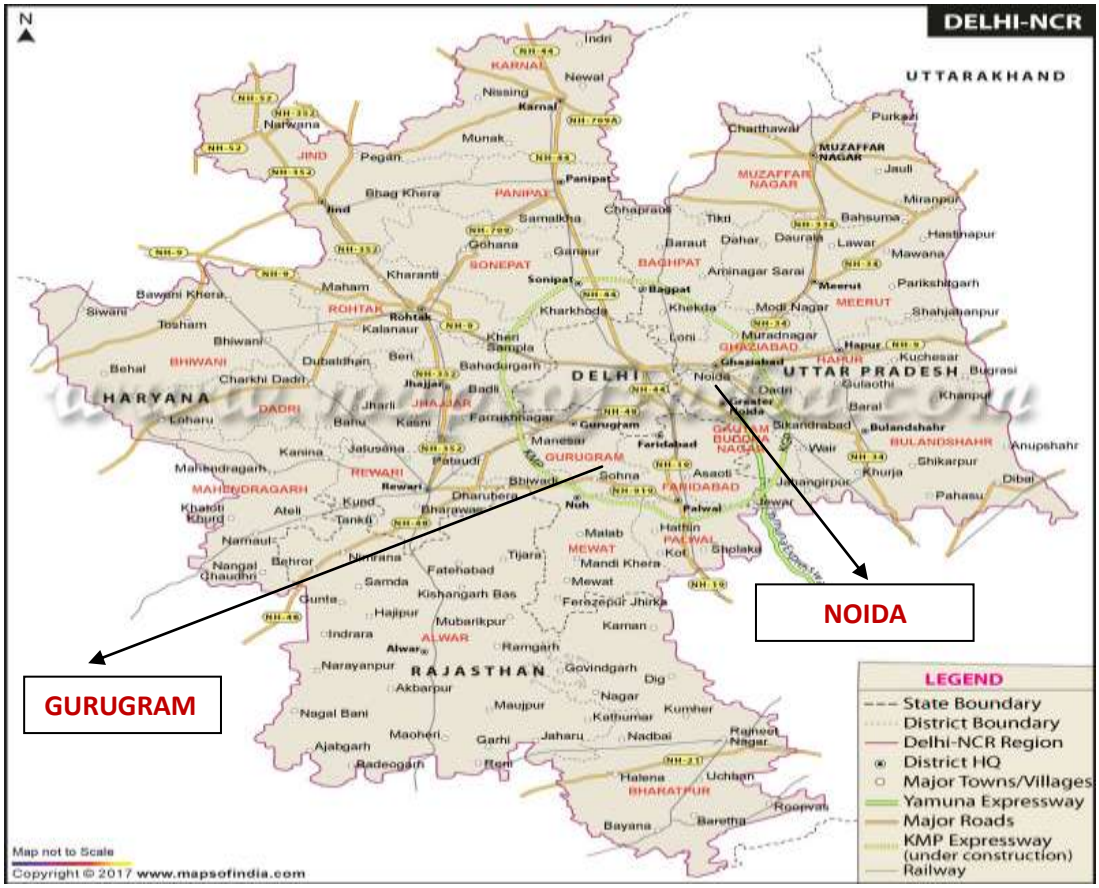

Figure 1. Map showing locations of study areas in NCR.

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 (Gurgaon and Noida) during July and August 2019. The study was conducted in the urban and peri-urban areas. Two localities were selected each from Gurgaon and Noida. The survey was made between 10 am-12 pm to detect *Aedes* larval breeding in a view to study the level of infestation of areas with *Aedes* larvae and 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; include 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:

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

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

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

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

RESULTS AND DISCUSSION

An *Aedes* larval survey was carried in 269 houses, 55 houses were found positive for *Aedes* breeding and out of 342 containers searched, 65 containers were found positive. A survey which was done at Gurgaon, Kadipur Village showed higher larval indices HI, CI and BI (11.1%, 20.3 % and 25.4 resp.) than Vishwakarma Colony, Basai Road (HI-13.4, CI- 13.2 and BI- 14.9). Also in Noida, survey was done during monsoon in which Bhangel Village has higher HI, CI and BI (29.7 %, 22.7% and 29.7%) than Salarpur village (HI-26.2, CI-18.9 and BI-26.2). Both colonies show higher *Aedes* indices than critical level. Details of larval indices were shown in Table 1. All these indices were found above critical level, which gives an early warning signal for preventing further transmission of the disease and also to prevent further outbreak situations. The most common *Aedes* mosquito breeding habitats were planted pot, earthen pot, cooler, plastic storage, plastic unused. Further, it was observed that potential breeding sites were found in bird pot, plastic unused, money plant, cement tank, unused cup, solid waste, etc. *Aedes* breeding was found in indoor, outdoor and peri-domestic areas. During monsoon all the water-holding devices kept open are flooded with rainwater and support breeding. Besides, households store drinking water in containers without proper covering. These holdings also contribute towards *Aedes* mosquitoes breeding. As the prevalence increases the incidence of these vector-borne diseases also increases.

Vector-borne diseases are on the rise in the last few years with epidemics reported in many countries. Kumar *et al*. (2014) the entomological indices are important indicators to know the dengue fever transmission. House Index and Container Index are also important determinants of the extent of breeding and intensity of mosquito breeding respectively. The House Index has been widely used to monitor the infestation levels. The Container Index provides valuable information on the proportion of water-holding containers that are infested. However, the Breateau Index is more applicable, as it correlates the positive (Bhat *et al*., 2014). Containers and Houses inspected and thus it is regarded as an excellent risk indicator of dengue outbreaks. Other than these larval indices, Pupal Indices are important to know the intensity of transmission and are considered the better and alternate indicators for adult mosquito abundance. The Pupal index has been frequently used for Operational Research purposes (Bhat *et al*., 2014). Current study indicated that larval indices were high which is higher than the critical level in Noida during monsoon, which is followed by Gurgaon during monsoon. Also in our study, the house index ranged from 11 and 29.7% due to monsoon season. The container index ranged from 13.2 to 22.7% and Breteau index varied from 14.9 to 29.7%, which reveals that during monsoon season, high breeding potentiality was found in residential colonies of Gurgaon and Noida. On analyzing Table 1, which depicts the results of entomological indices calculated in the residential colonies of Noida and Gurgaon shows a high risk of transmission of the disease due to the high House Index, Container Index and Breteau Index. This also shows that the application of control measures of vector is not been carried out effectively in these colonies. The studies which was done in 2013 in three districts of Punjab, Pakistan reveals 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. 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 indexranged 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. Although our study was conducted during the monsoon season, our findings were

almost similar to their study Saleem *et al*. (2014) in an 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 which is in contrast with our study except in Gurgaon. Vijayakumar *et al*. (2014). A previous study which was conducted in different socio-economic groups of Delhi, India also suggests that the number of *Aedes* larvae was higher in the transmission season than in the non-transmission season which is inconsistent with our study Vikram *et al*. (2015). The earlier study which was conducted in and around ports of Goa, India revealed high larval indices which are higher than our findings (Sharma *et al*., 2015). A similar study which was conducted in Tirunelveli, Tamil Nadu in 2012 larval indices were obtained as the HI, CI, BI, and PI varied from 5.00 - 43.33, 0.87-7.50, 5.00 - 63.33 and 00 - 200.00 (Figure 1 and 2) respectively which were higher than our results. This indicates that our area of study is comparatively better in terms of reduction of breeding sites, but still insufficient (Bhat & Krishnamoorthy, 2014). The earlier study which was conducted in Dhaka, Bangladesh in 2000 their findings were consistent with our study specifically in Gurgaon (Ferdousi *et al*., 2015).

Table 1. Larval indices and distribution of *Aedes* mosquito breeding habitats at different locations in NCR.

Location	Month	Colony	Total houses	Positive houses	Total containers	Positive containers	HI	CI	BI
Noida		Salarpur Village	65	17	90	17	26.2	18.9	26.2
	July	Bhangel Village	74	22	97	22	29.7	22.7	29.7
Gurgaon		Kadipur Village	63	7	79	16	11.1	20.3	25.4
	August	Vishwakarma Colony, Basai Road	67	9	76	10	13.4	13.2	14.9
Total			269	55	342	65			

HI-House Index, CI-Container Index, BI-Breteau Index.

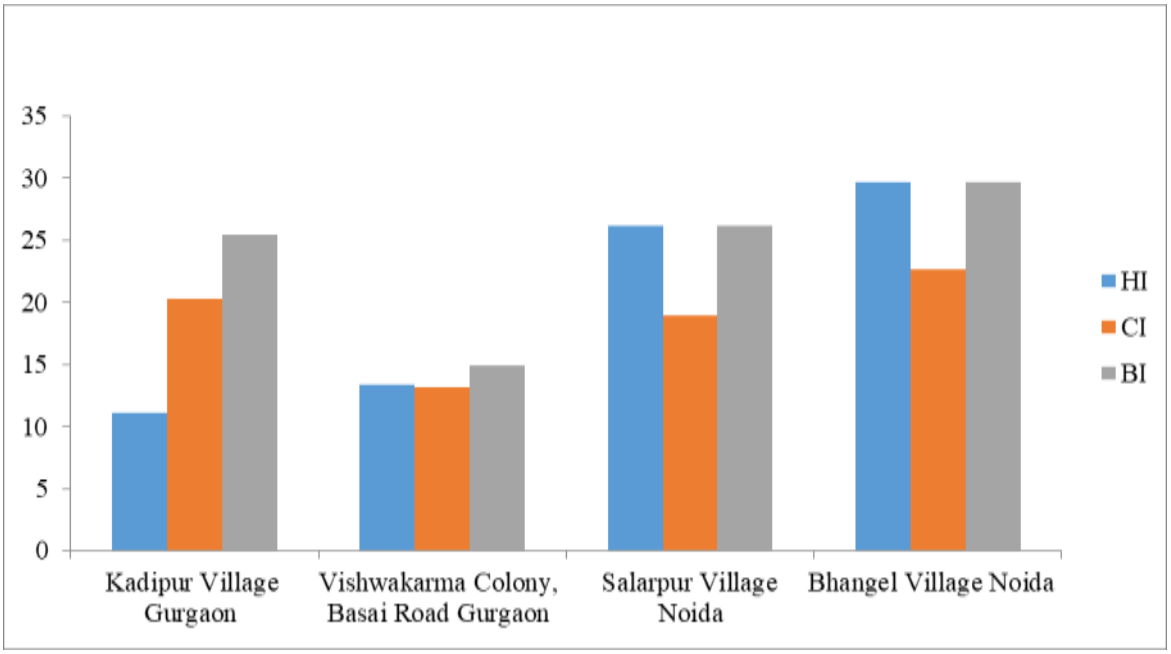

Figure 1. Graph showing larval indices of *Aedes* mosquito of different locations in NCR.

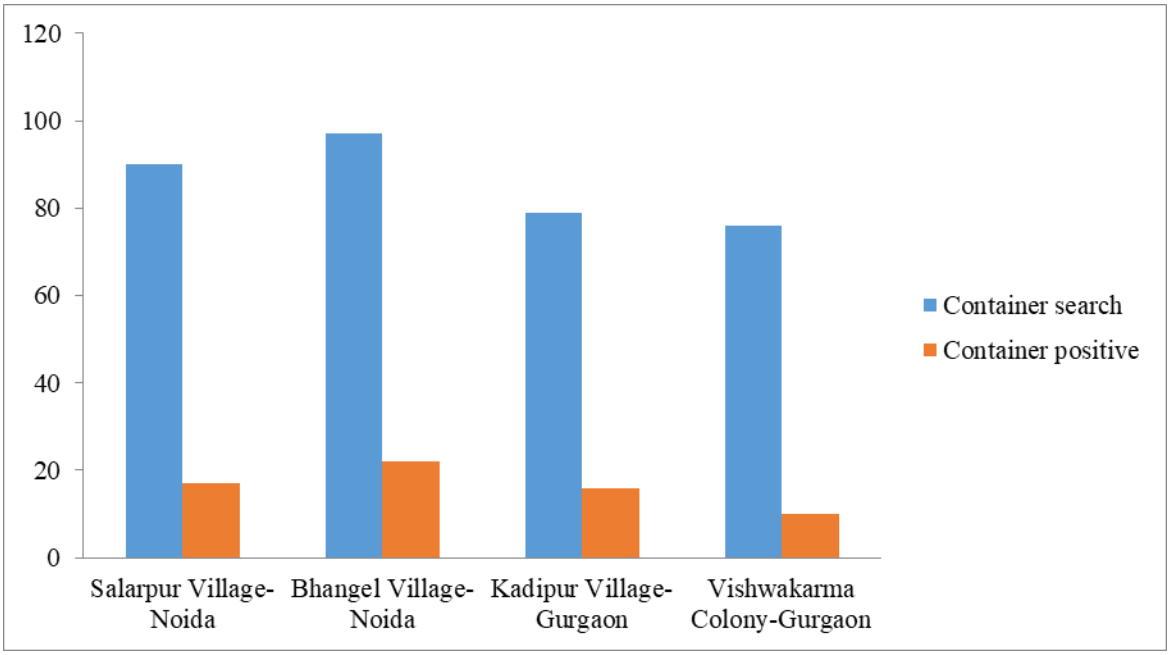

Figure 2. Graph showing detail positive container of different locations in NCR.

During our survey, the highest percentage of positive containers for larvae has been shown in plastic storage which is followed by planted pot, earthen pot, cooler, plastic unused. Further, it was observed that potential breeding sites were found in bird pot, plastic unused, money plant, cement tank, unused cup, solid waste, etc. *Aedes* breeding was found in indoor, outdoor and peri-domestic areas. However, the stored water should be changed regularly. Our findings revealed that the poor management of water storage is the main cause of mosquito breeding. High larval indices in NCR make the area vulnerable for transmission of vector and vector-borne diseases. This situation necessitated the further strengthening of the ecology/entomology based control method. These indices whose were above the critical index, indicating an impending outbreak, if appropriate control measures are not taken on time. The reason can be attributed to water storage practices, changes in lifestyle and socio-cultural behaviors among different communities.

CONCLUSION

The results of this study imply that the current control measures do not suffice to match the need. Control measures need to be adopted during the pre-monsoon season when indices are low and efforts need to be continued during the monsoon season where the indices are the highest. Larval surveys and surveys of potential breeding places need to be conducted at regular intervals to ensure sustained control of mosquito breeding.

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