

Research Article

A study of larval indices of *Aedes* and the risk for Dengue outbreak

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Abstract: Arboviral diseases are on an increase the world over, especially in developing countries like India. The problem has been perceived to be serious enough for the World Health Organisation to dedicate the World Health Day 2014, for awareness of such diseases. The World Health Day 2014, aptly has the slogan, “small bite, big threat”. Larval survey was carried out and House index (HI), container index (CI) and Breteau index (BI) were calculated. During the larval survey, a total of 2088 containers were examined in the entire study area. Out of these, 1018 containers were found to be positive for *Aedes* larval breeding. The most common breeding source were stagnant drains (100.00%) followed by discarded tyres (90.32%), discarded plastic containers (74.34%), puddles of water on ground (e.g., in tyre markings) (68.09%) and plastic trays under flower pots (53.61%). Breeding of *Aedes aegypti* and the relatively high values of the three indices in the present study makes this area have a high dengue potential. Measures such as integrated vector management, minimization of the breeding potential of *Aedes* by water management practice, proper disposal of tyres, discarded plastic containers and glass bottles by individuals, cleaning of the blocked and stagnated drains, implementation of urban by-laws, and health education are recommended for better control of breeding of *Aedes* species.

Keywords: *Aedes*, dengue, mosquito, larva, outbreak

INTRODUCTION

Arboviral diseases are on an increase the world over, especially in developing countries like India[1]. The problem has been perceived to be serious enough for the World Health Organisation to dedicate the World Health Day 2014, for awareness of such diseases. The World Health Day 2014, aptly has the slogan, “small bite, big threat” [2]. This is dedicated to highlighting simple measures that we can take in order to protect ourselves. Dengue fever (DF) as well as dengue hemorrhagic fever (DHF) are amongst the mosquito borne diseases that are caused by any of the four virus serotypes (DEN-1, DEN-2, DEN-3, DEN-4) belonging to genus *Flavivirus*. Both DF and DHF are transmitted by *Aedes* mosquito, out of which it is most commonly, *Aedes aegypti*[1]. Dengue is a major public health concern in today’s world. Owing to the distribution of the *Aedes* vector which is found in tropical and subtropical areas, dengue is seen more often in these areas, primarily in or semi urban areas [1]. The global incidence of dengue has grown dramatically in recent decades [2,3]. About half of the world’s population is now at risk [2,4,5]. Additionally, the potential and frequency for epidemics has risen because of the hyperendemicity (presence of multiple circulating serotypes) of dengue [1]. Besides, the

number of cases in the western hemisphere has more than tripled in the last decade [3]. Despite various efforts towards eradication, a large number of countries are still affected[4]. India, as a whole, is one of the most susceptible countries to epidemics of dengue. This is due to the conducive climatic conditions and the environment that offers a suitable environment for breeding of the *Aedes* mosquitoes. Besides, there are other problems like erratic water supply (that forces the population to store water in containers), poverty, illiteracy/ low education levels, all of which lead to poor sanitation. These factors are further precipitated by the population and its density. The aim of the present study was to conduct a survey for the larval indices of *Aedes* and estimate the risk for dengue outbreak in a residential area in North India.

MATERIALS AND METHODS

Larval Survey

Conducting surveillance of *Aedes* mosquito is one of the important aspects of disease control. This, in turn, helps to warn the community before the disease spreads in their area. Although there are indices and methods available for the various stages in the life cycle of the mosquito, from larva, pupa to adult, but the stage found best suited for surveillance is the larval stage

[10]. In a larval survey, various indices are used to record *Aedes aegypti* and *Aedes albopictus* density level. These indices are House index (HI), container index (CI) and Breteau index (BI) [10].

House index (HI)

Percentage of houses positive for larvae of *Ae. Aegypti*.

$$HI = \frac{\text{No. of houses positive for Aedes larvae}}{\text{No. of houses inspected}} \times 100$$

Container index (CI)

Percentage of water-holding containers positive for *Aedes* larvae.

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

Breteau index (BI)

Number of positive containers for *Ae. Aegypti*, per 100 houses.

$$BI = \frac{\text{No. of positive containers}}{\text{Per 100 houses inspected}}$$

A HI > 5% and/or a BI > 20 for any locality is an indication that the locality is Dengue sensitive and therefore adequate preventive measures should be taken [10]. Depending on potential for outbreak, an area can be placed into one of the following four categories:

- Priority I: Death due to Dengue confirmed
- Priority II: HI > 5, BI > 20
- Priority III: HI < 5, BI < 20
- Priority IV: Despite active search, no breeding sites found positive

METHODOLOGY

The area was inspected for possible breeding locations, including containers, stagnant water bodies, etc. using ladle or pipette, larvae and pupae were collected.

Collection technique

Five ladle dips were taken from each water collection and number of larva and pupae in bowl counted after 5 dips. Larval density is calculated. These dips were taken from the margin of water collection as larvae generally are found there. Since *Aedes* mosquitoes breed in artificial or natural containers which contain only small amounts of water, a pipette was used to check for the breeding in these containers. Collected specimens were placed in a specimen tube and labeled with location and genus found. The number of positive containers as well as the number of water-filled containers inspected was recorded (Table - 1). Total larvae in positive containers are counted to give approximate density per breeding site. Larvae were identified according to apparent morphological features with the help of a hand-lens. Subsequently, rearing of 4th instar larvae and pupae was carried out. Pupae and larvae of the 4th instar were placed in a ceramic bowl and a fraction of a yeast tablet was placed in the bowl. The bowl was labelled with location in which specimens were found and was placed inside a mosquito rearing net which was then closed.

RESULTS

During the larval survey, a total of 2088 containers were examined in the entire campus. Out of these, 1018 containers were found to be positive for *Aedes* larval breeding. Table – 1 shows the detailed description of containers. The most common breeding source were stagnant drains (100.00%) followed by tyres (90.32%), discarded plastic containers (74.34%), puddles of water on ground (e.g., in tyre markings) (68.09%) and plastic trays under flower pots (53.61%).

Table-1: Description of containers examined

S.No.	Type of container	Total containers examined	Total containers found positive	Percentage of containers found positive
1.	Overhead plastic tanks	108	12	11.11
2.	Discarded plastic containers	452	336	74.34
3.	Plastic trays under flower pots	873	468	53.61
4.	Water coolers	167	28	16.77
5.	Buckets	186	58	31.18
6.	Refrigerator defrost tray	112	22	19.64
7.	Stagnant drain	18	18	100.00
8.	Puddles of water on ground (e.g., in tyre markings)	47	32	68.09
9.	Glass bottles	69	16	23.19
10.	Earthen pots	22	0	0
11.	Tyres	31	28	90.32
12.	Ornamental ponds	3	0	00
	Total	2088	1018	48.75

Larval indices

$$HI = \frac{\text{No. of houses positive for } Aedes \text{ larvae}}{\text{No. of houses inspected}} \times 100$$

$$= 58/100 \times 100 = 58.00\%$$

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

$$= 1018/2088 \times 100 = 48.75\%$$

$$BI = \frac{\text{No. of positive containers}}{\text{Per 100 houses inspected}}$$

$$= 1018/100 = 10.18$$

Breeding was also found in tyres, other discarded containers, glass bottles etc. Stagnant drains, followed by discarded vehicle tyres, had the highest container index at 100.00% and 90.32% respectively. The larvae which were sampled from the breeding spots were isolated and reared for identification upto species level. The emerged adults were identified as *Aedes aegyptii*. The Breteau index as calculated by the number of containers found positive per 100 houses was 10.18.

DISCUSSION

Various indices as described above were also calculated and are shown above. Dengue is caused by several closely related viruses, called dengue types 1, 2, 3 and 4. The disease is transmitted from person to person mainly by *Aedes aegypti* but *Aedes albopictus* can also act as a vector. Dengue is a man made disease, as these vectors breed in containers both natural and man-made, in and around the house [9]. In the present study, a total of 2088 containers and 100 houses were inspected. Observations of the larval survey were recorded and the HI, CI, and BI were calculated to be 58.00%, 48.75% and 10.18 per 100 houses, respectively. In addition to calculating the total container index, details regarding each container type were also obtained. The individual container indices were calculated for each, as depicted in table – 1. Similar results were found in other such studies conducted, where discarded plastic containers contributed most to the breeding sites of larvae [11]. The larvae that were found in the larval survey were reared and the emerged adults were identified. They were all found to be *Aedes aegyptii* [12-14]. Anti larval measures in the form of spraying of larvicides and container management were done concurrently during the survey. Another study done in North India during a dengue outbreak found the HI, CI and BI as 33.3%, 21.0% and 40.0, respectively in one village [18] and in a similar study in another village they found HI, CI and BI as 13.6%, 2.8% and 10.3, respectively [16]. Comparable results were obtained from another similar

study conducted in villages where *Aedes* breeding was found in earthen pots and cemented tanks [17]. Studies done in island areas of India found that common that breeding sites for *Aedes aegypti* are small cement tanks, used tyres, solid waste material holding rain water, and, for *Aedes albopictus*, they are small pots holding drinking water for birds, metallic containers holding rain water, and tree holes [18, 19]. Similar studies done in another endemic state recorded the HI, CI and BI as 53.90, 19.38 and 177.06, respectively [21]. These high indices were the cause of sudden spurt of dengue cases in this region. The maximum positivity of *Aedes* larva was found in coconut shells and discarded tyres during this study [20]. A study conducted in yet another state endemic for dengue yielded similar results [21].

CONCLUSION

The present study conforms with the results obtained from other studies conducted in similar areas. Breeding of only *Aedes aegypti* was found in this study. Because of the relatively high values of the three indices in the present study, this area falls in the high priority category. In fact, in the recent past, there have been confirmed cases of dengue in this area. However, no death was reported. This obviates the need for creating awareness for protective measures against dengue since there is an established dengue potential in this area. Measures such as integrated vector management, minimization of the breeding potential of *Aedes* by water management practice, proper disposal of tyres, discarded plastic containers and glass bottles by individuals, cleaning of the blocked and stagnated drains, implementation of urban by-laws, and health education are recommended for better control of breeding of *Aedes* species.

Conflicts of interest: None identified

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