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Research Article

# A Descriptive Study on Larval Habitats of *Aedes aegypti* Mosquito for Predicting Dengue Outbreak and to Provide Preventive Actions in an Urban Area of Bangalore

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## I N F O

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## A B S T R A C T

*Introduction:* WHO recommends vector surveillance as an important determinant for predicting dengue outbreaks; so as to provide integrated vector control measures and health education for the community regarding source reduction. The present study was done to find out the habitats of *Aedes* aegypti mosquitoes and to find out the larval indices in an urban poor locality.

*Method:* A descriptive study was conducted by a door-to-door survey for breeding habitats of *Aedes aegypti* mosquitoes in the UPHC area along with the health workers. The sampling unit of the present study was the house and its surroundings, which were systematically searched for water-holding containers and each one was examined for the presence of larvae. Subsequently, the house index, container index and Breteau index were computed as risk indices. Later, all the households were given health education regarding source reduction and prevention of dengue.

*Results:* Among the 1112 houses surveyed with 2295 containers, 92 houses had breeding sites for Aedes larvae having 106 containers infested with *Aedes* mosquito larvae. The larval indices were found to have a container index of 4.62, a house index of 8.27 and a Breteau index of 9.53.

*Conclusion:* The present study area had high larval indices which predict dengue transmission. Therefore, immediate vector control measures were implemented with the help of the local municipal corporation to prevent dengue outbreaks in the study area.

**Keywords:** Larval Habitats, *Aedes aegypti,* Vector Index, Prevention, Dengue

## Introduction

Dengue is a viral communicable disease, which is there in all the regions of the World Health Organization (WHO). It has become a public health problem with 3.9 billion people at risk and more than 390 million cases annually in more than 128 countries globally.[1,2] The most severely impacted regions are the Americas, South-East Asia and Western Pacific; with Asia accounting for over 70% of the global load. The disease is of substantial concern in tropical and subtropical areas of the Southeast Asian region recorded morbidity of 2.9 million people between 2001 and 2010.[3,4]

In light of recent advancements in preventing the disease, WHO has suggested a global strategy for dengue prevention and control aimed to address the focus areas: 1) Early diagnosis and case management 2) Integrated vector surveillance 3) sustainable vector control measures 4) Vaccine research and implementation 5) Operations research. Therefore these focus areas have to be implemented, coordinated and adequately resourced, building the capacity of key stakeholders and primary healthcare providers within the communities.[5]

A key element of control programmes is the early detection of dengue epidemics. The Aedes aegypti mosquito breeds in natural habitats like tree holes and bromeliads, but it has now adapted well to urban environments and primarily breeds in man-made habitats like buckets, mud pots, containers, tyres, storm water drains, etc. Vector control programs primarily focus on removing *Aedes aegypti* larval habitats from the surrounding environment through source reduction, while also enhancing community involvement and intersectoral action.

The dengue outbreaks usually occur in the monsoon period, during which the breeding of the Aedes mosquitoes is highest in the containers with artificial collection of water.[6] Evidence on the breeding sites should activate a cascade of integrated vector control and behavioural interventions to achieve sustainable control. Timely vector surveillance and integrated vector control interventions play an important role in combating the disease.[7,8]

WHO has made it clear how critical it is to improve vector surveillance in order to implement sector-specific, locally appropriate, and long-lasting interventions against vector-borne illnesses.[9] The dengue epidemic alarm levels, vector control program targets, and transmission risk assessments are all accurately determined by the entomologic markers. In order to prevent dengue, predictions based on disease vector larval indices with specified threshold values are frequently employed such as house index, container index and Breteau index.[10]

The current study was conducted to find out the *Aedes aegypti* vector habitats in the study area and to determine the larval indices with the intention of predicting the risk of transmission and providing immediate vector control measures to prevent the outbreak through public measures and social and behavioural change communication on the breeding source reduction and disease prevention through integrated vector control measures.

## Materials and Methods

The present study was done subsequent to obtaining clearance from the Institutional Ethics Committee. A descriptive study was conducted in the urban area by a door-to-door survey for *Aedes* mosquito breeding habitats prior to the transmission period i.e., from June to August 2023 in the UPHC area of Bangalore along with the health workers.

The sampling unit of the present study was the house and its surroundings, which were systematically searched after obtaining written informed consent from the household; to observe the presence of *Aedes* mosquito larvae in various containers having artificial collection of water in domestic or peri-domestic areas of the house. The larvae were detected by throwing the light of a torch at the rim of the water-holding containers and were confirmed by the oscillatory movement of the *Aedes aegypti* larvae. The details regarding the breeding sites were recorded. Subsequently, the house index, container index and Breteau index were computed as risk indices.

- **House index (HI):** Percentage of houses infested with larvae HI: Number of Houses infested/Number of Houses inspected X 100
- **Container Index (CI):** Percentage of water-holding containers infested with larvae CI: Number of positive containers/Number of containers inspected X 100
- **Breteau Index (BI):** Number of positive containers per 100 houses inspected BI: Number of positive containers/Number of houses inspected X 100

Subsequently, health education was provided to all the households in the study area on the breeding places of *Aedes aegypti* mosquitoes and the importance of their elimination, disease prevention by personal protective measures and the various vector control measures with the help of pictures on a PowerPoint presentation. Likewise, the local municipality and the Urban Primary Health Centre (UPHC) were informed to take appropriate integrated vector control measures and intensify IEC activities.

## Results

The present study encompassed 1112 houses; among them, 92 were found to have breeding places for *Aedes aegypti* with a household index (HI) of 8.27%; likewise, 106 out of the 2295 containers inspected were found to have larvae, showing the container index (CI) of 4.62% and 92 houses

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had 106 containers with larvae, giving the Breteau index (BI) of 9.53% (Tables 1 and 2).

**Table 1.Larval Sites of Aedes aegypti Mosquito**

| Larval Sites | Number Surveyed | Number of Breeding Sites |
|---|---|---|
| Houses | 1112 | 92 |
| Containers | 2295 | 106 |

In the present study, the larval indices of Aedes aegypti mosquitoes were above the threshold levels of HI > 1, CI > 1, and BI > 5 which predicted the risk of dengue transmission.

**Table 2.Larval Indices of the Aedes aegypti Mosquito**

| Larval index | Percentage |
|---|---|
| House index (HI) | 8.27 |
| Container index (CI) | 4.62 |
| Breteau index (BI) | 9.53 |

In the study area, the water-holding containers with the highest rate of positivity for Aedes mosquito larvae were plastic containers (5.0%), followed by discarded tyres (4.3%), mud pots (4.2%), mud ditches (4.2%), coconut shells (3.8%) and unused vessels (3.1%) (Figure 1).

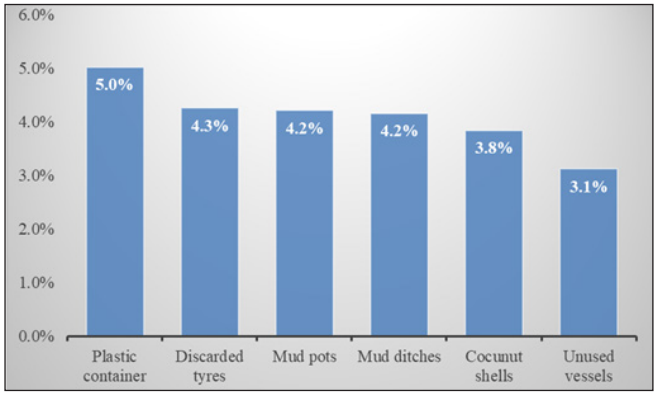


**Figure 1.Water-Holding Containers Positive for Aedes Mosquito Larvae**

The households were provided social and behavioural change communication for preventing dengue using a PowerPoint presentation on a laptop with pictures regarding vector breeding places and the various control measures which each household can take to prevent the spread of the disease.

In order to prevent the outbreak in the entire UPHC area/ locality, the municipal corporation and the UPHC implemented strong integrated vector control measures, which comprised environmental modifications, chemical control, and legislative measures. In a similar vein, the authorities also stepped up its IEC efforts through outdoor publicity such as hoardings, rallies, and the distribution of health education materials in the form of posters and handbills, as well as radio and television using local cable networks.

## Discussion

Dengue is a vector-borne disease, prevalent throughout the tropics with variations in risk influenced by socio-climatic factors.[11] The disease is transmitted to humans through infected female mosquitoes, primarily Aedes aegypti. These are hydrophilic and adapted to breeding in artificial water storage in domestic and peri-domestic habitation. During the rainy season, the species annexes peri-domestic areas and breeds abundantly in manmade water-holding containers. Early detection of vector density, which may lead to dengue epidemics is vital in controlling the disease epidemic.

Dengue is a preventable disease by proper vector control measures. The integrated vector control consists of a range of approaches which includes physical, chemical and biological methods to decrease the vector density. The larval indices of the disease vectors are commonly used for the prediction of the outbreak with well-defined threshold values.[12–15]

The House Index monitors the infestation levels of the vector in the given area, likewise, the Container Index gives information on the proportion of containers that are positive for *Aedes aegypti* larvae. The Breateau Index shows a relationship between positive containers and houses and is therefore considered very informative. It also has the potential to obtain details of all the larval habitats by concurrently recording the relative abundance of mosquito production. These facts are mostly pertinent to provide efforts for the elimination of the common habitats and providing social and behavioural change communication with community-based initiatives.

The present study revealed that the HI, CI, and BI were 8.27%, 4.62%, and 9.53% respectively, showing that all the larval indices were above the threshold for risk of transmission i.e., > 1, > 1 and > 5 for HI, CI and BI respectively. Another study conducted in Bangalore to predict the inter-epidemic risk in dengue-endemic rural areas using larval indices showed a CI of 6.8%, HI of 12% and BI of 13.6%.[16] Similarly, a dengue vector surveillance conducted in Thiruvananthapuram showed that the HI, CI and BI were 11.5, 9.9 and 5.2 respectively predicting a

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dengue outbreak.[17]

Another study from Pune to define the potentiality of a dengue outbreak revealed that HI, CI, and BI were 7.3%, 3.9% and 6.2% respectively.[18] Similarly, a prospective study on the significance of entomological surveillance during a dengue outbreak in Tirunelveli of Tamil Nadu state revealed the HI, CI, and BI to be 48.2%, 28.6%, & 48.2% respectively.[19] Another study conducted among all the 1206 houses in an urban poor locality showed the larval indices viz. house index, container index and Breteau index to be 6.14%, 3.54% and 7.37% respectively. The study concluded that all the larval indices were above the threshold levels of HI > 1, CI > 1 and BI > 5 for foreseeing the risk of dengue transmission in that area.[20]

All the studies indicated that the larval indices of *Aedes aegypti* were greater than the level of risk of disease transmission. Hence, a comprehensive approach through ordered vector surveillance and integrated vector control measures through physical, chemical and biological methods; Social and behavioural change communication for action at the household and community levels.[21] The awareness of households and the community has to be empowered with the knowledge about the modes of transmission, measures of vector control and health services availability so that they can avail services, whenever needed.

In the present study, the unit of analysis used is the manmade borders; which may not define the precise ecology of risk prediction, but they are useful markers for taking community-based control interventions, empowering policy-makers and healthcare providers in the affected area to strategically design holistic and sustainable vector control interventions.

## Conclusion

The study revealed that all the larval indices were high in the study area and envisaged the chance of dengue transmission. Hence, all the integrated vector control measures were taken to prevent the outbreak of the disease with the help of civic authorities, public health and IEC activities.

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