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Original Research Article

Trend of mosquito larval indices over a year in a rural area of Thrissur district, Kerala

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ABSTRACT

Background: Dengue is the most widely distributed viral disease in the world. Outbreak are usually seasonal, peaking during and after rainy seasons. Entomological surveillance is important in determining the factors related to disease transmission in order to prioritize areas and seasons for vector control. The objectives of the study were to determine the larval indices of aedes, assess the seasonal trend in larval indices and determine the major breeding site of Aedes mosquitoes.
Methods: A longitudinal study was conducted over a period of 12 months from January to December in Thrikkur panchayath area. From the total of seventeen wards, 4 wards are randomly selected and from these, 75 houses are randomly selected.
Results: From the surveyed houses 959 wet containers were examined of these 180 were found positive. Wet containers, positive containers and positive houses were more identified during rainy season. The most common site for vector breeding as per the survey was identified to be plastic containers. *Aedes albopictus* was the major species identified. Since the breteau index is between 5 -50, the area studied is considered as moderate risk for epidemics.
Conclusions: Results of the study indicated that the vector indices were more during monsoon period. So, control measures need to be adopted with much vigour even during the pre-monsoon and need to continue during the monsoon season also. Plastic containers were a major source of vector breeding and *Aedes albopictus* was the commonest species identified.

Keywords: *Aedes aegypti*, Breteau index, Container index, House index

INTRODUCTION

Vector-borne diseases account for more than 17% of all infectious diseases, causing more than 700 000 deaths annually.[1] Dengue is the most prevalent viral infection transmitted by Aedes mosquitoes. More than 3.9 billion people in over 129 countries are at risk of contracting dengue, with an estimated 96 million symptomatic cases and an estimated 40,000 deaths every year.[1] Many of vector-borne diseases are preventable, through protective measures, and community mobilization.

Dengue is a mosquito-borne viral infection. It is caused by a virus of the Flaviviridae family. There are four distinct, but closely related, serotypes of the virus that cause dengue (DENV-1, DENV-2, DENV-3 and DENV-4). The virus is transmitted to humans through the bites of infective female mosquitoes, primarily the *Aedes aegypti* mosquito. Mosquitoes can become infected from people who are viraemic with DENV. Human-to-mosquito transmission can occur up to 2 days before someone shows symptoms of the illness up to 2 days after the fever has resolved. Dengue is widespread throughout the tropics, with local variations in risk influenced by rainfall, temperature, relative humidity and unplanned rapid urbanization. The global incidence of dengue has grown dramatically in recent decades. About half of the world's population is now at risk. There are an estimated 100-400 million infections each year1. Recovery from infection is believed to provide lifelong immunity against that serotype. However, cross-immunity to the other serotypes after recovery is only partial, and temporary. Subsequent infections (secondary infection) by other serotypes increase the risk of developing severe dengue.

Aedes aegypti and *Ae. albopictus* are considered as efficient vectors for transmission of arboviral diseases such as dengue, chikungunya, and zika.[2] Among them, *Aedes aegypti* mosquito is considered the primary vector of DENV. It lives in urban habitats and breeds mostly in man-made containers. *Ae. aegypti* is a day-time feeder; its peak biting periods are early in the morning and in the evening before sunset. Female *Ae. aegypti* frequently feed multiple times between each egg-laying period. Once a female has laid her eggs, these eggs can remain viable for several months, and will hatch when they in contact with water. *Aedes albopictus*, a secondary dengue vector in Asia, has spread to more than 32 states in the USA, and more than 25 countries in the European region, largely due to the international trade in used tyres (a breeding habitat) and other goods (e.g. lucky bamboo). *Ae. albopictus* is highly adaptive. Its geographical spread is largely due to its tolerance of colder conditions, as an egg and adult. *Aedes albopictus* has been implicated as the primary vector of DENV in a limited number of outbreak, where *Aedes aegypti* is either not present, or present in low numbers.

The first epidemic in Kerala was reported in 2003 with 3546 cases and 68 deaths, representing the highest number of deaths due to dengue reported in India3. Kerala is now hyper endemic for dengue with presence of multiple serotypes, high rates of co-infection and local genomic evolution of viral strains. Entomological surveillance is used to determine the geographical distribution of major breeding sites, pinpoint high risk areas, forecast impending outbreaks and to facilitate appropriate and timely interventions. The most commonly used standardized indicators for vector surveillance are larval indices, which include House index (HI), Container index (CI) and Breteau index (BI).The larval indices are used to predict the outbreak of mosquito borne diseases and notify the community to take preventive measures. Those related to immature populations include House Index (HI), the percentage of houses infested with larvae or pupae; Container Index (CI), the percentage of water holding containers infested with larvae or pupae; the Breteau Index (BI), the number of positive containers per 100 houses inspected. When using the House index or the Breteau index, the definition of a house should be one unit of accommodation and the surrounding premises, irrespective of the number of people residing therein. Pupal surveys and adult surveys require more intense methods apart from observation and are time consuming. Adult surveys estimate adult population density using ovitraps, sticky traps, human landing collections or any similar traps.

Generally, larval stage surveillance is best suitable. Critical levels for HI, BI are taken as 10% and 50 respectively. Levels more than this is an indication that the locality is dengue sensitive and adequate preventive measures should be taken. A BI >50, considered high risk area, 5-50 moderate risk.[4]

Objectives current study are to determine the standardized larval indices of Aedes mosquitoes (CI, HI, BI) over a period of 12 months in a rural area of Thrissur district, Kerala and to assess the seasonal trends in larval indices from January to December 2018 in a rural area of Thrissur district, Kerala. Current study aimed to determine the major breeding sources for Aedes mosquitoes in a rural area of Thrissur district, Kerala.

METHODS

Study area

A longitudinal study conducted in the Thrikkur panchayat consisting of 17 wards, where the Rural Health Training Centre of Amala Institute of Medical Sciences is situated.

Study period

Study was conducted for the period of one year i.e. January to December 2018 were included in the study.

Sampling technique

Four wards (1, 7, 15, 17) were randomly selected from the total 17 wards of Thrikkur Grama panchayath in Thrissur District.

Method of data collection

Monthly vector survey were conducted in each of these 75 houses which were randomly selected from selected wards by a team of six members consisting of three Interns, one post-graduate student, one Entomologist, and one public health nurse. Containers with larvae or pupae were considered as positive containers. 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. All containers containing any volume of water were considered as potential breeding sites. Discarded tyres, metal drums, plastic drums, other metal containers, plastic buckets, flower pots, mud pots, cement tanks, and all other containers containing any volume of water were inspected. Larval presence was also identified by the wriggling movement. The adult mosquitoes resting indoors and within the immediate vicinity outside the house were also collected. Larvae and pupae were collected from positive containers using dipping and pipetting methods and were brought to the laboratory for identification. For confirmation of species identification, larvae were emerged to adult form and identified using morphological features.

Data analysis

Descriptive analysis was done manually to calculate mosquito larval indices and the proportion of different types of containers. The larval indices were calculated:

CI = Container index = No. of positive containers / No. of containers inspected x 100

HI = House Index = No. of positive houses / No. of houses inspected x 100

BI = Breteau index = No. of positive containers / No. of houses inspected x 100

Prioritizing areas

Depending on the potential for outbreak, an area can be placed into one of the four categories.[5]

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 positive.

RESULTS

From the surveyed houses, a total of 3072 potential containers (both wet and dry) were identified, of which 959 were contained water. Of these, 180 were positive for larval breeding. Wet containers, positive containers and positive houses were more during the rainy season; in May, June and July.

Table 1: Month-wise distribution of inspection findings.

Month (2018)	Wet containers	Dry containers	Positive wet containers	Positive houses
January	60	285	10	5
February	80	244	12	12
March	92	222	11	10
April	79	140	15	9
May	107	291	23	19
June	116	64	27	24
July	62	177	19	18
August	87	136	13	13
September	74	121	15	14
October	66	155	16	15
November	58	162	13	10
December	78	116	6	6
Total	959	2113	180	155

Table 2: Month-wise distribution of Larval indices.

Month (2018)	Container Index (CI)	House Index (HI)	Breteau Index (BI)
January	16.6	6.6	13.3
February	15	16	16
March	11.9	13.3	14.6
April	18.9	12	20
May	21.4	25.3	30.6
June	30.6	32	36
July	23.2	24	33.3
August	14.9	17.3	17.3
September	20.2	18.6	20
October	24.2	20	21.3
November	22.4	13.3	17.3
December	7.6	8	8

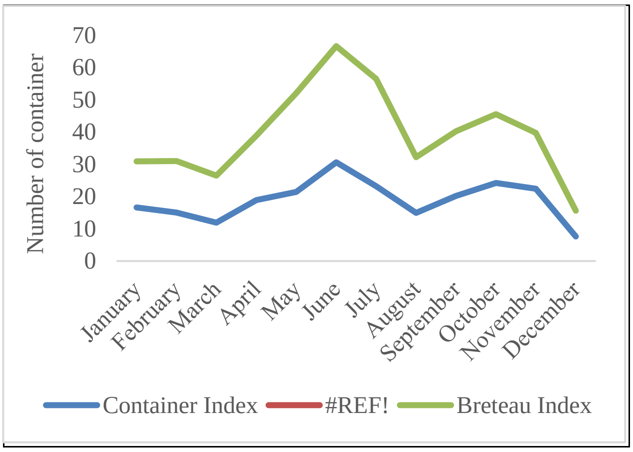

Figure 1: Time trend in Larval indices.

Table 3: Positive containers.

Type of container	No. of positive containers
Coconut shell	43
Plastic bottle	27
Plastic bucket	26
Plastic barrel	20
Paint bucket	1
Flower pot	23
Palm leaves	3
Tyre	8
Fridge tray	1
Tarpaulin sheet	4
Egg shell	8
Cement tank	3
Thermocol box	4
Steel container	4
Shoes	2
Grinding stone	3

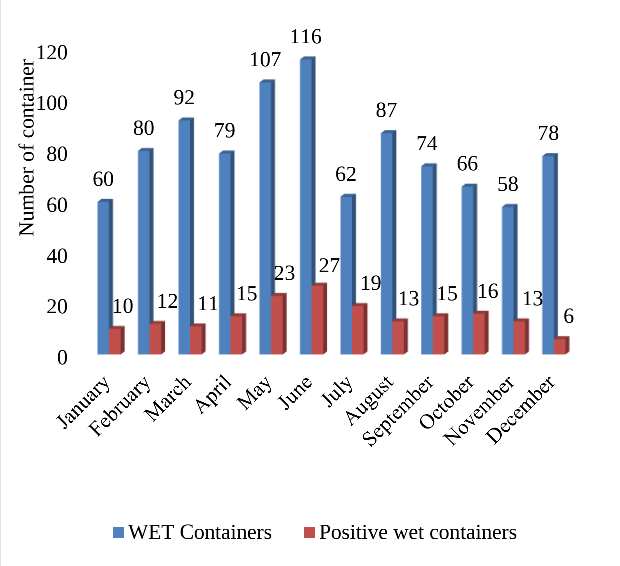

Figure 2: Wet and positive containers.

Table 4: Month wise isolated mosquito species.

Month	Outdoor	Number	Indoor	Number
January	*Aedes aegypti*	1	*Culex quinquefasciatus*	1
	Aedes albopictus	3		
February	*Aedes albopictus*	2	*Aedes albopictus*	1
	Culex quinquefasciatus	2	*Culex quinquefasciatus*	2
March	*Aedes albopictus*	3	*Culex quinquefasciatus*	1
	Culex quinquefasciatus	4		
April	*Aedes albopictus*	4	Nil	
May	*Aedes aegypti*	1	*Culex quinquefasciatus*	1
	Aedes albopictus	5		
June	*Aedes aegypti*	1	*Aedes albopictus*	1
	Aedes albopictus	6		
	C. quinquefasciatus	3		
July	*Aedes albopictus*	6	*Culex quinquefasciatus*	1
	Culex quinquefasciatus	2		
August	*Aedes albopictus*	5	nil	
	Culex quinquefasciatus	1		
September	*Aedes albopictus*	2	nil	
	Culex quinquefasciatus	3		
October	*Aedes albopictus*	3	nil	
	Culex quinquefasciatus	2		
November	*Aedes albopictus*	3	*Culex quinquefasciatus*	1
	Culex quinquefasciatus	4		
December	*Aedes albopictus*	2	nil	
	Culex quinquefasciatus	2		

All the three vector indices start increasing from May onwards, peaked during June and July months and decreased from August onwards. The most common site for vector breeding as per the survey was identified to be plastic containers (40.5 %) followed by coconut shells (23.8%), flower pot (12.7%), Tyre (4.4%). *Aedes albopictus* was the major species identified. Since the Breteau Index is between 5-50, the area studied is considered as moderate risk for epidemics.

DISCUSSION

There was an increase in number of infested houses and number of positive containers in May, June and July and is reflected by high HI, CI, BI during these months. High indices in the months of May, June and July are attributed to monsoon in Kerala during these months.[7-8] In our present study, in the month of June BI =36, HI = 32 and CI = 30.6. A similar study done by Radhakrishnan et al in Ernakulam district of Kerala, India, BI=67.13, HI =34.72,CI=19.8.[11] In both study BI, HI, CI have high value in June month. This may be the reason for high incidence of dengue fever in Kerala in monsoon season.

In our present study, most common species found was *Aedes albopictus*. It is also the commonest species of Aedes found in South India. A similar study done by Samuel et al in Thiruvananthapuram district, Kerala, India most common species were also Aedes albopictus.[4] The distribution of *Ae. albopictus* is associated with vegetation throughout rural and urban areas.[9-11] In Kerala, there is relatively thick vegetation in both urban and rural areas and this may be the reason for the similar distribution of the species in both the areas.

In our study, the most common site for vector breeding was identified to be plastic containers, a similar study done by Jesha et al in Perithalmanna, Malappuram district, Kerala, India the main source of active breeding was in discarded tins.[6] In another study done by Sekhon et al most common breeding source were small pots holding drinking water for birds.[5] So that, these studies were incoherence with our study. This difference may be due to the region where the study was conducted.

This study has limitation that due to the inconvenience of house owners, Indoor breeding sites were not properly checked.

CONCLUSION

Results of the study indicated that the vector indices were more during monsoon period. So, control measures need to be adopted with much vigour even during the pre-monsoon season and need to continue during the monsoon season also. Plastic containers were a major source of vector breeding highlighting the need for regulations to reduce plastic wastes. The commonest species identified was *Aedes albopictus*. Weekly dry day observance, source reduction and proper waste management are very important in the control of the vector. The studied area is at moderate risk for epidemics; So, Health Education and Community action Plans with the help of Local Self Government is needed to reduce mosquito density and there by prevent disease outbreaks. Entomological surveys need to be conducted at regular intervals to ensure sustained control of mosquito breeding.

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